PROJECT MANUAL / SPECIFICATIONS FOR

YONKERS PUBLIC LIBRARY
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YONKERS, NY 10710

CHILLER AND SWITCHGEAR REPLACEMENT
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ISSUED FOR BID **29 October 2024**

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For

YONKERS PUBLIC LIBRARY

GRINTON I WILL LIBRARY

DIVISION 26 - ELECTRICAL

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SECTION 011501 - SPECIAL PROJECT REQUIREMENTS

Excerpts from 8 NYCRR Section 155.5 as they address "General Safety and Security Standards for Construction Projects".

STATEMENT OF PURPOSE: "The occupied portion of any school building shall always comply with the minimum requirements necessary to maintain a certificate of occupancy"

1.1 GENERAL

A. Requirements set forth herein are in addition to and shall be considered as complementary to the General Conditions and the balance of Division #1 and Technical Specifications.

B. All Contractors, Subcontractors, Sub-subcontractors, Vendors and the like shall be required to familiarize themselves with said provisions.

C. All contractors, subcontractors, Sub-subcontractors, vendors and the like shall monitor their workers and require that they adhere to the following safety provisions during all construction and maintenance activities for the duration of the project.

1.2 REQUIREMENTS INCLUDED

A. Safe and Secure Storage of Construction Materials
B. Fencing – Project; Material storage areas; Container/Refuse areas
C. Gates – Manned during working hours; locked and secure off hours.
D. Sidewalk bridges, security barriers, etc. reference "Exterior Renovations"
E. Worker identification system
F. Temporary partitions – separation of construction areas from occupied spaces; construction, materials, inspection and maintenance
G. Worker access both horizontal and vertical in occupied buildings
H. Debris removal.
I. Ventilation of workspaces
J. Exiting
K. Fire and hazard prevention
L. No Smoking
M. Fire extinguishers
N. Temporary sprinklers (if any)
O. Smoke detectors (temporary)
P. Fire watch and maintenance of existing fire alarm systems
Q. Storage of gas and welding equipment
R. Noise abatement procedures
S. Construction fume controls
T. Off-Gassing/bake out procedures
U. Manufacturer's Material Safety Data Sheet log
V. Asbestos Code Rule 56
W. Asbestos TEM
X. Lead Abatement/Lead paint

1.3 SAFE AND SECURE STORAGE OF CONSTRUCTION MATERIALS – Coordinate with Sections 01 50 00 and 01 61 00 each as included with these documents.

A. Upon written approval from the Owner materials stored on the Site shall be neatly arranged and protected and shall be stored in an orderly fashion in locations that shall not interfere with the progress of the Work.

NOTE - If approval is given to store materials in any part of the building area, they shall be so stored as to cause no overloading of the structure.

1.4 FENCING – PROJECT; MATERIAL STORAGE AREAS; CONTAINER/REFUSE AREAS – Coordinate with Section 015000

A. Barrier fencing constructed as outlined in Section 01 50 00 shall be provided surrounding all work areas, material storage locations and around dumpsters and/or chutes when involved with demolition/removal operations.

B. Fencing shall be maintained in good sound condition throughout the entire course of construction by the Contractor and removed only when directed by the Architect.

1.5 GATES

A. Gates in construction fencing shall be of construction outlined in Section 01 50 00 and shall be under the Contractors' supervision throughout the workday and shall be secured in a locked condition at the close of any single business day and on all non-workdays. Gates shall be manned at all times work is in progress.

1.6 SIDEWALK BRIDGES, SECURITY BARRIERS, ETC. REFERENCE "EXTERIOR RENOVATIONS"

A. As applicable to the project involved, provide overhead protective devices for the work consisting of tubular framed scaffold bridges, joist trusses and solid decking. Provide guard rails, lights and warning signs.

1.7 WORKER IDENTIFICATION SYSTEM – Coordinate with Section 01 10 00, Article 1.01.

A. All Contractors' employees shall use a single means of access and egress, except in the case of emergency, to be designated by the Contractor.

B. The Contractor shall, for all work covered under the Contract, establish a security control system for personnel and material involved with the work herein.

C. The control system shall include photo identification badges and the like so as to insure against unauthorized entry to the site and resultant entry to the building proper.

1.8 TEMPORARY PARTITIONS – SEPARATION OF CONSTRUCTION AREAS FROM OCCUPIED SPACES; CONSTRUCTION, MATERIALS, INSPECTION AND MAINTENANCE – Coordinate with Section 01 50 00.

A. Provide temporary partitions from floors to underside of structure above, in sash and any other openings created by new construction, additions and alterations.

B. Such partitions shall be constructed dust-tight using steel studs and acoustically and/or thermally insulated, Level 1 taped fire rated gypsum.

C. Locate enclosures as directed by the Architect and/or as shown on the drawings.

D. In addition to partitions and closures, provide tight fitting filters over all return air grilles and/or open ducts in order to properly protect central air handling equipment.

E. Take all necessary precautions to avoid unnecessary dust spreading to adjoining rooms and spaces.

F. Keep all doors to spaces closed and provide positive seals around cracks, frames, doors and other openings within work areas.

G. WHERE EXTERIOR CLOSURES ARE REQUIRED, INSULATE SAME TO MAINTAIN A TEMPERATURE OF SIXTY-FIVE (65) DEGREES F. WITHIN THE PLANT WITHOUT THE USE OF SPECIAL HEATING EQUIPMENT.

H. All temporary enclosures/partitions/containment barriers shall be periodically inspected and maintained in good repair so as to prevent exposure to dust and contaminants outside the work and/or containment areas.

1.9 WORKER ACCESS BOTH HORIZONTAL AND VERTICAL IN OCCUPIED BUILDINGS

A. A specific stairwell and/or elevator shall be assigned for construction worker use during work hours. Workers may not use corridors, stairs or elevators designated for students or school staff.

1.10 DEBRIS REMOVAL – Coordinate with Sections 01 50 00, 01 77 00 and 02 41 20 as applicable to Project.

A. Large amounts of debris must be removed by use of enclosed chutes or similar systems. There shall be no movement of debris through corridors of occupied spaces of the building. No materials shall be dropped or thrown outside the walls of the building.

B. All occupied parts of the building or buildings affected by renovation activity shall be cleaned at the close of each workday.

C. School buildings occupied during any construction period shall maintain required health, safety and educational capabilities at all times that classes are in session.

1.11 VENTILATION OF WORKSPACES - SEE SECTIONS 02 82/83 00

1.12 EXITING

A. At all times, the Contractor is responsible for maintenance of safety and egress requirements from work areas.

NOTE: All legal forms of egress must be maintained at all times.

B. Provide temporary exit passage system(s) with guard and handrails and ramps and such other measures indicated on the drawings and as applicable to the particular project.

1.13 FIRE AND HAZARD PREVENTION – See Section 01 50 00 for requirements for fire watches, storage and maintenance of welding gasses and temporary heating and the like.

1.14 NO SMOKING – No smoking is permitted on the grounds or within the construction area of any project.

1.15 FIRE EXTINGUISHERS – Fire extinguishers shall be provided within the work area and shall be monitored on a scheduled maintenance basis and so tagged to indicate same.

1.16 TEMPORARY SPRINKLERS (IF ANY) – See Section 01 50 00 for applicable text and requirements.

1.17 SMOKE DETECTORS – The respective prime contractor shall provide a temporary battery powered smoke detection system for all areas under construction.

1.18 FIRE WATCH AND MAINTENANCE OF EXISTING FIRE ALARM SYSTEMS – See Section 01 50 00

A. All Contractors shall comply with the safety provisions of the National Fire Protection Association's "National Fire Codes" pertaining to the work and, particularly, in connection with any cutting or welding performed as part of the work.

B. During welding or cutting operations, a contractor's man shall act as a fire watcher. The fire watcher shall have proper eye protection and suitable firef ighting equipment including fire extinguisher (bearing current inspection Certificate), protective gloves and any other equipment deemed necessary.

C. The Respective Prime Contractor will provide for and maintain the proper operation of fire alarm and smoke detection systems in all areas throughout the course of the project. The Respective Prime Contractor will provide all labor and material required to accomplish this in occupied areas of the school buildings and in areas under construction.

1.19 STORAGE OF GAS AND WELDING EQUIPMENT – See Section 01 50 00 for specific requirements and controls.

1.20 NOISE ABATEMENT PROCEDURES

A. Develop and maintain a noise abatement program and enforce strict discipline over all personnel to keep noise to a minimum. Equipment and work shall not produce noise in excess of 60db in occupied areas or shall be scheduled for off hours or acoustical abatement procedures shall be taken. Noise level measurements (dba) shall be taken with a type 2 sound level meter in the occupied space in a location closest to the source of the noise.

B. Execute construction work by methods and by use of equipment which will reduce excess noise.

C. Equip air compressors with silencers, and power equipment with mufflers.

D. As established in Section 01 10 00, all contractors shall abide by the “no work” periods designated by the Owner.

1.21 CONSTRUCTION FUME CONTROLS – See Article 1.11 herein.

1.22 OFF-GASSING/BAKE OUT PROCEDURES – Not Required

1.23 MATERIAL SAFETY DATA SHEET LOG – Coordinate with Section 01 33 00

A. Contractor shall maintain "MSDS" file on site, accessible to workers and otherwise in compliance with jurisdiction's "Right To Know" legislation.

NOTE: The submittal of the required MSDS information shall be segregated from the required material/shop drawing/sample submittals in a separate binder and not co-mingled with the technical submittals, failure to so conform will be cause for rejection of any submittal.

1.24 ASBESTOS CODE RULE 56 AND ASBESTOS CONTAMINATED MATERIALS (ACM)

A. Abatement projects as defined by Rule 56 shall not be performed while the building is occupied.

B. In the event asbestos-contaminated materials are encountered during the work Contractor shall immediately notify the Architect and/or Owner for instructions as to procedures to be taken.

C. All asbestos abatement projects shall comply with all applicable federal and State laws including but not limited to the New York State Department of Labor industrial code rule 56(12 NYCRR 56), and the federal Asbestos Hazard Emergency Response Act (AHERA), 40 CFR Part 763 (Code of Federal Regulations, 1998 Edition, Superintendent of Public Documents, U.S. Government Printing Office, Washington, DC 20402; 1998; available at the Office of Facilities Planning, Education Building Annex, Room 1060, State Education Department, Albany, New York 12234). Large and small asbestos projects as defined by 12 NYCRR 56 shall not be performed while the building is occupied. Minor asbestos projects defined by 12 NYCRR 56 as an asbestos project involving the removal, disturbance, repair, encapsulation, enclosure or handling of 10 square feet or less of asbestos or asbestos material, or 25 linear feet or less of asbestos or asbestos material may be performed in unoccupied areas of an occupied building in accordance with the above referenced regulations.

1.25 LEAD ABATEMENT/LEAD PAINT

A. In the event lead based paint is encountered during the work Contractor shall immediately notify the Architect and/or Owner for instructions as to procedures to be taken.

B. Attention is directed to technical Section 02 83 00 for “protocols” concerning lead paint removals and preparation.

C. Any construction or maintenance operations which will disturb lead based paint shall be abated pursuant to protocols detailed in the “Guidelines for the Evaluation and Control of Lead-Based Paint Hazards in Housing” (June 1995; U.S. Department of Housing and Urban Development, Washington, DC 20410; available at the Office of Facilities Planning, Education Building Annex, Room 1060, State Education Department, Albany, NY 12234). All areas scheduled for construction as well as areas of flaking and peeling paint shall be

tested for the presence of lead and abated or encapsulated in accordance with the above noted guidelines

End of Section

SECTION 012900 - PAYMENT PROCEDURES

PART 1 - GENERAL

1.1 SUMMARY

A. Section includes administrative and procedural requirements necessary to prepare and process Applications for Payment.

1.2 DEFINITIONS

A. Schedule of Values: A statement furnished by Contractor allocating portions of the Contract Sum to various portions of the Work and used as the basis for reviewing Contractor's Applications for Payment.

1.3 SCHEDULE OF VALUES

A. Coordination: Coordinate preparation of the schedule of values with preparation of Contractor's construction schedule.

1. Coordinate line items in the schedule of values with other required administrative forms and schedules, including the following:
   a. Application for Payment forms with continuation sheets.
   b. Submittal schedule.
   c. Items required to be indicated as separate activities in Contractor's construction schedule.

2. Submit the schedule of values to Architect within 10 days after Notice of Award of Contract or at the preconstruction meeting, whichever comes first.

B. Format and Content: Use Project Manual table of contents as a guide to establish line items for the schedule of values. Provide at least one line item for each Specification Section.

1. Identification: Include the following Project identification on the schedule of values:
   a. Project name and location.
   b. Name of Architect.
   c. Architect's project number.
   d. Contractor's name and address.
   e. Date of submittal.

2. Arrange the schedule of values in tabular form with separate columns to indicate the following for each item listed:
   a. Related specification section or division.
   b. Description of the Work.
   c. Name of subcontractor.
   d. Name of manufacturer or fabricator.
   e. Name of supplier.

f. Change Orders (numbers) that reflect value.
g. Dollar value as a percentage of the Contract Sum to nearest one-hundredth percent, adjusted to total 100 percent.

3. Provide a breakdown of the Contract Sum in enough detail to facilitate continued evaluation of Applications for Payment and progress reports. Coordinate with Project Manual table of contents. Provide multiple line items for principal subcontract amounts in excess of five percent of the Contract Sum. No line item should exceed 10% of the contract sum.
4. Round amounts to nearest whole dollar; total shall equal the Contract Sum.
5. Provide a separate line item in the schedule of values for each part of the Work where Applications for Payment may include materials or equipment purchased or fabricated and stored, but not yet installed.
   a. Differentiate between items stored on-site and items stored off-site. If required, include evidence of insurance.

6. Provide separate line items in the schedule of values for initial cost of materials, for each subsequent stage of completion, and for total installed value of that part of the Work.
7. Allowances: Provide a separate line item in the Schedule of Values for each allowance. Show line-item value of unit-cost allowances, as a product of the unit cost, multiplied by measured quantity. Use information indicated in the Contract Documents to determine quantities.
8. Each item in the schedule of values and Applications for Payment shall be complete. Include total cost and proportionate share of general overhead and profit for each item
   a. Temporary facilities and other major cost items that are not direct cost of actual work-in-place may be shown either as separate line items in the schedule of values or distributed as general overhead expense, at Contractor's option.

9. Include a line item for each of the following in the specified percentage of the Contract Sum:
   a. Submittals and Shop Drawings: 1%
   b. Meetings and Documentation: 2%
   c. O&M and Closeout: 3%
   d. Punch List: 1%

10. Schedule Updating: Update and resubmit the schedule of values before the next Applications for Payment when fully executed Change Orders or Construction Change Directives result in a change in the Contract Sum.

1.4 APPLICATIONS FOR PAYMENT

A. Each Application for Payment following the initial Application for Payment shall be consistent with previous applications and payments as certified by Architect and paid for by Owner.

1. Initial Application for Payment, Application for Payment at time of Substantial Completion, and final Application for Payment involve additional requirements.

2. Each Application for Payment after the Initial Application for Payment shall include lien wavers for amounts paid with respect to the immediately preceding Application for Payment.

B. Payment Application Times: The date for each progress payment is indicated in the Agreement between Owner and Contractor. The period of construction work covered by each Application for Payment is the period indicated in the Agreement.

1. Submit draft copy of Application for Payment seven days prior to due date for review by Architect.

C. Application for Payment Forms: Use AIA Document G732 and AIA Document G703 as form for Applications for Payment.

D. Application Preparation: Complete every entry on form. Notarize and execute by a person authorized to sign legal documents on behalf of Contractor. Architect will return incomplete applications without action.

1. Entries shall match data on the schedule of values and Contractor's construction schedule. Use updated schedules if revisions were made.
2. Include amounts for work completed following previous Application for Payment, whether or not payment has been received. Include only amounts for work completed at time of Application for Payment.
3. Include amounts of Change Orders and Construction Change Directives issued before last day of construction period covered by application.

E. Stored Materials: Include in Application for Payment amounts applied for materials or equipment purchased or fabricated and stored, but not yet installed. Differentiate between items stored on-site and items stored off-site.

1. Provide certificate of insurance, evidence of transfer of title to Owner, and consent of surety to payment, for stored materials.
2. Provide supporting documentation that verifies amount requested, such as paid invoices. Match amount requested with amounts indicated on documentation; do not include overhead and profit on stored materials.
3. Provide summary documentation for stored materials indicating the following:
   a. Value of materials previously stored and remaining stored as of date of previous Applications for Payment.
   b. Value of previously stored materials put in place after date of previous Application for Payment and on or before date of current Application for Payment.
   c. Value of materials stored since date of previous Application for Payment and remaining stored as of date of current Application for Payment.

F. Waivers of Mechanic's Lien: With each Application for Payment, submit waivers of mechanic's liens from subcontractors, sub-subcontractors, and suppliers for construction period covered by the previous application.

1. Submit partial waivers on each item for amount requested, before deduction for retainage, on each item.
2. When an application shows completion of an item, submit final or full waivers.

3. Owner reserves the right to designate which entities involved in the Work must submit waivers.
4. Waiver Delays: Submit each Application for Payment with Contractor's waiver of mechanic's lien for construction period covered by the application.
    a. Submit final Application for Payment with or preceded by final waivers from every entity involved with performance of the Work covered by the application who is lawfully entitled to a lien.

5. Waiver Forms: Submit partial waivers of lien on form included at the end of this Section, executed in a manner acceptable to Owner.

G. Attachments to Applications for Payment: In addition to other requirements stated in the Contract Documents, include with each Application for Payment fully executed Partial Release and Waiver of Liens on the form included at the end of this Section. In addition, provide a current copy of the approved Contractor’s Construction Schedule, signed, indicating agreement to the schedule.

H. Transmittal: Submit two signed and notarized original copies of each Application for Payment to the Architect by a method ensuring receipt within 24 hours. Both copies shall include waivers of lien, and all other required attachments.

1. Transmit each copy with a transmittal form listing attachments and recording appropriate information about application.

I. Initial Application for Payment: Administrative actions and submittals (that have been previously approved) that must precede or coincide with submittal of first Application for Payment include the following:

1. List of subcontractors.
2. Schedule of values.
3. Contractor's construction schedule.
4. Products list.
5. Submittal schedule.
6. List of Contractor's staff assignments.
7. List of Contractor's principal consultants.
8. Copies of building permits.
9. Copies of authorizations and licenses from authorities having jurisdiction for performance of the Work.
10. Initial progress report.
11. Report of preconstruction conference.
12. Certificates of insurance and insurance policies.
13. Performance and payment bonds.
14. Data needed to acquire Owner's insurance.
15. Initial settlement survey and damage report if required

J. Application for Payment at Substantial Completion: After Architect issues the Certificate of Substantial Completion, submit an Application for Payment showing 100 percent completion for portion of the Work claimed as substantially complete.

1. Include documentation supporting claim that the Work is substantially complete and a statement showing an accounting of changes to the Contract Sum.

2. This application shall reflect Certificate(s) of Substantial Completion issued previously for Owner occupancy of designated portions of the Work.

K. Final Payment Application: After completing Project closeout requirements, submit final Application for Payment with releases and supporting documentation not previously submitted and accepted, including, but not limited, to the following:

1. Evidence of completion of Project closeout requirements.
2. Insurance certificates for products and completed operations where required and proof that taxes, fees, and similar obligations were paid.
3. Updated final statement, accounting for final changes to the Contract Sum.
4. AIA Document G706, "Contractor's Affidavit of Payment of Debts and Claims."
5. AIA Document G706A, "Contractor's Affidavit of Release of Liens."
6. AIA Document G707, "Consent of Surety to Final Payment."
7. Evidence that claims have been settled.
8. Final meter readings for utilities, a measured record of stored fuel, and similar data as of date of Substantial Completion or when Owner took possession of and assumed responsibility for corresponding elements of the Work.
9. Final liquidated damages settlement statement.

PART 2 - PRODUCTS (Not Used)

PART 3 - EXECUTION (Not Used)

END OF SECTION 012900

Attachments: Partial Waiver of Liens Form

SECTION 013100 - PROJECT MANAGEMENT AND COORDINATION

PART 1 - GENERAL

1.1 SUMMARY

A. This Section includes administrative provisions for coordinating construction operations on Project including, but not limited to, the following:

1. General project coordination procedures.
2. Conservation.
3. Administrative and supervisory personnel.
4. Project meetings.
5. RFI's.

1.2 COORDINATION

A. Coordination: Each contractor shall coordinate its construction operations with those of other contractors and entities to ensure efficient and orderly installation of each part of the Work. Each contractor shall coordinate its operations with operations, included in different Sections, that depend on each other for proper installation, connection, and operation.

1. Schedule construction operations in sequence required to obtain the best results where installation of one part of the Work depends on installation of other components, before or after its own installation.
2. Coordinate installation of different components with other contractors to ensure maximum accessibility for required maintenance, service, and repair.
3. Make adequate provisions to accommodate items scheduled for later installation.

B. If necessary, prepare memoranda for distribution to each party involved, outlining special procedures required for coordination. Include such items as required notices, reports, and list of attendees at meetings.

1. Prepare similar memoranda for Architect, Owner and separate contractors if coordination of their Work is required.

C. Administrative Procedures: Coordinate scheduling and timing of required administrative procedures with other construction activities and activities of other contractors to avoid conflicts and to ensure orderly progress of the Work. Such administrative activities include, but are not limited to, the following:

1. Preparation of Contractor's Construction Schedule.
2. Preparation of the Schedule of Values.
3. Installation and removal of temporary facilities and controls.
4. Delivery and processing of submittals.
5. Progress meetings.

6. Preinstallation conferences.
7. Project closeout activities.

D. Conservation: Coordinate construction activities to ensure that operations are carried out with consideration given to conservation of energy, water, and materials.

1. Salvage materials and equipment involved in performance of, but not actually incorporated into, the Work.

E. Use of the Site: The Owners Representative will administer allocation of available space equitably among separate Prime Contractors and other entities needing access and space, so as to produce the best overall efficiency in performance of the total work of the project. Each contractor shall schedule deliveries so as to minimize space and time requirements for storage of materials and equipment on site.

1.3 SUBMITTALS

A. Staff Names: Within 5 days of Notice to Proceed, Contractor shall submit a list of principal staff assignments, including superintendent and other personnel in attendance at Project site. Identify individuals and their duties and responsibilities; list addresses and telephone numbers, including home and office telephone numbers. Provide names, addresses, and telephone numbers of individuals assigned as standbys in the absence of individuals assigned to Project.

1. Post copies of list in Project meeting room, in temporary field office, and by each temporary telephone.

B. Company Safety Plan: Submit safety program including MSDS Management Plan for the Work of this Project.

1.4 REQUESTS FOR INFORMATION (RFI's)

A. General: All requests for information or clarification shall be forwarded to the Architect. Contractor shall maintain a log of the status of each request shall be prepared to discuss outstanding items at each progress meeting.

B. Procedure: Immediately on discovery of the need for interpretation of the Contract Documents, and if not possible to request interpretation at Project meeting, prepare and submit an RFI in the form specified.

1. RFIs shall originate with Contractor. RFIs submitted by entities other than Contractor will be returned with no response.
2. Coordinate and submit RFIs in a prompt manner so as to avoid delays in Contractor's work or work of subcontractors.

C. Content of the RFI: Include a detailed, legible description of item needing interpretation and the following:

1. Project name.
2. Date.
3. Name of Contractor.
4. Name of Architect
5. Names of Trade/Specialty Contractors affected and coordinated with.
6. RFI number, numbered sequentially.
7. Specification Section number and title and related paragraphs, as appropriate.
8. Drawing number and detail references, as appropriate.
9. Field dimensions and conditions, as appropriate.
10. Contractor's suggested solution(s). If Contractor's solution(s) impact the Contract Time or the Contract Sum, Contractor shall state impact in the RFI.
11. Contractor's signature.
12. Attachments: Include drawings, descriptions, measurements, photos, Product Data, Shop Drawings, and other information necessary to fully describe items needing interpretation.
    a. Supplementary drawings prepared by Contractor shall include dimensions, thicknesses, structural grid references, and details of affected materials, assemblies, and attachments.

D. Hard-Copy RFIs; Prepare on the RFI Submittal Form included at the end of this Section.

1. Identify each page of attachments with the RFI number and sequential page number.

E. Software-Generated RFIs: Software-generated form with substantially the same content as indicated above.

1. Attachments shall be electronic files in Adobe Acrobat PDF format.

F. Architect's Action: Architect will review each RFI, determine action required, and return it. Allow five working days minimum for Architect's response for each RFI. RFIs received after 1:00 p.m. will be considered as received the following working day.

1. The following RFIs will be returned without action:
    a. Requests for approval of submittals.
    b. Requests for approval of substitutions.
    c. Requests for coordination information already indicated in the Contract Documents.
    d. Requests for adjustments in the Contract Time or the Contract Sum.
    e. Requests for interpretation of Architect's actions on submittals.
    f. Incomplete RFIs or RFIs with numerous errors.

2. Architect's action may include a request for additional information, in which case Architect's time for response will start again.
3. Architect's action on RFIs that may result in a change to the Contract Time or the Contract Sum may be processed under “Changes to the Work” provisions in section 002100.

a. If Contractor believes the RFI response warrants change in the Contract Time or the Contract Sum, notify Architect in writing within 10 days of receipt of the RFI response, unless otherwise established in section .

G. On receipt of Architect's action, update the RFI log and immediately distribute the RFI response to affected parties. Review response and notify Architect within seven days if Contractor disagrees with response.

H. RFI Log: Prepare, maintain, and submit a tabular log of RFIs organized by the RFI number. Submit log bi-weekly. Include the following:

1. Project name.
2. Name and address of Contractor.
3. Name and address of Architect
4. RFI number including RFIs that were dropped and not submitted.
5. RFI description.
6. Date the RFI was submitted.
7. Date Architect's response was received.
8. Identification of related Minor Change in the Work, Construction Change Directive, and Proposal Request, as appropriate.

1.5 ADMINISTRATIVE AND SUPERVISORY PERSONNEL

A. General: In addition to Project Superintendent, Contractor shall provide other administrative and supervisory personnel as required for proper performance of the Work

1. Administrative and/or supervisory personnel shall always be present on the job site when work is being performed; this person shall be familiar with Project and authorized to conclude matters relating to progress.
2. Include special personnel required for coordination of operations with other contractors.

1.6 PROJECT MEETINGS

A. General: Architect will schedule and conduct meetings and conferences at Project site, unless otherwise indicated.

1. Attendees: Architect will inform participants and others involved, and individuals whose presence is required, of date and time of each meeting. Architect will notify Owner of scheduled meeting dates and times.
2. Agenda: Architect will prepare the meeting agenda and distribute the agenda to all invited attendees.
3. Minutes: Architect will record significant discussions and agreements achieved at all other meetings and will distribute the meeting minutes to everyone concerned, including Owner and Architect, within 3 days of the meeting.

B. Preconstruction Conference: Architect will schedule a preconstruction conference before starting construction, at a time convenient to Owner, and Architect,

but no later than 15 days after execution of the Agreement. Conference will be held at Project site or another convenient location. Architect will conduct the meeting to review responsibilities and personnel assignments.

1. Attendees: Authorized representatives of Owner, Architect, and their consultants; Contractor and its superintendent; major subcontractors; manufacturers; suppliers; and other concerned parties shall attend the conference. All participants at the conference shall be familiar with Project and authorized to conclude matters relating to the Work.
2. Agenda: Discuss items of significance that could affect progress, including the following:
    a. Tentative construction schedule.
    b. Phasing.
    c. Critical work sequencing.
    d. Designation of responsible personnel.
    e. Procedures for processing field decisions and Change Orders.
    f. Procedures for processing Applications for Payment.
    g. Distribution of the Contract Documents.
    h. Submittal procedures.
    i. Preparation of Record Documents.
    j. Use of the premises.
    k. Responsibility for temporary facilities and controls.
    l. Parking availability.
    m. Office, work, and storage areas.
    n. Equipment deliveries and priorities.
    o. First aid.
    p. Security.
    q. Progress cleaning.
    r. Working hours.

3. Contractor shall submit the following items at this meeting:
    a. Preliminary Contractor's Construction Schedule (if schedule has not yet been submitted).
    b. List of Subcontractors.
    c. Schedule of Values.
    d. Submittal Schedule.
    e. Products List (Proposed products and manufacturers including any substitution products proposed).

C. Preinstallation Conferences: When required in the individual Specification Section, conduct a Preinstallation conference at Project site before each construction activity that requires coordination with other construction.

1. Attendees: Installer and representatives of manufacturers and fabricators involved in or affected by the installation and its coordination or integration with other materials and installations that have preceded or will follow, shall attend the meeting. Advise Architect of scheduled meeting dates in advance.

2. Contractor shall prepare agenda, preside at conference, record minutes, and distribute copies after conference to participants. Review progress of other construction activities and preparations for the particular activity under consideration, including requirements for the following:
   a. Contract Documents.
   b. Options.
   c. Related Change Orders.
   d. Purchases.
   e. Deliveries.
   f. Submittals.
   g. Review of mockups.
   h. Possible conflicts.
   i. Compatibility problems.
   j. Time schedules.
   k. Weather limitations.
   l. Manufacturer's written recommendations.
   m. Warranty requirements.
   n. Compatibility of materials.
   o. Acceptability of substrates.
   p. Temporary facilities and controls.
   q. Space and access limitations.
   r. Regulations of authorities having jurisdiction.
   s. Testing and inspecting requirements.
   t. Required performance results.
   u. Protection of construction and personnel.

3. Record significant conference discussions, agreements, and disagreements.
4. Do not proceed with installation if the conference cannot be successfully concluded. Initiate whatever actions are necessary to resolve impediments to performance of the Work and reconvene the conference at earliest feasible date.

D. Progress Meetings: Architect will conduct progress meetings at weekly intervals, or as needed in the temporary field office at the Project site.

1. Architect will preside over these meetings.
2. Attendees: In addition to representatives of Owner, and Architect, each contractor, subcontractor, supplier, and other entity concerned with current progress or involved in planning, coordination, or performance of future activities shall be represented at these meetings. All participants at the conference shall be familiar with Project and authorized to conclude matters relating to the Work.
   a. A representative of Contractor shall be present at every progress meeting, regardless of whether or not that Contractor is performing work at the site at the time.
   b. Any decision reached at a job meeting shall be binding on a Contractor, whether or not he or his representative is present at such job meeting.

3. Agenda: Review and correct or approve minutes of previous progress meeting. Review other items of significance that could affect progress. Include topics for discussion as appropriate to status of Project.
   a. Contractor's Construction Schedule: Review progress since the last meeting. Determine whether each activity is on time, ahead of schedule, or behind schedule, in relation to Contractor's Construction Schedule. Determine how construction behind schedule will be expedited; secure commitments from parties involved to do so. Discuss whether schedule revisions are required to ensure that current and subsequent activities will be completed within the Contract Time.
   b. Review present and future needs of each entity present, including the following:
      1) Interface requirements.
      2) Sequence of operations.
      3) Status of submittals.
      4) Deliveries.
      5) Off-site fabrication.
      6) Access.
      7) Site utilization.
      8) Temporary facilities and controls.
      9) Work hours.
      10) Hazards and risks.
      11) Progress cleaning.
      12) Quality and work standards.
      13) Change Orders.
      14) Documentation of information for payment requests.

4. Reporting: Architect will distribute minutes of the meeting to each party present and to parties who should have been present and will include a brief summary, in narrative form, of progress since the previous meeting and report.
   a. Schedule Updating: Revise Contractor's Construction Schedule after each progress meeting where revisions to the schedule have been made or recognized. Issue revised schedule concurrently with the report of each meeting.

E. Coordination Meetings: Architect will conduct Project coordination meetings at intervals required by the Construction Documents. Project coordination meetings are in addition to specific meetings held for other purposes, such as progress meetings and preinstallation conferences.

1. Attendees: In addition to representatives of Owner and Architect each contractor, subcontractor, supplier, and other entity concerned with current progress or involved in planning, coordination, or performance of future activities shall be represented at these meetings. All participants at the conference shall be familiar with Project and authorized to conclude matters relating to the Work
2. Agenda: Review and correct or approve minutes of the previous coordination meeting. Review other items of significance that could affect progress. Include topics for discussion as appropriate to status of Project.

3. Any decision reached at a job meeting shall be binding on a Contractor, whether or not he or his representative is present at such job meeting
4. Reporting: Architect will record meeting results and distribute copies to everyone in attendance and to others affected by decisions or actions resulting from each meeting.

PART 2 - PRODUCTS (Not Used)

PART 3 - EXECUTION (Not Used)

END OF SECTION 013100

ATTACHMENTS:
RFI SUBMITTAL FORM

REQUEST FOR INFORMATION (RFI FORMAT)

<table>
<tr><td colspan="2">Contractor:</td><td colspan="3">Architect: KG&D Architects, PC</td></tr>
<tr><td colspan="2">Address:</td><td colspan="3">Address: 285 Main Street, Mt. Kisco, NY 10549</td></tr>
<tr><td colspan="2">Telephone:</td><td colspan="3">Telephone: 914-666-5900</td></tr>
<tr><td colspan="2">Fax:</td><td colspan="3">Fax: 914-666-0051</td></tr>
<tr><td colspan="2">Email:</td><td colspan="3">Email: rmarkgraf@kgdarchitects.com</td></tr>
<tr><td colspan="2">Project Name:</td><td colspan="3">Project Location:</td></tr>
<tr><td>RFI Number:</td><td>Date of Request:</td><td colspan="3">Requested Date of Response (5 business days minimum)</td></tr>
<tr><td colspan="5">Description, complete with backup data as necessary attached hereto:</td></tr>
<tr><td>Sketches of Conditions</td><td colspan="2">Specification Paragraph Reference(s):</td><td colspan="2">Drawing Reference(s):</td></tr>
<tr><td colspan="5">Proposed Solution:</td></tr>
<tr><td colspan="2">Cost Impact:</td><td colspan="3">Time Impact:</td></tr>
<tr><td colspan="5">Trade/Specialty Contractors Affected:</td></tr>
<tr><td colspan="5">Trade/Specialty Contractors Coordinated With:</td></tr>
<tr><td colspan="5">Submitted By:</td></tr>
<tr><td colspan="5">Architect's Response:</td></tr>
<tr><td colspan="2">By:</td><td colspan="3">Date of Response:</td></tr>
</table>

SECTION 013115 – COORDINATION DRAWINGS

PART 1 - GENERAL

1.1 SUMMARY

A. This Section includes preparation of coordination drawings for architectural, structural, mechanical, plumbing, fire protection, fire alarm, lighting, information technology, security, and electrical Work.

B. Related Sections include the following:

1. Division 01 Section "Project Management and Coordination" for administrative provisions for coordinating construction operations.
2. Division 01 Section “Closeout Procedures” for project record drawing requirements.
3. Division 21, 22, 23, 26, 27 and 28 for additional requirements.

1.2 DEFINITION AND INTENT

A. The Contract Drawings (mechanical, plumbing, and electrical plans) are diagrammatic only and are not intended to show the alignment, exact physical locations, or configurations of such Work. Performance by the Contractor shall be required to the extent consistent with the Contract Documents and reasonably inferable from them as being necessary to produce the intended results. Where possible, the Contractor shall take field measurements and verify field conditions and shall carefully compare such field measurements and conditions and other information known to the Contractor with the Contract Documents before commencing coordination drawings.

B. Coordination drawings are drawings prepared by Contractor that superimpose Work of multiple trades involved in the construction process. Coordination drawings indicate systems and components to be installed by the Contractor to maximize clear height and free area in ceiling cavities, allow for proper and adequate equipment service clearances, minimize space required by shafts and chases and provide the most efficient functioning and use of materials possible while complying with the final performance and finished appearance required by the Contract Documents.

C. Coordination drawings are intended to show the relationship and integration of different construction elements that require coordination during fabrication or installation to fit in the space provided, to function as intended, and to present the intended final finished appearance.

D. Coordination Drawings are not a replacement for shop drawings specified in the technical specifications or the Record Drawings required in Division 01.

E. The Contractor shall manage the process so that each trade/ sub contractor provides all required information in a timely manner. Coordination Drawings may be completed on a phased basis so as not to delay the overall project schedule. The CPM Schedule

specified elsewhere in Division 01 Section “Construction Progress Documentation” shall include the submission of Coordination Drawings. The same shall demonstrate how the Contractor intends to integrate the submission of Coordination Drawings to suit the overall project schedule. The Contractor shall pay all costs for reproducing copies of coordination drawings for use in the field.

F. Contractor shall maintain equipment access and pathways as indicated on the Drawings. Floor space in equipment rooms shall be maintained as indicated on the Drawings. Contractor shall clearly indicate access and floor space to be maintained in coordinated shop drawings submitted to the Owner and Architect as per the Specifications

1.3 CONTRACTOR'S USE OF ARCHITECT'S CAD FILES

A. Refer to Division 01 Section “Submittal Procedures” for availability of and use of Architect’s CAD Background Drawings.

1.4 SUBMITTALS

A. Coordination Drawings: Prepare and submit as informational submittal within 15 days of Notice to Proceed.

B. Submit coordination drawings in the same manner as shop drawings; refer to Section 013300 Submittal Procedures.

1.5 PROJECT CONDITIONS

A. Maintain marked up set of coordination drawings at Project site available for reference by Owner and Architect.

B. Maintain original CAD drawings or base drawings used to produce coordination drawings updated with revisions to reflect actual construction. Make drawing revisions at time of change to construction; Transfer information to CAD drawings no later than every 7 days.

C. Failure to submit coordination drawings will result in no changes to contract sum for necessary corrections to uncoordinated work.

PART 2 - PRODUCTS (Not Used)

PART 3 - EXECUTION

3.1 PREPARATION OF COORDINATION DRAWINGS, GENERAL

A. Prepare coordination drawings for Project using CAD drawings or similar coordination documentation overlay drawings indicating coordination of the project.

B. CAD Drawings: Produce coordination drawings and overlays using Architect's electronic base drawings furnished by the Architect.

1. Each trade shall be assigned a layer to create the detailing work of each section or division of the Specifications requiring coordination. The Contractor shall ensure that the layer assigned to one trade cannot be modified by another trade, and that the final product clearly differentiates which trade is responsible for the respective information shown. The latter may occur through the use of colors or other distinct graphic methods.

3.2 INFORMATION REQUIRED IN COORDINATION DRAWINGS

A. Architectural Work Information Required in Coordination Drawings:

1. Items which are recessed into ceilings and ceiling plenums, or surface mounted to ceilings.
2. Anchorages, fastenings, and supporting for items recessed in, attached to, or suspended from ceilings or structure above ceilings.
3. Firewalls, Fire Barrier, Fire partitions and smoke partitions on coordination drawings for coordination of life safety requirements.

B. Plumbing Work Information Required in Coordination Drawings:

1. Sizes and bottom elevations of piping with insulation thickness included.
2. Dimensions of major components, such valves, access doors and cleanouts.
3. Fire-rated enclosures around piping
4. Support of all roof mounted plumbing piping and equipment.
5. Required space to install, service and maintain all plumbing mechanical items and systems.

C. HVAC Work Information Required in Coordination Drawings:

1. Sizes and bottom elevations of ductwork, piping with insulation thickness included.
2. Fire dampers.
3. Acoustical lining in ductwork.
4. Identification of ductwork pressure class.
5. Dimensions of major components, such as dampers, valves, diffusers, access doors, cleanouts and electrical distribution equipment.
6. Fire-rated enclosures around ductwork.
7. Support of all roof mounted HVAC piping and equipment.
8. Required space to install, service and maintain all HVAC items and systems.

D. Electrical Work Information Required in Coordination Drawings:

1. Electrical Work, including telecommunications, data, security, lighting and fire alarm systems.
2. Runs of vertical and horizontal conduit 1 inch diameter and larger.
3. Light fixture locations.

4. Emergency egress light locations.
5. Smoke detector, and other fire alarm device locations.
6. Panelboard, switchboard, transformer, cable tray, and motor control center, and exit signs.
7. Location of pull boxes and junction boxes, dimensioned from column center lines.
8. Bottom elevation of all conduit runs 1-1/4 -inch diameter and larger and of all cable trays.
9. Support of all roof mounted conduit and photovoltaic equipment, cameras, and security system devices.
10. Required space to install, service and maintain all electrical items and systems.
11. Lightning protection.

E. Structural Work Information Required in Coordination Drawings:

1. Ceiling system.
2. Openings and sleeve locations required in slabs, walls, beams and other structural elements, including required openings not indicated on Contract Documents.
3. Slab edge locations and locations of sleeves dimensioned from building lines and floor lines.

F. Ceiling Systems and Plenum Space in Coordination Drawings:

1. For mechanical, plumbing, fire alarm, electrical, controls, and telecommunications Work penetrating acoustical ceilings, show locations of each item (including sprinkler heads, diffusers, grilles, access doors, light fixtures, smoke detectors, exit signs, speakers, and other visible ceiling mounted devices) relative to acoustical ceiling grid or to wall in gypsum board ceilings.
2. Locate components within ceiling plenums to maximize clear area for future installations of lights and equipment.
3. Clearly indicate areas of conflict between light fixtures, diffusers and grilles and plenum boxes and other components on coordination drawings.
4. Draw elements to dimensions appropriate for products to be installed. Use of symbols is not acceptable.

3.3 TRADE CONFLICTS IN CAD DRAWINGS AND OTHER OVERLAY DRAWINGS

A. The General Construction Contractor shall review the Coordination Drawings and indicate areas of Architectural, Equipment, Structural and other conflicts and obstacles and coordinate locations of rated and exterior walls to assure their continuity and closure as specified. The each trade Contractor shall determine that all work can be installed without interference. In the case of unresolved interference, the General Contractor shall notify the Architect. The Architect will then suggest to the General Construction Contractor as to how to revise the Drawings to eliminate interference. The General Construction Contractor shall then have the trade(s) revise their respective Drawings to eliminate the interference.

1. Each Contractor or trade shall approve the Coordination drawings in writing indicating approval of installation coordination and clearances

3.4 PREPARATION OF COORDINATION DRAWINGS

A. Organize coordination drawing submittals as follows:

1. Floor Plans: Provide floor plans and reflected ceiling plans for all floors. Show architectural, structural, mechanical, plumbing, fire protection, fire alarm, electrical, and telecommunications elements on floor plans and reflected ceiling plans.
2. Equipment Rooms and Spaces: Provide large scale drawings for equipment rooms and spaces showing plans and elevations of mechanical, plumbing, fire protection, electrical, and telecommunications equipment.
3. Structural Penetrations: Provide coordination drawings for each floor indicating penetrations and openings required for all trades.
4. In public and occupied areas without scheduled finish ceilings, appearance is a major coordination factor. Reposition proposed locations of work after Coordination Drawing review by the Architect. Provide adjustments to the exact size, location and offsets of ducts, pipes, and conduit to achieve reasonable appearance objectives. Provide these adjustments as part of the Contract or notify the Architect immediately as to why the adjustment cannot be made.

B. Prepare coordination drawings to a scale of 1/4" = 1'- 0" or larger (1/2"= 1'-0" for mechanical room plans); detailing major elements, components, and systems of mechanical equipment and materials in relationship with other systems, installations, and building components. Indicate locations where space is limited for installation and access and where sequencing and coordination of installations are of importance to the efficient flow of the Work, including (but not necessarily limited to) the following:

1. Detail complex areas at larger scale than typical floor plans.
2. Use a common architectural layout as background.
3. Indicate ductwork, pipes with 6-inch diameter and greater, and conduits with 3-inch diameter and greater by double lines. Use single lines for smaller mechanical piping and all electrical conduits. Draw piping, ductwork, lighting fixtures, and cable trays in scale.
4. Circle and clearly note deviations from Contract Documents with reason for deviation stated.
5. Provide name of representative of each subcontractor whose Work is indicated on coordination drawings, verifying their review and approval that their Work has been coordinated with each other trade and with architectural and structural Work.

END OF SECTION 013115

SECTION 013200 - SCHEDULING AND PROGRESS

1.1 GENERAL

A. Requirements set forth herein are in addition to and shall be considered as complementary to the General Conditions and the balance of Division #1 and Technical Specifications.

B. All Contractors, Subcontractors, Sub-subcontractors, Vendors and the like shall be required to familiarize themselves with said provisions.

1.2 REQUIREMENTS INCLUDED IN THIS SECTION

A. Preliminary Requirements
B. Commencement, Prosecution and Completion of the work
C. Submittal Schedule
D. Project Progress Schedule
E. Breach of Contract
F. Time of Completion

1.3 PRELIMINARY REQUIREMENTS

A. Within three (3) working days after bids are opened, and before the Contract is executed, the three (3) apparent low bidder for each trade/contract must submit to the Architect, in writing, a list of duration's and a sequence, in the form of a bar chart, for all activities that are the responsibility of the bidder. Contractor's proposed work force and other resource loading for each activity of the bar chart, broken down by trades, must also be provided. Failure to comply with this requirement may be cause for rejection of the bid.

B. The apparent low bidders, concurrent with the submission of bar chart, shall also submit to the Architect, in writing, the following information:
   1. Shop drawing and material sample schedules keyed to the duration's submitted in the bar chart. (See Section 013300)
   2. Schedules for the award of subcontractor and equipment contracts keyed to the duration's submitted for the bar chart.
   3. The name of the person who, as Scheduling Coordinator for the apparent low bidder, is authorized to act on behalf of the apparent low bidder on all matters of scheduling included in this Section. Once named, the Scheduling Coordinator may only be replaced after written notice is given to the Owner's Representative and Architect. The Contractor agrees, upon the request of either of the two parties, to replace the Scheduling Coordinator.

C. Failure to comply with this subsection 1.03 of this Section of the General Requirements may be cause for rejection of the bid and forfeiture of security.

1.4 COMMENCEMENT, PROSECUTION AND COMPLETION OF THE WORK

A. Contractor shall commence work under this contract upon receipt by him of Letter of Intent to Award, Notice to Proceed, and/or

Execution of the Contract and shall prosecute said work diligently and complete the work within the stated calendar days for each portion of the work as set

forth in Section 011000.

B. The time stated for completion for contract work includes final cleanup of area. Upon completion of total Contract work, ALL AREAS SHALL BE CLEAN.

C. The Contractor is to carry on responsibility for services and maintenance of such items as temporary roads, walks, ramps, field offices, parking areas, environmental controls and the like until work under this contract is complete, unless otherwise directed by the Owner. Coordinate work herein with Section 011000, Description of Work.

1.5 SUBMITTAL SCHEDULE

A. Within two (2) weeks after receipt of Letter of Intent to Award, Notice to Proceed, and/or Execution of the Contract, the General Contractor shall prepare a detailed listing of all items to be incorporated within the work, including all items of mechanical and electrical. This information will be incorporated in the "PPS" as prepared by the "General Contractor" in accordance with Paragraph 1.6 of this Section. Listing should generally include the following:

1. Overall project milestones
2. Proposed products list and statue report on material orders
3. Dates of shop drawing/sample submittals
4. Guaranteed delivery dates after shop drawing and/or sample approvals
5. Date of installation start
6. Date of installation completion

1.6 PROJECT PROGRESS SCHEDULE

A. Within two (2) weeks after receipt of Letter of Intent to Award, Notice to Proceed, and/or Execution of the Contract, but prior to the actual start of the field work, the Contractor shall submit to the Architect for his approval the proposed Project Progress Schedule giving the information listed below.

The minimum information contained within the required project progress schedule shall consist of:

1. The estimated dates the various classes of work included in the Schedule of Values will be started and completed.
2. The estimated percentages of completion to be obtained and the total dollar value of the various classes of said work projected to the end of each calendar month until substantial completion. Calculations shall be based upon - work in place; materials on site and not installed; materials fabricated and stored under suitable conditions and insured to full value in a manner satisfactory to Architect and Owner; and such other items as may be agreed to among the Contractor, Architect and Owner.
3. The estimated delivery and installation dates of the major pieces of equipment to be furnished and installed by the Contractor.
4. The estimated projected progress of work that will be performed away from the job site.
5. A delineation of the work that will be performed by the Contractor's

own forces and by his Subcontractors.

6. The estimated calendar dates on which all the work under the contract will be completed and ready for substantial completion and final inspections.

B. The Project Progress Schedule shall be based on an orderly progression of the Work, allowing adequate time for each operation, and leading to a reasonable certainty of Substantial Completion by the date established in Section 011000, Article 1.1.

The schedule will be reviewed by the Architect and Owner's Representative for compliance with the requirements of this article and will be accepted by them or returned to the contractor for revision and resubmittal.

Unless specifically required by law, no payment under this Contract shall be due until the Progress Schedule has been submitted to the Architect and Owner's Representative and approved by both parties.

C. As the work progresses, an up-to-date copy of the schedule with the actual percent completion of the various classes of the work indicated in red shall be submitted by the contractor to the Architect and/or Owner's Representative during the first week of each calendar month. (Distribution to be established as part of "preconstruction meeting").

The schedule may be adjusted and revised to meet unforeseen job conditions, but such changes shall, at all times, be approved by the Architect and the Owner's Representative in writing.

D. A copy of the schedule shall be available at all times at the job site for the inspection and guidance of other Contractors, Subcontractors and Vendors engaged on any construction phase of the project.

It shall be the responsibility of Each Contractor to ascertain that all his Subcontractors, Vendors and Material men periodically consult the Schedule so that their work schedule shall be maintained in conformance with his own.

It shall also be the responsibility of Each Contractor to periodically consult the Job Progress Schedules of any other Contractors that may be engaged on any separate construction of the project, so that undue delay in progress on their part shall not delay the work of the other Contractors.

E. AN UP TO DATE COPY OF PROJECT PROGRESS SCHEDULE MUST BE ATTACHED TO MONTHLY REQUISITION IN ORDER FOR PROCESSING TO BEGIN.

INCOMPLETE REQUISITIONS WILL BE REJECTED.

1.7 BREACH OF CONTRACT

A. In addition to the Owner's right to terminate the contracts as set forth in the Contract Documents, including Article 20 of the AIAI A104-2017 Agreement;

the Contractor's failure to comply with any requirement called for in subsections 20.2.1 above shall constitute a material breach of the Contract, and the Owner shall have the right to and may terminate the Contract, provided, however, that the failure of the Owner to so terminate shall not relieve the Contractor from future compliance.

1.8 TIME OF COMPLETION – Coordinate with Contract and Section 011000.

A. Notwithstanding the implementation of the Construction Schedule, it is the sole responsibility of the Contractor to complete the Work within a Contract Time which will assure the substantial completion of the Project by the required date.

End of Section

SECTION 013300 - SUBMITTAL REQUIREMENTS

NOTES:

- SUBMISSIONS CAN BE MADE ELECTRONICALLY PROVIDED THAT SAID SUBMISSIONS FOLLOWS THE CRITERIA OUTLINED HEREIN AND BOTH THE FORMAT FOR THE OVERALL PROCESS IS AGREED TO BETWEEN ALL PARTIES PRIOR TO INITIAL START OF THE PROJECT.
- SUBMITTAL TRANSMISSIONS SHALL BE LIMITED TO THE TECHNICAL PRODUCT AND DRAWING REQUIREMENTS ONLY. MSDS DATA SHALL NOT BE TRANSMITTED AS AN INTEGRAL PART OF THE SUBMITTAL BUT SHALL BE INCLUDED AS A SEPARATE DOCUMENT FOR THE EXPRESS PURPOSE OF ASSEMBLING THE REQUIRED FIELD MANUAL AS SPECIFIED HEREIN.
- ***ALL SUBMITTALS SHALL BE MADE THROUGH THE SUBMITTAL EXCHANGE PROCESS – EMAIL TRANSMITTAL OF SAME WILL NOT BE ACCEPTED AND WILL BE RETURNED WITHOUT REVIEW.***
- ***ALL COSTS INVOLVED WITH THE IMPLEMENTATION AND MAINTENANCE OF THE SUBMITTAL EXCHANGE WILL BE DEEMED AT THE SUBMITTING CONTRACTOR'S EXPENSE.***

1.1 GENERAL

A. Requirements set forth herein are in addition to and shall be considered as complementary to the Form of Agreement and the balance of Division 00, 01 and Technical Specifications.

B. All Contractors, Subcontractors, Sub-subcontractors, Vendors and the like shall be required to familiarize themselves with said provisions.

C. Definitions as apply to "Contractors" involved with the work of this Project shall be as set forth in Section 011000, Article 1.01.

D. Where practical, submittals shall be made in groupings where installations are complimentary. ***Failure to comply with this requirement will be cause for rejection of any or all submittals***.

Coordinate each submittal with fabrication, purchasing, testing, delivery, other submittals, and related activities that require sequential activity.

Architect reserves the right to withhold action on a submittal requiring coordination with other submittals until related submittals are received.

E. The Contractor is encouraged to submit for approval products made from recycled and/or environmentally responsible material. Every effort will be made by the Design Professional Team to approve these materials; the substitution request procedure shall still be enforced.

1.2 REQUIREMENTS INCLUDED IN THIS SECTION

A. Related Work Specified Elsewhere.

B. Approved Equal Clause/Substitutions/Options

C. Certification.

D. Manufacturer's Instructions

E. Submittal Instructions

F. Shop Drawings
G. Samples
H. Material Safety Data Sheet (MSDS) Submittals
I. Proposed Products List and Status Report on Material Orders
J. Scheduling of Submittals
K. Job Progress Schedule
L. Coordination Drawings
M. Progress Photographs
N. Certificates
O. Construction Waste Management Procedures and Certifications – See Section 017419.
P. V.O.C. Compliance certification – See individual technical sections.

1.3 RELATED WORK SPECIFIED ELSEWHERE

A. 012900 - Applications for Payment and the Schedule of Values
B. 013200 - Scheduling and Progress
C. 017700 - Project Closeout requirements
D. 017719 - Project Record Documents
E. Divisions 2 through 33 Sections for specific requirements for submittals in those Sections

1.4 CERTIFICATION

A. Certification of compliance with specification performance standards and manufacturers' specifications and directions shall be furnished for any portion of this work for which specific performance requirements and/or manufacturers' specifications are listed. It shall be the responsibility of the Contractor to secure two (2) copies of each certification when required and transmit same to the Architect.
B. Sample Certification Form (2 pages) Section 013306 as an exhibit at the close of this Section. Each item requiring certification shall be so noted and affidavits shall be filed singly to cover each specified material, installation, application and the like. CERTIFICATIONS SHALL BE SUBMITTED AS PART OF THE CLOSE OUT DOCUMENT REQUIREMENTS SET FORTH IN SECTION 017700.

1.5 MANUFACTURER'S INSTRUCTIONS

A. Where in these specifications an item is called for to be installed in accordance with the manufacturer's directions, specifications or recommendations, the Contractor shall furnish the Architect with two (2) printed copies of said directions, specifications or recommendations, before the item is installed.

1.6 SUBMITTAL INSTRUCTIONS

A. Transmit each submittal, except sample installations and sample panels to the Architect. Transmit submittals with Submittal Cover Sheet attached as Section 013302. On the Cover Sheet identify Contractor, indicate date of submittal, and include information prescribed by form and required in paragraph entitled, "Submittal Requirements" of the individual technical Section and as follows. Process transmittal forms to record actions regarding sample installations and panels.

1.7 SHOP DRAWINGS

A. The following serves as a further definition of the requirements for shop drawing submittals.

1. The Contractor shall submit to the Architect with such promptness as to cause no delay in the work, layout, detail, schedule, setting, product data and shop drawings for each part of the work as specified or required.
   a. Submission of data for review by the Structural and Mechanical/Electrical Engineers shall be sent directly to those Engineers with duplicate transmittals sent to the Architect.
2. BEFORE SUBMITTING ANY DATA FOR APPROVAL, THE CONTRACTOR SHALL CHECK THE SUBMITTALS OF ALL SUBCONTRACTORS FOR ACCURACY AND CONTRACT COMPLIANCE. ALL SUBMITTALS SHALL BE UNDER THE COVER SHEET ATTACHED HERETO. SUBMITTALS NOT COMPLYING WITH THE ABOVE SHALL BE RETURNED TO THE SUBMITTING CONTRACTOR WITHOUT EXAMINATION BY THE ARCHITECT. CONTRACTOR SHALL SEE THAT ALL WORK CONTIGUOUS WITH AND HAVING BEARING ON WORK INDICATED ON DRAWINGS IS ACCURATELY AND DISTINCTLY ILLUSTRATED AND THAT WORK SHOWN IS IN CONFORMITY WITH CONTRACT REQUIREMENTS.
3. Shop drawings shall be numbered consecutively and shall represent:
   a. All working and erection dimensions.
   b. Arrangement and sectional views.
   c. Necessary details, including information for making connections to other work.
   d. Kinds of materials and finishes. Colors, where applicable
4. Shop drawings shall be dated, and shall generally contain:
   a. Name and Number of project.
   b. Name, address and telephone number of submitting Contractor.
   c. Description of required equipment, materials, and classification item numbers.
   d. Locations at which materials or equipment are to be installed in the Work.
   e. Identification of drawings, schedules, notes and/or details and specification sections and related paragraphs/articles to which they apply.
   f. Equipment or fixture identification corresponding to that used in Contract Documents.
   g. Accessories and special or non-standard features and materials which are being furnished.
   h. Properly marked with external connection identification as related to the project where they consist of standard factory assembly or field installation drawings.

In addition to the general data required above, mechanical and electrical submissions shall contain:

a. Manufacturer's specifications including materials of construction, metal gauge, thickness and finish.
b. Certified dimensional drawings including clearances required for maintenance or access (coordinate with Section 013114)
c. Performance data, ratings, operating characteristics, and operating limits.
d. Electrical ratings and characteristics.
e. Wiring and control diagrams, where applicable.
f. Certifications requested, including UL label or listing.
g. List of accessories which are required but are NOT being provided by the product manufacturer or are NOT being furnished under this Section. Identify the Section(s) under which the accessories are being furnished.

5. Submission of data for approval shall be accompanied by letter of transmittal, in duplicate, containing the name of the project, Contractor's name, number of drawings, titles and other pertinent data.
6. Procedure for Submitting Shop Drawings and Product Data
7.

a. After completion of checking, the Architect, and Engineer (as appropriate) will retain one print for his record and return the remaining copies to the submitting Contractor.

The average "turnaround time" of any one in-house submittal by the Architect shall not exceed 15 business days for review and at least 20 business days when another consultant is involved.

b. For drawings returned "Resubmit," "Amend & Resubmit," "Disapproved" or "Rejected-Resubmit," the original drawings shall be corrected, and resubmitted until final approval.

NOTE: The Owner reserves the right to backcharge the Contractor for the additional costs beyond the review of any resubmittal.

c. For drawings returned "Approved", "No Exceptions Taken", "Approved as Noted", and "Make Corrections Noted", the Contractor shall obtain and provide sufficient prints as required for the field.

Note: It is the responsibility of the Contractor to confirm all dimensions, quantities, and the coordination of materials and products supplied by him with other trades. Approval of shop drawings containing errors does not relieve the contractor from making corrections at his expense.

8. No work as called for by shop drawings shall be done until Architect's approval.

9. IF SUBMITTALS SHOW VARIATIONS FROM CONTRACT REQUIREMENTS BECAUSE OF STANDARD SHOP PRACTICES, OR OTHER REASONS, CONTRACTOR SHALL MAKE SPECIFIC MENTION OF SUCH VARIATION IN HIS LETTER OF TRANSMITTAL.
10. APPROVAL OF SHOP DRAWINGS IS GENERAL. IT SHALL NOT RELIEVE CONTRACTOR OF THE RESPONSIBILITY FOR ACCURACY OF SUCH DRAWINGS, NOR FOR THE FURNISHING OF MATERIALS OR PROVISION OF WORK REQUIRED BY THE CONTRACT AND NOT SHOWN ON THE SHOP DRAWINGS.

    Unless it is an interpretation of design intent, approval of shop drawings shall not be construed as approval of departures from Contract.

11. If the Contractor should alter any information on previous submittals, besides the notations called for by the Architect, he must circle this new information to bring it to the Architect's attention.

    Where practical, in submitting data for approval, all associated drawings, product data and the like, relating to a complete assembly shall be submitted at one and the same time so that each may be checked in relation to the entire proposed assembly.

    PARTIAL SUBMISSIONS WILL BE RETURNED WITHOUT ACTION TAKEN. EXTRANEOUS MATERIAL ON PRODUCT DATA SHEETS SHALL BE STRUCK PRIOR TO SUBMITTAL.

    Resubmittals of any data shall be “complete”, i.e. – Lighting Fixture resubmittal shall include all fixtures whether or not some have been approved so that when the entire submittal is approved, a full record copy is on file.

12. Contractor shall have copies of all approved shop drawings as listed in Paragraph 1.06.A.6 above on the job at all times and shall make them available to the Architect or the Owner's representatives.

1.8 SAMPLES

A. The following serves as a further definition of the requirements for sample submittals:
    1. Names of proposed manufacturers, materialmen and dealers who are to furnish materials, fixtures, appliances or other fittings shall, where practical, be submitted to the Architect for early approval to afford proper investigation and check.
    2. No manufacturer will be approved for any materials to be furnished under this contract unless he shall be of good reputation and shall have plant of ample capacity and shall have successfully produced similar products.
    3. All transactions with manufacturers and subcontractors shall be through the Contractor.
    4. Unless otherwise specified, samples shall be in duplicate (2) and of

adequate size to show quality, type, color, range, finish, texture, etc. Deliver one (1) sample to field office and one (1) sample to Architect's office unless otherwise directed.

5. Each sample shall be labeled, bearing material and quality names, submitting Contractor's name, and project name, and other pertinent data.

In accordance with OSHA regulation Number 1910.1200, a Material Safety Data Sheet (MSDS) shall be submitted for each product to be incorporated in the work.

The sole purpose for requiring submittal of MSDS sheets as outlined herein and respective technical sections is to advise the Contractor that health and safety is of primary importance to the execution of the work and for the future occupants of the project under construction. It is to be assumed, and will be enforced, that the submission of MSDS sheets be made as a separate package, covered by its own transmittal and marked “for evidence of legal compliance”. This submission will be noted and returned with a stamp indicating “SUBMITTED INFORMATION ONLY, NOT REVIEWED”.
Failure to observe these submittal requirements will be cause for rejection of the entire submittal.

The safe handling of products by the applicator according to MSDS warnings is a safety issue, like any other, entirely within the purview of the Contractor.

6. Where Specifications require manufacturer's printed installation directions, such directions and diagrams shall accompany samples. Coordinate with Paragraph 1.05 herein
7. A duplicate letter of transmittal from the submitting Contractor requesting approval of the sample shall accompany the samples.
8. Transportation charges to designated locations must be prepaid on all samples.
9. Materials shall not be ordered until approval is received in writing from the Architect. All materials shall be furnished equal in all respects to the samples which were approved.

1.9 MATERIAL SAFETY DATA SHEET (MSDS) SUBMITTALS

A. As specified in Paragraph 1.07 of this Section and within the technical sections forming this Specification, the Contractor is directed to the following requirements concerning "MSDS" submissions.
   1. Submit MSDS's for all products used during construction whether incorporated within the work or used in the performance of the work.
   2. Identify which products may be harmful to construction workers or other building occupants.
   3. Develop means and methods for protection of construction workers

and other building occupants from potentially harmful products. **Submit said means and methods to the Owner for review and approval**.

B. Further, the Contractor with assistance from each individual contractor shall maintain a "MSDS" file on site, accessible to workers and otherwise in compliance with jurisdiction's "Right To Know" legislation.

C. Attention is directed Section 017700, Article 1.04.A.5 for final closeout submittal of MSDS compilation to the Owner.

1.10 CERTIFICATES

A. Submit a Summary of Solid Wastes Generated, manifests, weight tickets, and the like in accordance with requirements of Section 017491 Construction Waste Management.

B. Submit, as required by each technical section a certification for V.O.C. compliance.

End of Section

CONTRACTOR REQUEST FOR ELECTRONIC DRAWING FILES

The Architect, for the convenience of the Client/Owner, has electronic copies or representations of Drawings, Specifications and Project Manuals. Requests for electronic copies of such Drawings, Specifications and Project Manuals by the Contractor, for the Contractors use or the use of Subcontractors, shall be made in writing to the Client/Owner as outlined hereinbelow and shall outline the benefit derived from such a request. The Contractor shall be prepared to reimburse the Client/Owner for any costs involved in preparing such electronic documents for the Contractors use.

Architect's Project Number:	
Project Name:	
Architect:	
Client/Owner:	
Contractor/Recipient's Name:	
Attention to:	
Contractor/Recipient's Address:	
Date of Request:	
Date of Release:	

As requested, attached is a list of electronic drawing files. For the release of these electronic drawing files to the recipient, the following items shall be understood, acknowledged and signed by the authorized personnel of the recipient with the fee included.

A. The electronic drawing files are the property of the Architect, and the Contractor is granted a license to use the electronic files only in connection with the subject project.

B. The electronic drawing files do not necessarily represent the Contract Documents associated with the referenced project. These files are solely for the use of the recipient and are not a representation of the scope of work for the project. Any use by contractors, subcontractors or fabricators shall be on all of the same terms and conditions being applicable to such users who shall acknowledge the same in writing. The Recipient may use the electronic drawing files only. Electronic drawing files or portions thereof, shall not be provided to anyone else without the written approval of the Client/Owner. The use of the electronic drawing files, documents and any reprographics shall not identify any member of the Architect or Architect's consultants or sub- consultants or the Client/Owner without the written approval from the parties.

C. The entire risks as to the results and performance of the package including the

electronic drawing files, are assumed by the Contractor/recipient. The Client/Owner, the Architect and the Architect's consultants and sub-consultants, including directors, employees, representatives, and licensors of the company, shall not have any liability to the Contractor/recipient or any other person or entity for any direct, indirect, incidental special or consequential damages whatsoever, including, but not limited to, the loss of revenue or profit, lost data, or any other personnel, commercial or economic loss, and claims by third parties. Even if the Client/Owner and Architect and the Architect's consultants and sub-consultants has been advised of the possibility of such damages; said Client/Owner and Architect and the Architect's consultants and sub-consultants shall not be held liable as stated above.

D. The Contractor/recipient hereby agrees to indemnify and hold the Client/Owner, the Architect and the Architect's consultants and sub- consultants harmless from and against any cost, damage, liability, loss or claim arising from violation of this license. The Contractor/recipient and all subcontractors of all tiers also agrees that, in addition to all other remedies hereunder, the Contractor/recipient and such parties grant the Client/Owner the right to seek injunctive or other equitable relief to prevent the violation or require the performance of any of the Contractor's/recipient's obligations under this license, and the Contractor/recipient hereby consents to the issuance of such relief by any court of competent jurisdiction without the need to post any bond or security.

E. The electronic files requested are as follows:

Electronic file name	Corresponding Drawing (close approximation)
1.	
2.	
3.	
Etc.	
Total number of files:	

CONTRACTOR'S/RECIPIENT'S AGENT SIGNATURE: _____

NAME IN BLOCK LETTERS: _____

AUTHORIZED POSITION HELD: _____

DATE OF SIGNATURE: _____

End of Section

SUBMITTAL COVER SHEET

Contractor:_____

Address:_____ **Telephone:** (__)_____

Owner:

Name of Project:

TYPE OF SUBMITTAL:

☐Shop Drawings ☐Schedule ☐Physical Sample
☐Technical Data ☐Certificate ☐Color Sample
☐Test Report ☐Warranty ☐_____

Submission # for this Submittal: **1st** **2nd** **3rd** **4th** (circle one)

Description:

Product Identification: _____

_____

Manufacturer: _____

Subcontractor/Supplier:_____

DOCUMENT REFERENCES: (Must be fully filled out)

Spec Section No.:_____ Drawing No(s):_____

Paragraph: _____ Rm. Or Det. No(s):_____

Contractor Remarks:

Contractor Submittal Review Stamp

THE ATTACHED MATERIAL HAS BEEN REVIEWED BY THE UNDERSIGNED AND IS BELIEVED TO COMPLY WITH ALL REQUIREMENTS OF THE CONTRACT DOCUMENTS. THE UNDERSIGNED UNDERSTANDS VERIFICATION OF FIELD DIMENSIONS, AND COORDINATION WITH OTHER TRADES, REMAINS THE RESPONSIBILITY OF THE CONTRACTOR.

DATE: _____ BY (SIGN): _____

Consultant use below this line:

Architect Submittal Review Stamp

☐NO EXCEPTIONS ☐MAKE CORRECTIONS NOTED
☐REJECTED ☐REVISE AND RESUBMIT
☐EXAMINED ☐SUBMIT SPECIFIED ITEM

CHECKING IS ONLY FOR GENERAL CONFORMANCE WITH THE DESIGN CONCEPT OF THE PROJECT AND GENERAL COMPLIANCE WITH THE INFORMATION GIVEN IN THE CONTRACT DOCUMENTS. ANY ACTION SHOWN IS SUBJECT TO THE REQUIREMENTS OF THE PLANS & SPECIFICATIONS. CONTRACTOR IS RESPONSIBLE FOR DIMENSIONS WHICH SHALL BE CONFIRMED & CORRELATED AT THE JOB SITE; FABRICATION PROCESSES AND TECHNIQUES OF CONSTRUCTION; COORDINATION OF HIS WORK WITH THAT OF ALL OTHER TRADES & THE SATISFACTORY PERFORMANCE OF HIS WORK

KG+D ARCHITECTS, P.C.

DATE_____ BY_____

CERTIFICATION OF SPECIFICATION
COMPLIANCE

I/WE, the MANUFACTURER/SUPPLIER and INSTALLER of _____

_____

as specified in Section Number _____of the Contract Documents prepared by KG+D Architects, PC, 285 Main Street, Mount Kisco, NY, 10549, for the:

Yonkers Public Library
Grinton I. Will Branch
Chiller and Switchgear Replacement

do (does) herein certify that -

1. All materials furnished for said project do fully comply with all specification requirements as stated within the Contract Documents.

2. That no asbestos containing materials of any nature are used in the work.

3. That execution of the Work covered by this certification has been performed in accordance with the drawings prepared by the design professional team.

CONTRACTOR: _____

CERTIFICATION BY:_____ TITLE: _____

ADDRESS: _____

CERTIFICATION DATED: _____

Distribution:

Original and One Copy to: KG+D Architects, PC
285 Main Street
Mount Kisco, NY 10549

CERTIFICATION OF SPECIFICATION COMPLIANCE

CORPORATE ACKNOWLEDGEMENT

)SS.
)

On the _____ day of _____, before me came _____ to me known and who by me being duly sworn did depose and say that he resides at _____ that he is the officer of the said corporation executing the foregoing instrument, that he knows the seal of said corporation, that the seal affixed to said instrument is such corporate seal, that it was so affixed by order of the Board of Directors of said corporation and that he signed his name thereto by like order.

_____
Notary Public

INDIVIDUAL ACKNOWLEDGEMENT

State of
)SS.
)
County of

On the _____ day of _____, before me came _____ to me known and who by me being duly sworn did depose and say that he resides at _____ that he is the individual who executed the foregoing instrument.

_____
Notary Public

PARTNERSHIP ACKNOWLEDGEMENT

State of
)SS.
)
County of

On the _____ day of _____, before me came _____ to me known and who by me being duly sworn did depose and say that he resides at _____ that he is the partner in the firm of _____ doing business under the name of _____ and that he executed the foregoing instrument on behalf of said partnership.

_____
Notary Public

SECTION 013529 - HEALTH AND SAFETY PLAN

PART 1 – GENERAL

1.1 GENERAL

A. Requirements set forth herein are in addition to and shall be considered as complementary to the General Conditions of the Contract and the balance of Division #1 and Technical Specifications.

B. All Contractors, Subcontractors, Sub-subcontractors, Vendors and the like shall be required to familiarize themselves with said provisions.

C. Definitions as apply to "Contractors" involved with the work of this Project shall be as set forth in Section 011000.

1.2 REQUIREMENTS INCLUDED IN THIS SECTION

A. Provide all labor, equipment and materials and perform all operations in connection with monitoring air quality, decontaminating equipment and providing worker health and safety protection for all Contractor and Subcontractor personnel.

B. Develop a site-specific Health and Safety Plan (HASP) specifically addressing the potential hazards that may be encountered. This plan shall meet all Occupational Safety and Health Administration (OSHA) requirements.

C. Review the requirements and data presented and supplement the program with any additional measures deemed necessary to fully comply with regulatory requirements and adequately protect personnel on the site.

1.3 REFERENCES

A. OSHA Regulation 29 CFR 1910.120

B. OSHA Regulation 29 CFR 1926.62

1.4 DEFINITIONS

A. Site Safety Official (SSO): The individual who is responsible to the Contractor and has the authority and knowledge necessary to implement the site safety and health plan and verify compliance with applicable safety and health requirements.

B. SSO shall possess full and complete authority to order stoppage of any work which he deems unsafe.

1.5 SUBMITTALS

A. Provide within seven (7) days after execution of the Agreement.

1. Site-specific HASP including the Emergency Response Plan to the Owner, Owner’s Representative and Architect for review, including provisions for decontamination and a contingency plan for unforeseen emergencies. The review is only to determine if the HASP meets basic regulatory requirements and the minimum requirements of this Section. The review will not determine the adequacy of the HASP to address all potential hazards, as that remains the sole responsibility of the

Contractor.

2. Current certification of employee's health and safety training and certification of employee's baseline medical exam status.
3. Certification of additional required health and safety training for Supervisors.
4. Qualifications and experience of the SSO for approval.

B. Submit minutes of weekly safety meetings at periodic progress meetings.

1.6 CONTRACTOR'S RESPONSIBILITIES

A. Contractor is solely responsible for the health and safety of workers employed by the Contractor, any Subcontractor and anyone directly or indirectly employed by any of them.

B. Develop and follow a site-specific Health & Safety Plan (HASP) in accordance with the requirements of paragraph 1.07.

C. Provide a full-time SSO regardless of whether or not the Work is at a defined Uncontrolled Hazardous Waste Site.

D. Pre-arrange emergency medical care services at a nearby hospital, including establishment of emergency routes of travel.

E. Meetings:

1. Conduct daily job briefings with all site personnel to discuss relevant health and safety issues including but not limited to hazards, monitoring, procedures and controls. Document attendance and topics covered.
2. At a minimum, conduct weekly safety meetings with all site personnel, documenting attendance and topics covered.

F. Train all workers assigned to areas where contaminated media are likely to be encountered in accordance with 29 CFR 1910.120.

G. Include those workers involved with the abatement of Asbestos containing materials in a medical surveillance program and respiratory protection program that meet the requirements of 29 CFR
1910.120 and 29 CFR 1910.134, respectively.

H. In areas where contaminated media are likely to be encountered, monitor air quality in and around work area using appropriate air monitoring equipment/analysis, as indicated in Part 2. Record all readings and maintain record on site. Stop work and/or upgrade respiratory protection or personal protective equipment levels if action levels established in the HASP are exceeded. Ensure that degree and type of respiratory protection provided is consistent with the monitored concentrations and individual chemical parameters. Lawfully dispose of all contaminated clothing and equipment that cannot be decontaminated.

1.7 HEALTH & SAFETY PLAN (HASP) REQUIREMENTS

A. The following items shall be addressed in the HASP:

1. Safety and health hazard assessment
2. Procedures for emergency medical treatment and first aid
3. Map indicating route to hospital for emergency medical care
4. Lead Exposure Control Plan (29 CFR 1926.62)
5. Equipment decontamination procedures
6. Air monitoring procedures and action levels

7. Personal protective equipment and decontamination
8. Physical hazard evaluation and abatement including:
    a. Equipment operation
    b. Confined space entry
    c. Slips and falls
    d. Building collapse
    e. Falling debris
    f. Encountering unmarked utilities
    g. Cold and heat stress
    h. Hot work (cutting and welding)
    i. Excavation entry
9. Training requirements
10. Recordkeeping requirements
11. Emergency response plan that includes:
    a. Names of three (3) emergency response contractors, experienced in the removal and disposal of oils and hazardous chemicals, that the contractor intends to use in the event of an emergency
    b. Evacuation routes and procedures
    c. Emergency alerting and response procedures

1.8 CONTINGENCY MEASURES & NOTIFICATIONS

A. The potential for encountering hazardous buried objects or materials that could pose a threat to human health or the environment exists at the Project Site. In the event that potentially hazardous materials are encountered during the work under this contract, the responsibilities of the Contractor and the Owner's Representative are described herein.

B. The procedures and protocols to be used by the SSO in defining materials that are potentially hazardous include screening with a photoionization detector, odor, visual appearance of a material, and obvious oil or chemical contaminated materials.

C. Upon encountering suspected hazardous buried objects or materials as described above, cover the excavation immediately if no imminent danger, as defined by the SSO, is present. If there is an imminent danger, as defined by the SSO, evacuate the area immediately. The SSO shall then notify the Owner's Representative of the situation.

D. Establish, properly barricade, and mark the area as an exclusion zone under the direction of the SSO. The SSO shall establish the exclusion zone boundaries based upon air quality monitoring using a photoionization detector and other equipment as appropriate. The exclusion zone shall be established at a minimum 50-foot radius around the location where the potentially hazardous material is encountered. Work within the exclusion zone shall be discontinued until the hazardous condition has been remediated and testing indicates that a hazard does not exist. Other activities of the site, outside the limits of the exclusion zone shall continue. Ambient air quality monitoring shall be performed by the SSO to demonstrate that ambient air quality in other portions of the site is not adversely impacted by the exclusion zone condition.

E. Notify Owner's Representative regarding the presence of potentially hazardous

materials. Owner's Representative may direct the Contractor to notify regulators and to obtain necessary regulatory approvals for remediation.

F. Mobilize the appropriate equipment and personnel to sample and test the hazardous material within the exclusion zone to determine the remedial action required, subject to the Owner's Representative's direction. Contractor may be directed to remove and legally dispose of the material. Compensation for the removal and disposal of hazardous material will be as a Change in Work and Change in Contract Price in accordance with the Subcontract Agreement, if not covered under a specific bid item.

PART 2 - PRODUCTS

2.1 AIR MONITORING EQUIPMENT

A. Provide and maintain portable photoionization detector or organic vapor analyzer capable of detecting organic vapors or total hydrocarbons. Equipment shall be sensitive to the 0.5 PPM level.

B. Provide and maintain an oxygen analyzer to measure oxygen concentration in any trench or confined space prior to entry, as determined by the SSO.

C. Provide and maintain an explosimeter whenever the potential for accumulation of explosive gases exists, as determined by the SSO.

D. Provide and maintain air monitoring equipment as required for the collection/monitoring of airborne asbestos fibers. All air samples related to abatement work shall be analyzed by a laboratory accredited by the American Industrial Hygiene Association.

E. All air monitoring equipment shall remain the property of the Contractor.

PART 3 - EXECUTION - NOT USED

End of Section

SECTION 014100 - PERMITS AND COMPLIANCE

1.1 GENERAL

A. Requirements set forth herein are in addition to and shall be considered as complementary to the General Conditions and the balance of Division #1 and Technical Specifications.

B. All Contractors, Subcontractors, Sub-subcontractors, Vendors and the like shall be required to familiarize themselves with said provisions.

1.2 REQUIREMENTS INCLUDED

A. Permits and Licenses

B. Compliance

C. Additional Compliance

1.3 PERMITS AND LICENSES

A. The Contractor shall obtain, maintain and pay for all permits and licenses necessary for the execution of the work and for the use of such work when completed.

1.4 COMPLIANCE

A. The Contractor shall give all notices, pay all fees and comply with all laws, rules and regulations applicable to the work.

1.5 ADDITIONAL COMPLIANCE

A. The Contractor, Subcontractors, and the employees of the Contractor and Subcontractors, shall comply with all regulations governing conduct, access to the premises, operation of equipment and systems, and conduct while in or near the premises and shall perform the work in such a manner as not to unreasonably interrupt or interfere with the conduct of business of the Facility.

B. Further, attention is directed to requirements of Section 011501.

End of Section

SECTION 014219 - REFERENCE STANDARDS

1.1 QUALITY ASSURANCE

A. Applicability of Standards: Unless the Contract Documents include more stringent requirements, applicable construction industry standards have the same force and effect as if bound or copied directly into the Contract Documents to the extent referenced. Such standards are made a part of the Contract Documents by reference.

B. Publication Dates: Comply with standards in effect as of date of the Contract Documents, unless otherwise indicated.

C. Conflicting Requirements: Where compliance with two or more standards is specified, and the standards may establish different or conflicting requirements for minimum quantities or quality levels comply with the most stringent requirement. Refer uncertainties and requirements that are different, but apparently equal, to Architect for a decision before proceeding.

1.2 REFERENCE STANDARDS - The abbreviations, which may be used in the construction specifications, refer to the organizations and specifications of the organizations listed below.

AABC	Associated Air Balance Council
AI	Asphalt Institute
AISC	American Institute of Steel Construction
ADC	Air Diffusion Council
ALSC	American Lumber Standards Committee
AMCA	Air Movement and Control Association
ARMA	Asphalt Roofing Manufacturers Association
ASC	Adhesive and Sealant Council
ASLA	American Society of Landscape Architects
ASHRAE	American Society of Heating, Refrigerating and Air Conditioning Engineers, Inc.
ASTM	American Society for Testing and Materials International
CLFMI	Chain Link Fence Manufacturers Institute
CRI	Carpet and Rug Institute
CS	Commercial Standard of NBS
FS	Federal Specifications (General Services Administration), Specifications Unit (WFSIS)
GANA	Glass Association of North America
GS	Green Seal
IEEE	Institute of Electrical and Electronics Engineers
IESNA	Illuminating Engineering Society of North America
IGMA	Insulating Glass Manufacturers Alliance
LSGA	Laminators Safety Glass Association
MFMA	Maple Flooring Manufacturers Association, Inc.
AIMA	North American Insulation Manufacturers Association
NFPA	National Fire Protection Association
NFRC	National Fenestration Rating Council
NHLA	National Hardwood Lumber Association
NOFMA	National Oak Flooring Manufacturers Association
NPCA	National Paint and Coatings Association
NPA	National Particleboard Association
NSF	National Sanitation Foundation International

NTMA	The National Terrazzo and Mosaic Association
RFCI	Resilient Floor Covering Institute
SFPA	Southern Forest Products Association
SIGMA	Sealed Insulating Glass Manufacturers Association
SPC	Southern Pine Inspection Bureau (Grading Rules)
SSPC	Steel Structures Painting Council
WDMA	Window & Door Manufacturers Association
WMMP	Wood Molding and Millwork Producers Association
WRI	Wire Reinforcement Institute, Inc.
WSFI	Wood and Synthetic Flooring Institute
WWPA	Woven Wire Products Association

B. Federal Agencies

CE	Army Corps of Engineers)
CPC	Consumer Product Safety Commission
EPA	Environmental Protection Agency
DOE	Department of Energy
NIST	National Institute of Standards and Technology
OSHA	Occupational Safety & Health Administration

Further attention is directed to industry guide complied by Sweet's division of McGraw-Hill denoted as "PROJECT INFORMATION AND SERVICES" as well as in the web site www.4specs.com wherein a comprehensive list of international organizations representing building product manufacturers, associations, institutes, governmental agencies and testing bureaus is put forth.

1.3 APPLICABLE CODES: The following is a listing of applicable codes within the jurisdiction of the Work:

A. IBC: 2020 International Building Code
B. IFC: 2020 International Fire Code
C. IMC: 2020 International Mechanical Code
D. IPC: 2020 International Plumbing Code
E. IGC: 2020 International Fuel Gas Code
F. IEBC: 2020 International Existing Building Code
G. IECC: 2020 International Energy Conservation Code
H. MPS: 1998 Manual of Planning Standards
I. 115: 8 NYCRR 155 Regulations of the Commissioner of Education

End of Section

SECTION 016100 - MATERIAL AND EQUIPMENT

1.1 GENERAL

A. Requirements set forth herein are in addition to and shall be considered as complementary to the General Conditions and the balance of Division #1 and Technical Specifications.

B. All Contractors, Subcontractors, Sub-subcontractors, Vendors and the like shall be required to familiarize themselves with said provisions.

1.2 REQUIREMENTS INCLUDED

A. General Standards
B. Products
C. Sustainability
D. Transportation and Handling
E. Storage and Protection

1.3 GENERAL STANDARDS APPLICABLE TO ALL SPECIFICATION SECTIONS

A. These provisions, standards, and tolerances shall apply to all work under this Contract. Where stricter standards and tolerances are specified elsewhere in these Specifications or in references specified in these Specifications, they shall take precedence over these standards and tolerances.

B. Build and install parts of the Work level, plumb, square, and in correct position unless specifically shown or specified otherwise.

1. No part shall be out of plumb, level, square, or correct position so much as to impair the proper functioning of the part or the Work as judged by the Architect.
2. No part shall be out of plumb, level, square, or correct position so much as to impair the aesthetic effect of the part or the Work as judged by the Architect.

C. Make joints tight and neat. Provide uniform joints in exposed work. Arrange joints to achieve the best visual effect. Refer choices of questionable visual effect to the Architect.

D. Under potentially damp conditions, provide galvanic insulation between different metals which are not adjacent on the galvanic scale.

E. Manufacturers, subcontractors, and workmen shall be experienced and skillful in performing the work assigned to them.

F. All paint used on all products shall conform to ANSI Z66.1, Specifications for Paints and Coatings Accessible to Children to Minimize Dry Film Toxicity.

G. The Drawings do not attempt to show every item of existing work to be demolished and every item of repair required to existing surfaces. Perform work required to remove existing materials which are not to be saved and to restore existing surfaces to condition equivalent to new as judged by Architect. If possible, repairs shall be indistinguishable from adjacent sound surfaces. Where it is impossible to achieve repairs, which are indistinguishable from adjacent sound surfaces to remain, notify Architect in writing, and proceed according to his instructions.

1.4 PRODUCTS

A. Products include material, equipment and systems.

B. Comply with Specifications and referenced standards as minimum requirements.

C. Components required to be supplied in quantity within a Specification Section shall be the same and shall be interchangeable.

D. In the case of an inconsistency between Drawings and the Specifications, or within either document which is not clarified by addendum, the product of greater quality or greater quantity of work shall be provided in accordance with the Designer's interpretation.

E. Provide environmentally preferable products to the greatest extent possible. To the greatest extent possible, provide products and materials that have a lesser or reduced effect on the environment considering raw materials acquisition, production, manufacturing, packaging, distribution, reuse, operation, maintenance, and/or disposal of the product.

1.5 SUSTAINABILITY

A. In the selection of the products and materials of this section as well as for the entire project, preference will be given to those with the following characteristics:

1. Water based
2. Water-soluble
3. Can be cleaned up with water
4. Non-flammable
5. Biodegradable
6. Low or preferably no Volatile Organic Compound (VOC) content
7. Manufactured without compounds that contribute to ozone depletion in the upper atmosphere
8. Manufactured without compounds that contribute to smog in the lower atmosphere
9. Do not contain methylene-chloride
10. Do not contain chlorinated hydrocarbons
11. Contains the least possible of post-consumer or post- industrial waste

1.6 TRANSPORTATION AND HANDLING

A. Arrange deliveries of materials in accordance with construction schedules in order to avoid delay in, conflict with, or the impeding of the progress of the Work and conditions at the site. Deliveries shall be made during regular work hours, unless approved otherwise by the Owner.

B. Deliver materials in undamaged condition, in manufacturer's original containers or packaging, with identifying labels intact and legible.

1.7 STORAGE AND PROTECTION

A. Store materials in accordance with manufacturer's instructions, with seals and labels accessible for inspection.

Contractor shall be responsible for work and equipment until fully inspected, tested and accepted. Carefully store materials and equipment which are not immediately installed after delivery to site. Close open ends of work with temporary covers or

plug during construction to prevent entry of obstructing material or damaging water.

B. Materials stored on the Site shall be neatly arranged and protected and shall be stored in an orderly fashion in locations that shall not interfere with the progress of the Work or with the operations of the Owner.

C. Interior Storage: Maintain temperature and humidity within the ranges required by manufacturer's instructions.

NOTE - Should it become necessary during the course of the Work to move materials or equipment stored on the Site, the Contractor, at the direction of the Architect, shall move such material or equipment.

D. Protection After Installation
   1. Provide adequate coverings to protect installed materials from damage resulting from natural elements, traffic, and subsequent construction.
   2. Remove when no longer needed.

End of Section

SECTION 017419 - CONSTRUCTION WASTE MANAGEMENT

PART 1 - GENERAL

1.1 GENERAL

A. Requirements set forth herein are in addition to and shall be considered as complementary to the General Conditions of the Contract and the balance of Division #1 and Technical Specifications.

B. All Contractors, Subcontractors, Sub-subcontractors, Vendors and the like shall be required to familiarize themselves with said provisions.

C. Definitions as apply to "Contractors" involved with the work of this Project shall be as set forth in Section 011000, Article 1.1

D. Any and all “Waste Handlers and Haulers” shall be licensed by the Authority having jurisdiction over “Solid Waste Management” and a copy of said license shall be submitted in accordance with Article 1.05 herein.

1.2 DESCRIPTION OF WORK

A. This Section specifies requirements for a complete program for implementation of waste management controls and systems for the duration of the Work.

1.3 INTENT

A. The Owner has established that this Project shall generate the least amount of waste practical and that processes that ensure the generation of as little waste as possible due to error, poor planning, breakage, mishandling, contamination, or other factors shall be employed.

B. Of the waste that is generated, as many of the waste materials as economically feasible shall be reused, salvaged, or recycled. Waste disposal in landfills shall be minimized to the greatest extent practical. With regard to these goals each Contractor shall develop, for Owner's Representative’s review and Architect’s review, a Waste Management Plan for this Project. Contractor shall be responsible for segregating his/her waste into different dumpsters. Contractor shall be responsible for ensuring that debris will be disposed of at appropriately designated licensed solid waste disposal facilities, as defined by governing laws of the jurisdiction of the Work.

1.4 WASTE MANAGEMENT PLAN

A. Waste Management Plan: Contractor shall provide a plan containing the following:

1. Analysis of the proposed jobsite waste to be generated, including types and rough quantities.
2. Landfill Options: The name of the landfills where trash and building debris will be disposed of, the applicable landfill tipping fees, and the projected cost of disposing of all Project waste in the landfills.
3. Landfill Certification: Contractor’s statement of verification that landfills proposed for use are licensed for types of waste to be deposited and have sufficient capacity to receive waste from this project.

4. Alternatives to Landfilling: A list of each material proposed to be salvaged or recycled during the course of the Project. Include the following and any additional items proposed:
    a. Cardboard
    b. Clean dimensional wood
    c. Beverage containers
    d. Concrete
    e. Bricks and masonry
    f. Asphalt
    g. Metals from framing, banding, stud trim, ductwork, piping, rebar, roofing, other trim, steel, iron, galvanized sheet steel, stainless steel, aluminum, copper, zinc, lead, brass, and bronze
    h. Glass, colored glass allowed
    i. Plastic
        1. Type 1: Polyethylene Terephthalate (PET, PETE)
        2. Type 2: High Density Polyethylene (HDPE)
        3. Type 3: Vinyl (Polyvinyl Chloride or PVC)
        4. Type 4: Low Density Polyethylene (LDPE)
        5. Type 5: Polypropylene (PP)
        6. Type 6: Polystyrene (PS)
        7. Type 7: Other. Use of this code indicates that the package in question is made with a resin other than the six listed above or is made of more than one resin listed above and used in a multi-layer combination.
    j. Paint and paint cans
    k. Insulation
    l. Others as appropriate
5. Meetings: A description of the regular meetings to be held to address waste management.
6. Materials Handling Procedures: A description of the means by which any waste materials identified above will be protected from contamination, and a description of the means to be employed in recycling the above materials consistent with requirements for acceptance by designated facilities.
7. Transportation: A description of the means of transportation of the recyclable materials (whether materials will be site-separated and self-hauled to designated centers, or whether mixed materials will be collected by a waste hauler and removed from the site) and destination of materials.

1.5 SUBMITTALS

A. Construction Waste Management Plan: Submit 3 copies of plan within 21 days of date established for the Notice to Proceed.

B. Calculations and supporting documentation to demonstrate end-of- project recycling rates meeting the requirements for Construction Waste Management Plan of Item above.

C. For materials separated for recycling off-site, establish a method for tracking the weight of the recycled material. The method shall be included in the CWM Plan for the Architect's review and approval.

D. Waste Reduction Progress Reports: Concurrent with the Applications for Payment, submit three copies of report. Include monthly tabulations for demolition and construction waste sent off-site for disposal or recycling.
E. Waste haulers solid waste management license.

PART 2 - PRODUCTS - NOT USED

PART 3 - EXECUTION

3.1 RECYCLING
A. Metal, including but not limited to aluminum stairs, structural beams and sections, and reinforcing steel shall be recycled.
B. Wood that is not painted and does not contain preservatives (i.e. creosote, arsenic, and chromium-containing preservatives) shall be segregated and recycled.

3.2 WASTE MANAGEMENT PLAN IMPLEMENTATION
A. All sorting will be done “off-site” by a recognized construction and demolition processing facility who will be responsible for provision of all documentation as to where loads were processed, and the recycling rate achieved.
B. Hazardous Wastes: Any unforeseen hazardous wastes shall be separated, stored, and disposed of according to local regulations.

End of Section

SECTION 017419 -CONSTRUCTION WASTE MANAGEMENT

1.1 GENERAL

A. Requirements set forth herein are in addition to and shall be considered as complementary to the General Conditions of the Contract and the balance of Division #1 and Technical Specifications.
B. All Contractors, Subcontractors, Sub-subcontractors, Vendors and the like shall be required to familiarize themselves with said provisions.
C. Definitions as apply to “Contractors" involved with the Work of this Project shall be as set forth in Division 0.

1.2 DESCRIPTION OF WORK

A. This Section specifies requirements for a complete program for implementation of waste management controls and systems for the duration of the Work.

1.3 INTENT

A. The Owner has established that this Project shall generate the least amount of waste practical and that processes that ensure the generation of as little waste as possible due to error, poor planning, breakage, mishandling, contamination, or other factors shall be employed.
B. Of the waste that is generated, as many of the waste materials as economically feasible shall be reused, salvaged, or recycled. Waste disposal in landfills shall be minimized to the greatest extent practical. With regard to these goals the Contractor shall develop, for Owner's Representative's review and Architect's review,” a Waste Management Plan for this Project. Each Contractor shall be responsible for segregating their own waste into different dumpsters as directed by the Architect and/or Owner. The Contractor shall be responsible for ensuring that debris will be disposed of at appropriately designated licensed solid waste disposal facilities, as defined by governing laws of the jurisdiction of the Work.

1.4 WASTE MANAGEMENT PLAN

A. Waste Management Plan: The General Contractor shall provide a plan containing the following:
    1. Analysis of the proposed jobsite waste to be generated, including types and rough quantities.
    2. Landfill Options: The name of the landfills where trash and building debris will be disposed of, the applicable landfill tipping fees, and the projected cost of disposing of all Project waste in the landfills.
    3. Landfill Certification: Contractor's statement of verification that landfills proposed for use are licensed for types of waste to be deposited and have sufficient capacity to receive waste from this project.
    4. Alternatives to Landfilling: A list of each material proposed to be salvaged or recycled during the course of the Project. Include the following and any additional items proposed:
        a. Cardboard.
        b. Clean dimensional wood.
        c. Beverage containers.
        d. Land clearing debris.

e. Concrete.
f. Bricks and masonry.
g. Asphalt.
h. Gypsum boards.
i. Acoustical ceiling material (grid separate).
j. Metals from framing, banding, stud trim, ductwork, piping, rebar, roofing, other trim, steel/ iron, galvanized sheet steel, stainless steel, aluminum, copper, zinc, lead, brass and bronze.

5. Meetings: A description of the regular meetings to be held to address waste management.
6. Materials Handling Procedures: A description of the means by which any waste materials identified above will be protected from contamination, and a description of the means to be employed in recycling the above materials consistent with requirements for acceptance by designated facilities.
7. Transportation: A description of the means of transportation of the recyclable materials (whether materials will be site-separated and self-hauled to designated centers, or whether mixed materials will be collected by a waste hauler and removed from the site) and destination of materials.

PART 2 -PRODUCTS -Not Used

PART 3 -EXECUTION

3.1 RECYCLING

A. Metal, including but not limited to aluminum stairs, structural beams and sections, and reinforcing steel shall be recycled.
B. Wood that is not painted and does not contain preservatives (i.e. creosote, arsenic, and chromium-containing preservatives) shall be segregated and recycled.

3.2 WASTE MANAGEMENT PLAN IMPLEMENTATION -All sorting will be done "off site" by a recognized construction and demolition processing facility who will be responsible for provision of all documentation as to where loads were processed and the recycling rate achieved.

End of Section 017419

SECTION 017700 - PROJECT CLOSE OUT

1.1 GENERAL

A. Requirements set forth herein are in addition to and shall be considered as complementary to the General Conditions and the balance of Division #1 and Technical Specifications.

B. All Contractors, Subcontractors, Sub-subcontractors, Vendors and the like shall be required to familiarize themselves with said provisions.

1.2 REQUIREMENTS INCLUDED

A. Final Cleanup

B. Required Close Out Documentation

C. Project Close Out Inspections

1.3 FINAL CLEANUP

A. The Contractor shall leave the work ready for use and occupancy without the need of further cleaning of any kind.

B. The Contractor shall remove all tools, appliances, project signs, material and equipment from the phased areas as soon as possible upon completion of the work.

C. The work is to be turned over to the Owner in new condition, in proper repair and in perfect adjustment to the satisfactions of the Owner.

1.4 REQUIRED CLOSE OUT DOCUMENTATION

A. Prior to final payment the Owner shall receive, in addition to those documents required by the General Conditions, the following:

1. Project record documents as per Section 01 77 19
2. The Contractor's general guarantees
3. Specific guarantees of material, equipment and systems installed in the work. A copy of all test data taken in connection with the work.
4. Copies of all Certification of Specifications Compliance as per Section 01 33 00
5. Record of Material Safety Data Sheets (MSDS)
6. Certified Payroll Records

1.5 PROJECT CLOSE OUT INSPECTIONS

A. When the Work has reached such a point of completion that the building or buildings, equipment, apparatus or phase of construction or any part thereof required by the Owner for occupancy or use can be so occupied and used for the purpose intended, the Contractor, prior to notification to the Architect, shall make a preliminary inspection of the Work to insure that all the requirements of the Contract have been met and the Work is substantially complete and is acceptable. Upon such notification, the Architect shall make a detailed inspection of the Work to ensure that all the requirements of the Contract have been met and that the Work is complete and is acceptable.

B. A copy of the report of the inspection shall be furnished to the Contractor as the inspection progresses so that the Contractor may proceed without delay with any part of the Work found to be incomplete or defective.

C. When the items appearing on the report of inspection have been completed or corrected, the Contractor shall so advise the Architect. After receipt of this notification, the Architect shall inform the Contractor of the date and time of final inspection. A copy of the report of the final inspection containing all remaining contract exceptions, omissions and incompletions shall be furnished to the Contractor.

D. After the receipt of notification of completion and all remaining contract exceptions, omissions and incompletions from the Contractor, the Architect will reinspect the Work to verify completion of the exception items appearing on the report of final inspection.

E. Upon completion of reinspection, the Architect will prepare a certificate of final acceptance or will furnish to the Contractor a copy of the report of the Architect's reinspection detailing Work that is incomplete or obligations that have not been fulfilled but are required for final acceptance.

End of Section

SECTION 017719 - PROJECT RECORD DOCUMENTS

1.1 GENERAL

A. Requirements set forth herein are in addition to and shall be considered as complementary to the General Conditions of the Contract and the balance of Division #1 and Technical Specifications.

B. All Contractors, Subcontractors, Sub-subcontractors, Vendors and the like shall be required to familiarize themselves with said provisions.

C. Definitions as apply to "Contractors" involved with the work of this Project shall be as set forth in Section 011000, Article 1.01.

1.2 REQUIREMENTS INCLUDED

A. Project Record Drawings

B. Record Drawing Certification

1.3 PROJECT RECORD DRAWINGS

A. The purpose of the project drawings is to record the actual location of the work in place including but not limited to underground lines, concealed piping within buildings, concealed valves and control equipment, and to record changes in the work.

In addition to the above, these drawings shall be "color-coded", by each trade, on a daily basis to indicate progress of the work. Color legend will be assigned by the Architect.

B. In addition to the sets of contract drawings that are required by the Contractor on the site to perform the work, the Contractor shall maintain, at the site, one (1) copy of all drawings, specifications and addenda that are part of the Contract as awarded.

Each of these documents should be clearly marked "Project Record Copy", maintained in a clean and neat condition available at all times for inspection by the Owner or the Architect, and shall not be used for any other purpose during the progress of the work.

The Architect will be the custodian of the project record documents until the end of the Project.

C. Project Record Requirements

1. The Contractor shall mark up the "Project Record Copy" to show:
    a. Approved changes in the work
    b. Location of underground work and concealed work
    c. Details not shown in the original Contract Documents
    d. Any relocation of work including piping, conduits, ducts and the like
    e. All changes in dimensions
    f. All access doors and "tack" locations access points in accessible ceilings
    g. Location of all plumbing, heating, ventilating, air conditioning or

electrical assemblies, whether existing to remain or newly installed
h. Revisions to any electrical circuitry

2. Such information shall include, but shall not be limited to:
   a. Footing depth in relation to finished grade elevations
   b. Any change in floor elevations
   c. Any structural changes
   d. Any substitutions
   e. Elevations and locations of all underground utilities, services, or structures referenced to permanent above ground structures or monuments
   f. Designation of all utilities as to the size and use of such utilities
   g. All invert elevations of manholes
   h. The location of all utilities, services and appurtenances concealed in building structures that have been installed differently from that required by the Contract
   i. Any and all approved change orders

and other such data as required by the Architect and/or Owner so as to establish a complete record of "As-Constructed" conditions.

D. The Contractor shall keep the project record documents up-to-date from day to day as the work progresses. Appropriate documents are to be updated promptly and accurately; no work is to be permanently concealed until all required information has been recorded.

E. The project record drawings are to be submitted by the Contractor to the Architect when all the work is completed and is approved by the Owner and the Architect before the Contractor may request final payment.

If the project record drawings as submitted are found to be unacceptable due to incompleteness or inaccurate information, the drawings shall be returned to the offending Contractor for corrective action and resubmitted for approval prior to the release of final payment.

FINAL PAYMENT IS CONTINGENT UPON PREPARATION OF FINAL PROJECT RECORD DRAWINGS ON A SET OF "PRINTS" and CAD DISKETTES IN "DXF" or “DWG” FORMAT AS APPROVED BY THE OWNER (A SET OF BASE DISKETTES WILL BE FURNISHED BY THE ARCHITECT) AND SUBMITTAL OF SAME TO THE OWNER, THROUGH THE ARCHITECT.

F. In addition to the drawings required as mentioned above, the Contractor shall submit a list of all approved Shop Drawings of the Work as installed.

From this list the Architect will select the drawings desired for permanent records. The Contractor shall furnish these in a bound set to the Owner as part of the closeout requirements.

1.4 RECORD DRAWING CERTIFICATION

A. The record drawings required under the terms and conditions of this Section shall be reviewed and processed by each of the Prime Contractors as part of their overall contractual responsibility.

B. This certification may be issued for individual trades or as a collective document to cover the entire record drawing requirements of the project.

The format of this certification shall be as follows: These record drawings prepared by:

_____

for _____ have been reviewed by the undersigned and:

Appear to be an accurate representation of the work incorporated within the project and are accepted as submitted in accordance with the technical documents.

This record document review made by this office is for determination of compliance to the requirements of the contract documents.

Firm Name: _____

Review Date: _____ By: _____

End of Section

SECTION 024119 - SELECTIVE REMOVALS AND DEMOLITION

PART 1 - GENERAL

1.1 Applicable provisions of the Conditions of the Contract and Division #1, General Requirements, govern work in this Section.

1.2 DESCRIPTION OF WORK

A. The work of this Section consists of the provision of all plant, materials, labor and equipment and the like necessary and/or required for the complete execution of all selective removal and demolition work as indicated by reference notes on the Drawings without limitation, and in coordination with MEP demolition plans, and as required for this project including proper protection of existing plant functions and facilities from damage and dirt during construction operations, including the following:

1. Perform all required demolition work within existing structure to accommodate new program and use. Insure adequate protective measures are taken to protect existing components to be retained against damage. Any and all damges will be corrected at no cost to the Owner.
2. Provide all temporary shoring systems as necessary in conjunction with the removal and new opening operations.
3. Perform saw cutting operations on existing concrete floors to permit execution of the work.
4. Removal, leveling, flash patching, repairs, infill, and other work required at existing floors to remain in order to align with new work and receive new finishes
5. Cutting and patching of existing roof assembly, new openings, and modifications to existing structural framings for work required on roof including new HVAC equipment, penetrations, drainage, as scheduled and/or noted.
6. Perform cutting and chasing operations in connection with electrical work where indicated so as to permit recessed mounting of conduits and boxes. Coordinate with "Electrical" for extent of chasing.
7. Remove existing partitions, doors, frames and the like from all areas designated, salvage doors, frames and hardware for reuse as scheduled and/or noted.
8. Removals of ceiling and wall finishes throughout the building, including areas adjacent to the work area, as required for new mechanical, electrical, plumbing, and fire alarm work as shown on Drawings.
9. Salvage and relocate existing furniture, equipment and casework to extent shown and/or required.
10. Strip existing applied finishes including floors, walls, bases, and ceiling systems as required to permit execution of the work for the Project.
11. Perform balance of all demolition and removal work as required by the drawings and existing conditions, including performing of all necessary cutting, removals, and the like for the proper installation of all new work.
12. Properly protect existing plant functions and facilities from damage and dirt during construction operations.
13. Perform demolition of abandoned piping, wiring, or equipment items when safely disconnected from operating services.

NOTES:

1. Cutting and patching requirements shall be as defined in Sections 013113 and

017329 and coordinated herein. Coordinate with Trade Contractors.

2. In the event contaminated earth or asbestos-contaminated materials are encountered during the demolition work of any Prime Contractor, said Contractor shall immediately notify the Architect in writing for instructions as to procedures to be taken. Demolition and removals shall be done in such a manner to permit the Owners' consultant and asbestos abatement contractor access to the areas as required to look for, identify and abate asbestos conditions before damaging possible asbestos. All Contractors shall cooperate with the Owners' separate contractors to expedite abatement. The Owner will arrange for timely inspection, testing and abatement if necessary.

B. The Contractor shall:
   1. Take photographs of existing conditions of structure surfaces, equipment and adjacent improvements that may be misconstrued as damage related to removal operations. These photographs shall be submitted to the Owner's Representative prior to start of any work.
   2. Provide temporary barricades and other forms of protection required to protect occupants of the building and general public from injury due to selective removals and demolition work.

1.3 RELATED WORK SPECIFIED ELSEWHERE - Entire Project Specification with specific reference to Sections noted above.

1.4 QUALITY ASSURANCE
A. Requirements of Regulatory Agencies
   OSHA Code requirements governing removal and demolition Work.
   1. Comply with applicable requirements of American National Standards Institute (ANSI) Standard A10.6-1969, Safety Requirements for Demolition.
B. Do all demolition work only at such times and in such a manner as is approved by the Owner and is in compliance with above referenced codes, documents, procedures, plans or instructions. Noise shall be held to a minimum when working in or around functioning areas.

1.5 SUBMITTALS

A. Submit a schedule indicating proposed methods and sequence of operations for selective removals and demolition Work prior to commencement of operations. Include details for dust and noise control operation. Provide a detailed sequence of removals and demolition work to ensure uninterrupted progress of school sessions.
B. Material Safety Data Sheet (MSDS) must be submitted for each product.
C. Schedule of items and materials to be salvaged. Identify procedures for disassembly.
   1. Coordinate with Solid Waste Management Plan. Identify materials to be recycled. Identify materials to be salvaged for reuse on site and off site.

1.6 REQUIREMENTS AND RESTRICTIONS
A. Do all removal work only at such times and in such a manner as is approved by the Owner and is in compliance with above referenced codes, documents, procedures, plans or instructions. Noise shall be held to a minimum when working in or around functioning areas.
B. The work of this section shall be accomplished by a Contractor experienced in

removal and alteration work on projects of similar size and complexity within the past 5 years. Evidence of such experience on 5 such projects shall be submitted to the Owner for his evaluation.

C. Provide temporary barricades and other forms of protection required to protect Board of Education property, personnel, students, occupants of the building and general public from injury due to selective removals and demolition work.
   1. Protect from damage existing finish work that is to remain in place and which becomes exposed during operations.
   2. Protect floors with building paper or other suitable covering.
   3. Strict dust control measures shall be implemented and maintained at all times.

D. Maintaining Traffic
   1. Ensure minimum interference with roads, streets, parking lots, driveways, sidewalks, paths and adjacent facilities.
   2. Do not close or obstruct streets, driveways, lots, paths, sidewalks, passages and the like without permission of the Owner.
   3. When required by Owner or governing authorities, provide alternate routes around closed or obstructed traffic ways.

E. Notify all corporations, companies, individuals or local authorities owning, or having jurisdiction over, utilities running to, through or across areas disturbed by demolition operations. The Contractor shall notify the following prior to beginning operations:
   1. Digsafe
   2. All utility companies whose services are within 10 feet of the work of this Contract.

F. Keep public ways clear of all spillage from trucks hauling material to and from the project site.

G. Strict dust control measures shall be implemented and maintained at all times. Thoroughly wet down all work being demolished and all trucking ways as necessary to prevent spreading dust.

H. Damages - Promptly repair any and all damages to all property and finishes caused by the removals and demolition work; to the Owner's satisfaction and at no extra cost to the Owner.

1.7 SUSTAINABILITY

A. In the selection of the products and materials of this section as well as for the entire project, preference will be given to those with the following characteristics:
   1. Water based.
   2. Water-soluble.
   3. Can be cleaned up with water.
   4. Non-flammable.
   5. Biodegradable.
   6. Low or preferably no Volatile Organic Compound (VOC) content.
   7. Manufactured without compounds that contribute to ozone depletion in the upper atmosphere.
   8. Manufactured without compounds that contribute to smog in the lower atmosphere.
   9. Do not contain methylene-chloride.
   10. Do not contain chlorinated hydrocarbons.
   11. Contains the least possible of post-consumer or post-industrial waste.

PART 2 - PRODUCTS

2.1 MATERIALS

A. Protective Devices and Materials shall be the Contractor's option, subject to approval of the Architect and in compliance with the reference standard.

B. Power driven Tools - only hand held electric power driven tools conforming to the following criteria shall be used to cut or drill concrete and masonry:

1. Electric Chiseling Hammer
   a. Power Data 115 Volts AC; 7-8 Amps; Three wire grounded connection
   b. Percussion 2400-2600 Impacts per Minute
   c. Type/Size Hand held (+ 18 inch length)
   d. Unit Weight 12-15 pounds (minus chisel bit)
2. Electric Hammer Drill
   a. Power Data 115 Volts AC; 5-8 Amps; Three wire grounded connection
   b. Percussion 2400-3200 Impacts per Minute
   c. Type/Size Hand held (+ 18 inch length)
   d. Unit Weight 12-15 pounds (minus chisel bit)
   e. Speed Data 0-0500 RPM (Under load)
3. Electric Core Drill
   a. Power Data 115 Volts AC; 7-8 Amps; Three wire grounded connection
   b. Floor or wall anchored unit.
   c. Speed Data 0-1500 RPM (Under load)

Any other hand operated electric tools used for cutting, sawing or other operations shall be submitted to the Owner's Representative for approval prior to use for execution of the Work.

PART 3 - EXECUTION

3.1 INSPECTION

A. Prior to commencement of the selective removals and demolition Work, inspect the areas in which the Work will be performed. Determine and list the existing conditions of rooms or area surfaces and equipment. After the Work in each respective area is completed, determine if adjacent surfaces or equipment have been damaged as a result of the Work; if so, the damage shall be corrected at the Contractor's expense.

3.2 REMOVALS AND DEMOLITION WORK

A. Perform selective demolition Work in a systematic manner and use such methods as required to complete the Work indicated on the Drawings in accordance with the requirements of the Project Specifications and governing City, State, and Federal regulations.

B. Do no demolition or remove any items until it is certain that a condition will not be created which might jeopardize the weathertightness or structural adequacy of the existing building.

C. Demolish masonry walls and structural elements in small sections.

D. Do not throw rubbish or old materials of any kind from the upper stories to any point outside the building.

E. Proceed with the work of demolition and removal in an orderly manner and without noise or other disturbance to the operations of the existing facility.

3.3 DISPOSAL OF DEMOLISHED MATERIALS – Coordinate with Section 01 74 19 for Waste Management Plan Implementation.

A. Remove debris, rubbish and other materials resulting from the removals and demolitions from the building immediately; transport and legally dispose of materials off the project site. Disposal method shall be in accordance with City, State, and Federal regulations.

B. Burning of removed materials is not permitted on the job site or any area of the Owner's property.

3.4 CLEANUP AND REPAIR

A. Upon completion of removals and demolition Work, remove tools, equipment and all remaining demolished materials from the site.

B. Repair all damaged areas caused by the removals and demolition Work. Repair adjacent construction or surfaces soiled or damaged by selective demolition work.

C. All areas in which Work was performed under this Section shall be left "broom-clean."

End of Section

SECTION 230100 - GENERAL CONDITIONS

PART 1 - GENERAL

Applicable Provisions of the Conditions of the Contract and Division 1 General Requirements govern work in this section.

1.1 GENERAL CONDITIONS

A. Before submitting a proposal, Bidders shall examine all related to this work and shall become fully informed as to the extent and character of the work required and its relation to the other work in the building.

B. Before commencing work, the Contractor will examine all conditions of the project upon which his work is in any way dependent for perfect workmanship according to the intent of this Specification. No "waiver of responsibility" for incomplete, inadequate or defective adjoining work will be considered unless notice has been filed by this Contractor and acceded to by the Owner's representative in writing before the Contractor begins any part of the work.

C. The Contractor will pay for all licenses, permits and inspection fees required by civil authorities having jurisdiction. Comply with all laws, ordinances, regulations, and fire underwriter’s requirements applicable to work herein specified without additional expense to the Owner.

D. Small scale drilling through walls and floors or cutting of piping insulation which may contain asbestos shall be performed by a person with a “restricted asbestos handler allied trades certificate” and shall have a copy of it in his possession at all times while working of the project. This shall also apply to removal of piping, ductwork or equipment insulation.

E. It is specifically intended that anything (whether material or labor), which is usually furnished as a part of such equipment, as is hereinafter called for (and which is necessary for the completion and proper operation) shall be furnished as part of this Contract without additional cost the Owner, whether or not shown in detail or described in the Specifications.

F. When Drawings and Specifications conflict or there is a question as to the proper intent of this Contract, the Contractor shall assume the greater quantity, the higher quality and/or the more expensive method in his pricing. All questions shall be directed to the Architect/Engineer in writing only and only up to ten (10) days prior to bidding.

G. The Drawings indicate the general runs of the piping, ductwork, etc. systems and the location of equipment and apparatus, however it shall be understood that the right is reserved by the Architect/Engineer to change the location of piping work, ductwork, equipment and apparatus to a reasonable extent as building conditions may dictate, prior to their installation without extra cost to the Owner.

H. All components supplied by this Contractor shall be UL listed and/or ETL labeled and shall conform to ASHRAE Standard 15.

I. Any changes from the Drawings and Specifications and any interpretation thereof shall have the prior approval of the Architect/Engineer. The Contractor shall submit in writing, at the time of signing the Contract, any items of necessary labor and materials, which, in his opinion, are lacking in requirements of the Drawings and Specifications to insure a complete job in all respects. No consideration will be granted to alleged misunderstanding of materials to be furnished, work to be done, or conditions to be complied with, it being understood that the tender of a proposal carries with it the agreement to all items and conditions referred to herein, or indicated on the accompanying Drawings.

END OF SECTION 230100

SECTION 230110 - SCOPE OF WORK

PART 1 - GENERAL

Applicable Provisions of the Conditions of the Contract and Division 1 General Requirements govern work in this section.

1.1 SCOPE OF WORK

A. The work under this section includes all labor, materials, equipment, tools, transportation, and the performance of all work necessary and required for the furnishing and installation complete of all work as shown on the Contract Documents, including but not necessarily limited to the following:

1. All required piping, valves and related specialties.

2. Base mounted and centrifugal pumps.

3. Variable frequency drives.

4. Duct and Pipe insulation.

5. Rigging of equipment.

6. Furnish all combination motor starter/disconnects for equipment (with the exception of starters and electric items already mounted on equipment or equipment not requiring same). Fan motor starter/disconnects shall have contacts for ATC connection and a terminal block connection for Fire Alarm fan shutdown. Starters per manufacturers recommendations. Underwriters inspection and certificate required. Coordinate with Electrical Contractor.

7. Water Balancing.

8. Automatic temperature controls with complete wiring (regardless of voltage).

9. Testing, adjusting and start-up of equipment.

10. Painting and identification of all equipment and piping.

11. Firestopping per NFPA requirements (UL approved systems).

12. Operating and maintenance instructions.

13. As-Built Drawings - Refer to Division 1.

14. Cutting and Patching - Refer to Division 1.

15. Excavation and Backfill - Refer to Division 2.

1.2 REMOVALS

A. Removals should be coordinated with other trades affected.

B. Piping which penetrates the construction may be cut and capped provided capping is done beneath the finished surfaces so that construction over it can be achieved.

C. All removals shall be removed from the site.

1.3 ALTERATION WORK

A. All equipment, piping, control components, etc. to be removed, shall be disposed of or salvaged as directed by the Owner. They shall not be removed from the premises without the Owner's approval.

B. Removal of any piece of equipment or terminal device shall include removal of connecting ductwork and piping back to existing mains that remain. Cap each branch air/water-tight. Controls and control components shall also be removed. Do not leave components (controllers, pneumatics, etc.) that have no function. Provide control wiring, ductwork, piping, etc. as necessary to maintain continuity of service for equipment or terminal devices to remain.

C. All piping to be removed shall be properly plugged or capped so that upon completion of all new work, all abandoned piping shall be concealed in finished areas.

D. No dead ends shall be left on any piping upon completion of job. The existing system shall be left in perfect working order upon completion of new work.

E. Location and sizes of existing piping, ductwork, equipment, etc. are approximate. Exact sizes and locations of all existing work shall be verified on the job.

END OF SECTION 230110

SECTION 230170 - AIR COOLED LIQUID CHILLERS

PART 1 – GENERAL

Applicable Provisions of the Conditions of the Contract and Division 1 General Requirements govern work in this section. Submit shop drawings for checking and approval.

1.1 SUMMARY/SYSTEM DESCRIPTION/ACCEPTABLE MANUFACTURERS

A. Section includes design, performance criteria, refrigerants, controls, and installation requirements for a fully inverter air-cooled scroll heat pump chiller. The package ISHPC shall be provided as specified on the drawings. The package ISHPC shall meet the standards referenced in this specification and meet all local codes in effect.

B. The air-cooled variable refrigerant flow heat pump modular chiller may consist of multiple individual chiller modules. The chiller module shall be available in nominal capacities of 17, 20, 33-, 40-, 50- and 60-ton systems. All systems shall be completely factory wired and tested prior to shipment. Each module shall include a minimum of 2, 4 or 6 compressors and be matched to 1, 2 or 3 stainless steel plate and frame evaporator(s) for increased internal redundancy. The quantity of “tube in fin” air-cooled condensers coil per system shall match the number of compressors allowing each compressor to have a fully independent refrigerant circuit reducing the potential loss associated with a compromised system. Each ISHPC has a Digital Chiller Controller capable of independent control or plant control of up to a maximum of 5 systems. In the event of a malfunctioning circuit the chiller will continue to operate at available maximum capacity with the alarm information made available in the history of the Chiller Control or for a potential BMS. The main chiller PCB and controls shall be independent of operation needed for a simultaneous heating and cooling application. The main PCB can control locally and remotely from BMS System. The chiller controls shall have an optional BACnet gateway available to help meet the programming and integration needs of third party BMS systems.

C. Acceptable Manufacturers:
   1. LG Electronics
   2. (Approved Equal)

1.2 REFERENCES

A. Unit shall be rated in accordance with AHRI (Air-Conditioning, Heating and Refrigeration Institute) Standard 550/590.

B. The Chiller Cooling Performance shall be compliant with applicable sections of Table 6.8.1-16 Heat Pump and Heat Recovery Water-Chilling Packages Minimum Efficiency Requirements of ASHRAE Standard 90.1-2022.

C. Unit construction shall comply with UL 60335 Safety Code, UL (Underwriters Laboratories) latest edition.

D. The approved Third-Party Agency Compliance Stamp shall be on the name plate of the registered product with proper file number.

E. A COC or Certificate of Compliance document shall be available upon request.

F. An operational test, in which the chiller is run, is performed at the factory. This test checks for proper operation of fans, various controls, and safeties. A certificate of unit testing, indicating successful end-of-line testing, is available upon request.

1.3 SUBMITTALS

A. Submit shops drawings and product data in accordance with the specifications.

B. Submittals shall include the following:

1. Total Model Selection Summary for the chiller.

2. Combined System Performance Information (certification is not in scope of AHRI 550-590):
   a. Ambient Temperature Cooling and Heating (°F)
   b. Cooling and Heating Capacity (Ton and MBH)
   c. Power for Cooling and Heating (kW)
   d. EER and COP (Btu/Whr and W/W)
   e. NPLV (Cooling Only Btu/Whr)
   f. Water Temperature Cooling and Heating (in/out °F)
   g. Fluid Flow Rate Cooling and Heating (GPM)
   h. Pressure Drop Cooling and Heating (ftAq)

3. Individual Chiller Specifications to include:
   a. Dimensions (width, height, and length)
   b. Weight (lb.)
   c. Refrigerant Type, # of circuits and amount required per circuit.
   d. Sound Data in accordance with AHRI Standard 370-2015
      i. Sound Power Cooling and Heating
      ii. Sound Pressure Cooling and Heating (5 feet and 30 feet)
   e. Compressor Type and Quantity
   f. Oil Type and Oil Charge (oz)
   g. Evaporator Type, Flow Rate Cooling and Heating, Connection (Size/ Type) and Pressure Drop (ftAq)
   h. Fan Motor Type, Flow (CFM) and Power (W)

4. Dimensioned plan and elevation view drawings and location water connections size and type.

5. Electrical Specifications to include Model, Voltage, Phase, Maximum Fuse Amps (MFA) or Maximum Circuit Breaker Amps, Minimum Circuit Amps (MCA) Running Load Amps (RLA), Minimum Start Current (MSC) and Quantity of Independent Circuits.

6. Enhance Sound Information for Cooling and Heating tested in accordance with AHRI Standard 370-2015 (data based on individual unit installation). Sound Pressure Values shall be provided based on Q=2 (180 degree) profile using formula: Lp =Lw – 10 log [Q / ($4\pi^2$)]

7. In the Heating mode only 100% overall data is to be provided.

8. Single-line schematic diagram of line voltage and control system indicating points for field interface/connection.

Model	Octave bands, Hz (Sound Power dBA)													Overall A-Weighted Load			
	63	125	200	250	500	1000	1250	2000	2500	4000	5000	8000	10000	100%	75%	50%	25%

Model	Octave bands, Hz (Sound Pressure 5 Feet dBA)													Overall A-Weighted Load			
	63	125	200	250	500	1000	1250	2000	2500	4000	5000	8000	10000	100%	75%	50%	25%

Model	Octave bands, Hz (Sound Pressure 30 Feet dBA)													Overall A-Weighted Load			
	63	125	200	250	500	1000	1250	2000	2500	4000	5000	8000	10000	100%	75%	50%	25%

9. AHRI 550-590 Cooling Performance Data Page to include:
   a. Unit information
      i. Model
      ii. Power Supply (phase, # of wires and volts)
      iii. Refrigerant Type
      iv. Cooling Capacity (Ton)
      v. Quantity of Compressors
      vi. Dimensions (length inch, height inch and width inch)

vii. Operating Weight (lb)
viii. Shipping Weight (lb)
ix. Refrigerant Charge (lb)
x. Sound Pressure (AHRI Standard 370-2015 5 Feet and 30 Feet)

b. Cooling Performance Data
i. System KW (W/O Pump)
ii. EER (Btu/Whr)
iii. Full Load Power Input per Ton (kW/usRT)
iv. NPLV (Btu/Whr)
v. 100% EER (Btu/Whr)
vi. 75% EER (Btu/Whr)
vii. 50% EER (Btu/Whr)
viii. 25% EER (Btu/Whr)

c. Evaporator Data
i. Heat Exchanger Structure
ii. Fluid Type and % of Glycol
iii. Water Connection (Size and Type)
iv. Fouling Factor ($h \cdot ft^2 \cdot °F/Btu$)
v. Entering Water Temp (°F)
vi. Leaving Water Temp (°F)
vii. Flow-rate (GPM)
viii. Pressure Drop (ftAq)

d. Condenser Data
i. Heat Exchanger Structure
ii. Refrigerant Type
iii. Altitude (ft above sea level)
iv. Number of Fans
v. Total Air Flow Each (CFM)
vi. Entering Air Temperature (DBT °F)

10. Heating Performance (Tested in accordance with AHRI 550-590 Procedure- not in certification scope of standard)
a) Unit information
i. Model
ii. Power Supply (phase, # of wires and volts)
iii. Refrigerant Type
iv. Heating Capacity (MBH)
v. Quantity of Compressors
vi. Dimensions (length inch, height inch and width inch)
vii. Operating Weight (lb.)
viii. Shipping Weight (lb.)
ix. Refrigerant Charge (lb.)
x. Sound Pressure (AHRI Standard 370-2015 5 Feet and 30 Feet)

b) Heating Performance Data
i. System KW (W/O Pump)
ii. COP (W/W)

c) Evaporator Data
i. Heat Exchanger Structure
ii. Fluid Type and % of Glycol

iii. Water Connection (Size and Type)
iv. Fouling Factor (h·ft²·°F/Btu)
v. Entering Water Temp (°F)
vi. Leaving Water Temp (°F)
vii. Flow-rate (GPM)
viii. Pressure Drop (ftAq)

d) Condenser Data
i. Heat Exchanger Structure
ii. Refrigerant Type
iii. Altitude (ft above sea level)
iv. Number of Fans
v. Total Air Flow Each (CFM)
vi. Entering Air Temperature (DBT °F)

1.4 QUALITY ASSURANCE

A. Qualifications: Equipment manufacturer must specialize in manufacturing the products specified and have at least five years of experience with the equipment and refrigerant offered.

B. Regulatory Requirements: Comply with the codes and standards specified. Heat Pump Chiller manufacturer's plant must be ISO registered.

1.5 DELIVERY, STORAGE, AND HANDLING

A. The Heat Pump Chiller shall be delivered with condensing section completely assembled and refrigerant charge matching the name plate.

B. Comply with manufacturer's installation instructions for rigging, unloading, and transporting the heat pump chiller modules.

1.6 LIMITED PARTS ONLY WARRANTY

A. One-Year Parts Only Limited Warranty for a Qualified Product: Part(s), including the compressor, are warranted for a period of twelve (12) months starting on the date of initial start-up, or if the start-up date is not available, the Limited Warranty Period will begin twelve (12) months from the date of manufacture (the “Standard Parts Limited Warranty Period”).

B. Standard Additional Two (2) Year Compressor Limited Part Only Warranty: The compressor is warranted for an additional two (2) year period after the end of the applicable Standard Parts Limited Warranty Period (the “Compressor Limited Warranty Period”), for qualified products.

C. The qualified system must be started by an individual that has successfully completed LG’s Chiller Training Requirements with current approval status in LG Warranty Approval System. The Start-up is to be completed pursuant to LG’s current published instructions, meeting all submission requirements, within eighteen (18) months of date of manufacture. Start-up agent is to hold a current government issued license that authorizes that individual to service and install HVAC equipment in the state where the chiller is located. Service and maintenance of the chiller shall only be performed by a qualified individual, as detailed and provided in the Limited Parts Only Warranty.

D. Maintenance of the heat pump chiller equipment while under warranty is mandatory and shall be performed in accordance with the applicable published instructions provided within the installation manual. Proper fluid conditions and required hydronic accessories are to be maintained and installed per the installation manual during the warranty period. Annual testing reports and documentation shall be stored and made available upon request by the manufacturer as part of the owner's responsibility and is required under the Limited All Parts Only Warranty.

PART 2 – PRODUCTS

2.1 INVERTER SCROLL HEAT PUMP CHILLER DESCRIPTION

1. Provide and install as detailed on plans Factory-assembled, single-piece air-cooled variable refrigerant flow liquid heat pump chiller(s) in the quantity required. Contained within the unit cabinet shall be all factory wiring, piping, controls, refrigerant charge (R32), and special features prior to field start up.

2. The heat pump chiller shall be functionally evaluated at the factory to ensure components including sensors, wiring, electronics, and microprocessor controls operate properly per the needed value and function.

3. Chiller shall be reverse cycle air cooled heat pump and provide both hot and cold water. Remote mode change, start stop, leaving water set point, demand limiting, and remote trouble stop hard wire contacts shall be provided as standard.

4. Each outdoor unit refrigeration circuit shall include, but not limited to the following components:
    1. Refrigerant strainer(s)
    2. Check valve(s)
    3. Inverter driven, medium pressure vapor injection, high pressure shell compressors.
    4. Oil separator(s)
    5. Accumulator /controlled volume receiver(s)
    6. 4-way reversing valve(s)
    7. Vapor injection valve(s)
    8. Oil Level sensor(s)
    9. Electronic expansion valve(s)
    10. Sub-cooler (s)
    11. Vapor Injection Valve(s)
    12. High and low side Schrader valve service ports with caps
    13. Shared brazed plate water to refrigerant heat exchanger with (4) refrigerant connections and (2) water connections, 316 stainless steel construction with (2) refrigerant circuits and a single water circuit, heat exchanger refrigerant circuits shall be rated to 650 PSIG, water circuit rated to 340 PSIG.

2.2 DESIGN AND PERFORMANCE REQUIREMENTS

A. General: The unit shall be in accordance with the standards referenced in section 1.2 and any local codes in effect.

B. The ISHPC shall have Certified AHRI 550/590 Cooling Performance of IPLV 20.13 EER and a full load 10.65 EER.

C. Heating Performance shall be a minimum COP of 3.53 (W/W) at 47°F ambient air and 2.1 COP (W/W) at 17°F ambient air. Performance shall be in calculated in accordance with AHRI 550/590 testing procedures at the “M” or medium temperature conditions detailed in ASHRAE Standard 90.1 2022, Table 6.8.1-16 Heat Pump and Heat Recovery Water-Chiller Packages- Minimum Efficiency Requirements.

D. The Heat Pump Chiller shall be capable of providing 100% of the rated capacity in note C above at an ambient condition of 32°F db / 30°F wb, derating of capacity above 32°F is note acceptable. The minimum heating part load performance at 32°F with constant flow shall be 100% Capacity = COP of 2.75 (W/W), 75% Capacity = COP of 2.89 (W/W), 50% Capacity = COP of 3.03 (W/W), 25% Capacity = COP of 2.91 (W/W).

E. Performance: Refer to the schedule of performance as noted in contract documents. The heat pump chiller shall be capable of stable operation to a minimum percentage of 20% of rated capacity of full load.

F. Operating Range: The heat pump chiller shall have the ability to control leaving chilled fluid temperature from 14°F to 68°F in cooling and 86°F to 140°F in heating. Unit shall be capable of starting and running at outdoor ambient temperatures from 5°F to 125°F in cooling and -22°F to 95°F in heating mode without additional accessories.

G. Low ambient cooling down to 5°F without the need for field installed additional factory installed accessories.

H. Acoustics: Sound pressure level measured in accordance with ISO 3745 Standard for anechoic room rated conditions. The manufacturer shall provide the necessary sound treatment if required to comply with a maximum sound pressure of 56 dBA for both cooling and heating mode based on an A-Weighted Test at 30 feet and 76 dBA at 5 feet A-Weighted Test in accordance with ANSI/AHRI Standard 370-2015. Sound data shall be based on individual unit installation and report to comply with section 1.3.B.6 of this document.

I. The maximum acceptable A-Weighted ANSI/AHRI Standard 370-2015 rated sound pressure performance at 30 feet shall be: 61 db(A) in both heating and cooling modes measured per individual module. Values provided a Q=2 a 180° profile and *Lp = Lw – 10 log [Q / ($4\pi r^2$)].*

J. Each refrigeration circuit shall contain a 316 stainless steel brazed plate fluid heat exchanger and EEV for sub-cooling and vapor injection operations. All heat exchangers shall maintain independent refrigerant circuits with a rated capacity limit of 125 MBH per AHR 550/590 testing procedure.
INVERTER chiller-heat pump shall be provided with a factory installed fusible plug or rupture disc.

K. Outdoor fan motors shall be BLDC type motors. Speed varies based on target refrigeration pressure that will vary based on mode and ambient condition. Targets are determined by internal heat pump chiller control logic.

2.3 HEAT PUMP CHILLER COMPONENTS

A. MATERIALS OF CONSTRUCTION

1. Chiller shall be capable of capturing all condenser water created in the heating mode with water collected in drain pans with condensate lines attached that exit the bottom of the chiller allowing for proper collection and drainage if desired or required by local code.

2. The casing shall be constructed so that it is easy to disassemble and assemble during maintenance/repair. It shall be insulated to prevent condensation, and structurally sound to prevent vibration and/or abnormal noise.

3. Exterior panels shall have an epoxy coat with a salt spray rating of up to 500 hours.

B. COMPRESSOR/COMPRESSOR COMPONENTS AND SEQUENCE OF OPERATION

1. The R32 Compressor shall be a hermetic, high-side shell (HSS), commercial grade, compliant scroll direct-drive design. The compressor shall be designed and assembled by the INVERTER chiller-heat pump manufacturer specifically for use in the air source INVERTER chiller-heat pump product line. Third party manufactured, branded, or designed to the INVERTER chiller-heat pump system's OEM specifications by a third-party manufacturer shall not be acceptable.

2. Compressor Design: The compressor design shall be of the high-pressure shell scroll type where the internal pressure below the scroll plates of the compressor shall be at the same high pressure and high temperature. The motor shall be cooled by high pressure gas at temperatures above saturation conditions and minimize the mixing of refrigerant liquid with oil in the sump. The system shall employ a high-pressure oil return method returning recovered oil from the oil separator directly into the oil sump of the compressor; oil shall not be allowed to return via the suction line. Bearing surfaces are continually coated with oil. The compressor shall employ an Aero-bearing constructed with high lubricity materials increasing operation time in case of low sump oil level. The fixed and oscillating compressor scroll components shall be made of high grade (GC25) or denser steel material. All scrolls shall be heat treated and tempered. The oscillating scroll shall be finely machined and polished. PVE refrigerant oil shall be used as the sole liquid used to maintain a seal between the high and low sides of the compression chamber. Compressors that require any mechanical or wearable sealant material between the moving surfaces of the compression chamber are NOT ACCEPTABLE.

3. Single frame systems will have 2 inverter compressors, Double Frame systems will have 4 inverter compressors and Triple Frame systems will have 6 compressors. Each compressor has a nominal capacity of 10 tons.

4. Each refrigeration circuit shall employ a single inverter compressor with a maximum refrigerant charge not to exceed 10.4 lbs.

5. All compressors shall employ high pressure oil return directly into the compressor oil sump. Oil-return via the suction line shall not be permitted.

6. All compressors shall provide, during off cycle, a trickle charge to the windings to keep oil warm. External crankcase heaters shall not be permitted.

7. All inverter-driven compressors within a frame are to operate in unison at the same level. Staging of compressors shall not be permitted within a frame.

8. Compressor shall soft start via inverter and shall load only to the required load. Compressors start current for 208-230V the minimum start current shall not exceed 25% of MCA and the 460V the minimum start current shall not exceed 20% of MCA.

9. The system design is to have a shared evaporator between 2 compressors. System is designed to run on any active compressor that is not offline from an error code. External human interface shall not be acceptable if required for emergency operation. Compressor Error messages are available from Main PCB for BMS interface. Local HMI or Chiller Control shall also keep record of compressor error codes as a redundant feature.

10. Vibration prevention isolation rubber grommets shall be installed to isolate compressor from base frame.

11. Inverter Compressor Control and Sequence: Each compressor shall be equipped with a dedicated inverter compressor drive. The control of multiple compressors using a single drive shall not be acceptable. The frequency variable boundary of inverter scroll compressor shall be minimum 30Hz and maximum 127Hz. The inverter driver controller shall be matched with the physical properties of the compressor. The drive shall be manufactured by the INVERTER chiller-heat pump unit manufacturer. The inverter drive and matching compressor shall have been thoroughly evaluated as a matched pair. The inverter drive shall be programmed to avoid operating the compressor at any speed that results in harmonic vibration, nuisance noise, or mechanical damage to either the driver or the compressor with power provided that is within the tolerance specification. The compressor inverter drive assembly and software must be designed, manufactured, and supplied by the INVERTER chiller-heat pump product manufacturer. Third party branded inverter driver hardware and/or driver software or inverter driver hardware and/or software provided by a third-party manufacturer to meet OEM specifications shall not be allowed. All inverter drive hardware or software manufactured in, is a product of, or sourced from China, or using a broker or third-party provider as an intermediary that obtains the product from CHINA shall not be acceptable.

12. Hot Gas Bypass: Includes factory-mounted hot gas bypass valve, solenoid valve, for each circuit.

13. Inverter Compressor Refrigerant Flow Control Requirements: An active refrigerant -in-circulation control system consisting of a refrigerant storage container, interconnecting refrigerant piping control valves, pressure transducers, microprocessor control, and software to continuously monitor necessary refrigeration cycle operating parameters to maintain stable cycle operation between minus (-)22°F and 125°F ambient conditions. The refrigerant system operating conditions shall be checked by the algorithm at three-minute intervals and if needed automatically and dynamically remove and store refrigerant to the storage tank or inject refrigerant from the tank into the refrigerant circuit. The algorithm shall adjust the needed refrigerant with input:

    a. As the outdoor air temperature changes.
    b. System mode of operation changes.
    c. The path of refrigerant flow through the outdoor coil is modified.
    d. The system's target suction and head pressure control values are adjusted.

14. Maximum Hz operation shall be set at local control or external connection to Unit Main PCB. When reduced capacity and or load shedding is desired.
15. In an event of low load application, below 20% of full rated capacity, an alternating operation should allow for uniform average operation time for each compressor.
16. Oil Management: The system shall utilize a high-pressure oil return system to ensure a consistent film of oil on all moving compressor parts at all points of operation. Oil is returned to compressor through a separate high pressure oil injection pipe directly into the oil sump. Oil returned to the compressor via the suction port of the compressor shall not be allowed. Each compressor shall be provided with a high efficiency independent centrifugal cyclone type oil separator, designed to extract oil from the oil/refrigerant gas stream leaving the compressor. The system shall have an oil level sensor in the compressor to provide direct oil level sensing data to the main controller. The sensor shall provide data to main outdoor unit PCB to start oil return mode. The system shall only initiate an oil return cycle if the sensed oil level is below oil level target values as determined by the microprocessor. The system shall display an error if the oil sensor signals low oil level for a period of 130 minutes or longer. A default oil return algorithm shall automatically initiate the oil return mode if the system detects a failure of the oil sump sensor. A fault code shall be reported by the system. Timed oil return operations or systems that do not directly monitor compressor oil level shall not be permitted.

17. Vapor Injection Requirement and Description: System shall have a medium pressure gas vapor injection function employed in the heating and cooling modes to increase system capacity when the outdoor ambient temperatures are low and to lower compressor lift when temperatures are high. The compressor vapor injection flow amount shall be controlled by the vapor injection sub-cooling algorithm reset by discharge gas temperatures of the compressor. Pressure differential design shall draw oil from the compressor sump reservoir, pressurize the oil and inject the oil directly to the crankshaft journals maintaining a consistent film of oil between all moving parts. Auxiliary, indirect, or electronically driven oil pumps are not acceptable. The viscosity property of the PVE oil in the compressor sump shall be maintained regardless of compressor operation and the surrounding ambient temperature. The compressor shall be equipped with control to

automatically supply the compressor windings with a trickle charge of electricity enough to maintain the oil temperature above the refrigerant boiling temperature that is automatically activated only when the ambient temperature is below 40F, and the compressor is not running. The addition of external crank case heaters shall not be allowed. Low side shell (LSS) type compressors that use suction vapor to cool the compressor motor shall not be allowed.

18. Vapor Injection Sub-cooler: Each compressor circuit shall a factory provided and mounted sub-cooler assembly consisting of a brazed plate type sub-cooling heat exchanger and EEV providing refrigerant sub-cooling modulation control by fuzzy logic of EEV and by mode of operation to provide capacity and efficiency as required. Brazed plate shell & tube heat exchangers shall not be allowed for this function.

19. Internal Compressor Cooling Requirements and Description: The motor winding insulation shall be designed to operate continuously at a minimum temperature of 180°F without deterioration. The motor cooling system shall be designed to always maintain an acceptable operational temperature and, in all conditions, using high pressure, hot refrigerant vapor as motor coolant. Low side shell (LSS) and compressors that use low pressure, low temperature refrigerant gas to cool the motor shall not be allowed.

20. Active Refrigerant Volume Management: The INVERTER chiller-heat pump system shall be able to operate at all published conditions in cooling or heating mode without the need to add or remove refrigerant from the system. The air source unit shall be provided with an isolated vessel, interconnecting piping, valves, and sensors to store refrigerant and actively pass refrigerant to (or from) the refrigerant circuit in real time as necessary to maintain stable refrigeration cycle operation. The air source unit microprocessor shall be provided with an algorithm that monitors the INVERTER chiller-heat pump system head pressure, suction pressure, sub-cooling, superheat, compressor speed, high and low side temperatures, chilled water temperatures, hot water temperatures, status of water flow and the load on the system at three minute intervals and if needed, automatically and dynamically remove and store refrigerant to the storage tank or inject refrigerant from the tank into the refrigerant circuit. INVERTER chiller-heat pump systems that cannot perform active refrigerant control are not acceptable.

21. Compressors are designed to operate independently. Unless the error code interrupts control power the error of compressor will be broadcasted to BMS front end, and the remaining compressors normal operation is not interrupted.

22. SCCR: Shor Circuit Current Rating for the heat pump chiller shall be 56 kA at 208V, 62 kA at 230V and 65 kA at 460V. All kA (kilo Amperes) values are tested and provided as RMS (root mean square) symmetrical current values.

C. FLUID HEAT EXCHANGERS

1. The fluid heat exchanger shall be a 316 stainless-steel plate and frame type heat exchanger.

2. As standard, the fluid heat exchanger shell and fluid piping in the heat pump chiller shall be insulated with rigid poly styrene, 1 1/4" thickness and black color.

3. The maximum volume per independent refrigerant circuit shall not exceed .25 cubic ft. feet of volume.

4. The maximum number of water to refrigerant circuits shall not exceed a single water circuit and two independent refrigerant circuits as a 1 to 2 ratio per the internal design of the heat exchanger.

D. AIR COOLED HEAT EXCHANGER

1. The air-cooled heat exchange arrangement shall be 3-row, 14 FPI (fins per inch), 48 rows. Use wide louvered aluminum fin. The coil(s) shall be sized to provide full heat rejection at a maximum 125°F or -22F minimum ambient temperature for 460V chiller heat pumps and 122°F or -22F for 208-230V chiller heat pumps both at sea level.

2. The coil(s) shall be factory tested to a minimum 600 psig.

3. Air Cooled heat exchanger shall include "black fin II" coating, a heavy anti-corrosion treatment protecting the heat exchanger from high salinity, humidity, and pollution. The coating is applied to the fin stock only and the corrosion performance is compliant to meet a 10,000-hour rated salt spray performance test that is conducted in accordance with ASTM B117 standard.

4. ISO 21207 Salt Spray Test Method B – 10,000 hours performance compliant.

5. ASTM B-117 Acid Salt Test – 900 hours performance compliant.

6. The Black Fin II coating shall be certified by Underwriters Laboratories and per ISO 21207.

7. Air Cooled heat exchanger shall be used with 99.9% purity or above phosphorus deoxidized copper without joint and it shall be constructed with Pre-Coated Aluminum fins that are mechanically bonded to increase the thermal transfer surface area. (Cross fin and tube type).

8. Fan(s) shall be connected directly to driving motor. Motor shall be BLDC type that can increase efficiency. The fan motors shall vary speed to maintain refrigeration head pressure.

9. Fan design at rated cooling capacity shall not exceed 90% of full or maximum RPM/Hz.

10. The system is capable of low noise operation and can reduce sound by up to 3 db.

E. ELECTRONIC EXPANSION VALVES

1. EEV's shall be used during the adiabatic-expansion process within the refrigerant cycle to expand high pressure liquid refrigerant at both the Air-cooled heat exchanger and the fluid heat exchanger exit thereby converting to low temperature/low pressure state.
2. LEV's (linear expansion valves) shall be activated to adjust refrigerant amount according to fluid heat exchanger load during cooling operation.
3. Based on data from various sensors installed in the chiller heat pump, the microprocessor shall be able to analyze the operation status of the system and compressor shall control the optimum refrigerant amount linearly.
4. By applying electric pulse signal (up to 2,000 pulses) to the stepping motor, it shall be able to adjust refrigerant flow and superheat and sub-cooling.

F. CONTROL SYSTEM

1. Controller shall operate to control the overall system at optimal condition with a micro-computer unit installed in the chiller heat pump, and be able to control electronic expansion valve and inverter driven compressor(s) based on the 4 measured values: suction gas pressure, discharge gas pressure, discharge gas temperature, and heat exchanger refrigerant temperature
2. Control system shall include sensor(s) functionality connected to the heat pump chiller and the varying operation mode status.
3. Heat Pump Chiller shall be equipped with self-protection devices and system protection functionality.
4. Internal flow switch is included as standard, installed, and wired.
5. External contact closure indicating pump operation is required and is to be hard wired to heat pump chiller main PCB.
6. Continued heat operation during defrost is required on systems that are at or above 33 tons or double and triple frame modules.
7. Target Evaporator temperature is set based on leaving water temperature allowing for energy savings as leaving water temps settings can change with the application and time of day.
8. If the unit is off and not running due to error the service tool provided by the manufacturer shall be capable of downloading the last 180 seconds of operational time the chiller was running, helping to diagnose field service issues that may arise.

G. HEAT PUMP CHILLER UNIT CONTROLLER AND DISPLAY (HMI- HUMAN MACHINE INTERFACE)

1. The HMI control interface can be applied for simple product control. Relocation & re-installation of HMI controller shall be possible.
2. The HMI may be relocated up to 1500 wire feet away from chiller heat pump.
3. Black box function shall retain the last 180 seconds of operational data prior to a failure.
4. Scheduled operation shall be possible via the HMI.
5. High ambient control box for operation in ambient temperatures to 125°F (52°C).

6. The controller shall be equipped with a cycle indication display to directly monitor refrigerant pressure conditions for refrigerant cycle and high-pressure gas safety management.
7. Chiller heat pump optional interface controller/HMI shall be capable of networking up to 5 chiller heat pump modules and control & monitor up to five (5) chiller heat pumps as one system if desired. For systems larger than five modules parallel networks of up to 99 modules may be installed and controlled via BMS.
8. Optional Heat Pump Chiller Control BACnet Gateway. The Control Gateway shall include Niagara4.7 or later based hardware, with a minimum 512 MB DDR SDRAM, 2GB total eMMC flash storage with user space set at 1GB, 1 RS485 port, 2 10/100 MB Ethernet ports, with BACnet and Modbus network protocol capability. Standard interface is BACnet/IP. BACnet/MSTP is an optional solution and should be specified if needed.

H. WATER PIPING AND FLOW REQUIREMENTS:

1. The heat pump chiller is to be capable of a minimum flow is at a 20-degree delta between entering and leaving water and maximum flow capable of a 4-degree delta between entering and leaving water temperatures.
2. The heat pump chiller is provided with a factory installed flow switch that is prewired as a required safety circuit for operation.
3. A strainer (50 Mesh or above) shall be provided, by others, and installed in the supply fluid piping to each module to prevent solid bodies or particles from entering the fluid heat exchanger. Strainer shall be installed on leveled pipe and shall be serviceable by individual manual isolation valves, by others permitting each strainer to be removed and allowing the remaining modules to continue to operate.
4. Flexible joints shall be installed at the inlet and outlet pipes of each module.
5. Fluid piping and needed insulation shall be properly specified by the engineer and be compliant per local code for both process and comfort cooling applications.
6. Piping is to be installed and service valves provided so that each heat pump chiller module shall have service valves and the isolation of an independent module in the array shall not affect the flow and operation of the additional heat pump chiller modules that work together to create the heat pump chiller plant. On a four-pipe system this is required for both hot and cold water.
7. The maximum water pressure design for the system is 300 psi.
8. All water piping and accessories to be independently supported from the equipment and the dead weight of the pipe or accessories is not transmitted or supported by the equipment in any way.
9. The following fluid specification shall be maintained; Water- PH 7-9, total dissolved solids less than 1000PPM, hardness (CaCo3) 30-500 PPM, alkalinity (CaCo3) 0-500 PPM, chlorides less than 200 PPM, sulfates less than 200 PPM. Water with 25% glycol- PH 7-9, total dissolved solids 1000 -10,000 PPM, conductivity 1000-5000 PPM, hardness (CaCo3) 30-500 PPM, alkalinity (CaCo3) more than 500 PPM, chlorides less than 200 PPM, sulfides less than 200 PPM. Other fluid conditions shall be as defined in specifications provided elsewhere.

END OF SECTION 230170

SECTION 230190 - PUMPS

PART 1 - GENERAL

Applicable Provisions of the Conditions of the Contract and Division 1 General Requirements govern the work in this section. Submit shop drawings for checking and approval.

PART 2 - PRODUCTS

2.1 FLOOR MOUNTED PUMPS

A. The pumps shall be model series 1510 as manufactured by ITT Bell & Gossett with performances noted on the Drawing schedule.

B. The pumps shall be single stage; vertical split case design in cast iron and bronze construction. The pump's internals shall be capable of being serviced without disturbing piping connections or motor. The impeller shall be of the enclosed type, dynamically balanced and keyed to shaft and secured with a suitable locknut.

C. Pump seal shall be standard single mechanical seal with carbon seal ring and Remite (or equal) seat. A replaceable shaft sleeve shall be furnished to cover the wetted area of the shaft under the seal of packing.

D. The bearing frame assembly of the pump shall be fitted with re-greaseable ball bearings equivalent to electric motor bearing standards for quiet operation. The pump and motor shall be mounted on a common baseplate of heavy structural steel design with securely welded cross members and open grouting area.

E. The pumps shall be factory tested at the operating conditions, thoroughly cleaned and painted with one coat of machinery enamel prior to shipment. A set of installation instructions shall be included with the pump at the time of shipment.

PART 3 - EXECUTION

3.1 INSPECTION

A. Inspect equipment space locations before beginning installation. Verify that the space is correct for entry and access. Do not proceed with installation of the equipment until unsatisfactory conditions have been corrected.

3.2 INSTALLATION

A. Comply with manufacturer's instructions and recommendations for installation of equipment, accessories and components.

B. All heating, ventilating and air conditioning equipment shall be carefully designed, constructed and installed so as to prevent any objectionable noise or vibration reaching any part of the building outside of the mechanical equipment room. Care shall also be taken to prevent transmission of noise or odor through ductwork into other spaces. The Contractor shall be required to rectify or replace at his own expense, any equipment not complying with the foregoing requirements.

3.3 CLEANING

A. Clean interior and exterior surfaces promptly after installation of equipment and components. Take care to avoid damage to protective coatings and finishes. Remove excess sealants, lubrication, dirt and other foreign substances.

END OF SECTION 230190

SECTION 230200 - HYDRONIC SPECIALTIES

PART 1 - GENERAL

Applicable provisions of the Conditions of the Contract and Division 1 General Requirements govern the work in this section. Submit shop drawings for checking and approval.

PART 2 - PRODUCTS

2.1 AIR SEPARATOR

A. Furnish and install as shown on Drawings, an external low velocity air separator unit consisting of a steel tank with screwed piping connections and a tapping to connect the air separator directly to the compression tank with screwed piping connections and a tapping to connect the air separator directly to compression tank.

B. The unit is to be furnished with a steel base and constructed in accordance with ASME boiler pressure vessel code and stamped 125 psi working pressure. The air separator shall be ITT Bell & Gossett “Rolairtrol” or approved equal.

2.2 EXPANSION TANKS (S)

A. Furnish and install pre-charged bladder type expansion tank(s) of size and capacity as shown on Drawings. Tank shall have carbon steel shell and heavy-duty butyl rubber bladder.

B. Tank to be constructed for (125 psig) working pressure and to be guaranteed leakproof by manufacturer. Tank to be stamped with "U" symbol and Form U-1 furnished denoting compliance with paragraph U-69 for Construction of Unfired Pressure Vessels Section VIII ASME.

2.3 AIR VENTS

A. Install at all high points automatic air vents to eliminate air binding. All automatic air vents shall be approved heavy duty type equipped with petcocks and tubing for manual venting. All vents installed in coils, etc. shall be of manual key operated type.

B. All vents concealed from view shall be accessible through access doors. Vents shall be by Hoffman, Anderson or ITT Bell & Gossett, 125 psig rated.

2.4 PRESSURE GAUGES

A. Furnish and install pressure gauges on suction and discharge sides of each pump and as required to check operation of equipment; pressure gauges shall have 4-1/2"diameter dials, Ashton, Ashcroft or approved equal.

2.5 THERMOMETERS

A. Install thermometers at all locations in piping system as noted on Drawings and as required to check system performance. Thermometers shall be installed at the supply and return of coils and 3-way diverting valves as manufactured by Trerice, Weksler or Moeller, with 4-1/2 inch face, cast aluminum case, chrome plated steel ring, white background with black embossed markings, glass window, stainless steel pointer, brass movement, 316 stainless steel bulb. Provide separable, universal angle sockets for all thermometers.

2.6 TRIPLE DUTY VALVES

A. Furnish and install at each pump a nonslam check valve with a spring loaded disc and a calibrated adjustment feature permitting regulation of pump discharge flow and shut-off. Valves shall be designed to permit repacking under full line pressure.

B. Unit shall be installed on discharge side of pump in a horizontal or vertical position with the stem up. Allow for minimum clearance of valve stem. This unit shall be cast iron body construction suitable for maximum working pressure of 175 psig and maximum operating temperature of 300 degrees F.

C. All units shall be ITT Bell & Gossett Triple Duty Valve model or approved equal.

2.7 SUCTION DIFFUSERS

A. Furnish and install at each pump a suction diffuser. Units shall consist of angle type body with inlet vanes and combination Diffuser-Strainer-Orifice Cylinder with 3/16 inch diameter openings for pump protection. A permanent magnet shall be located within the flow stream and shall be removable for cleaning.

B. The orifice cylinder shall be equipped with a disposable fine mesh strainer, which shall be removed after system startup. Orifice cylinder shall have a free area equal to five times cross section area of pump suction opening. Vane length shall be no less than 2-1/2 times the pump connection diameter. Unit shall be provided with adjustable support foot to carry weight of suction piping. Each Suction Diffuser to be ITT Bell & Gossett model or approved equal.

2.8 COMBINATION BALANCING / SHUT-OFF VALVES (Circuit Sensors /Setters and Flow Meters)

A. Provide Circuit Sensor/Setter balance valves as manufactured by Bell & Gossett or approved equal.

B. Circuit Sensors: Furnish and install as shown on Drawings, a cast iron wafer-type flow meter designed for low pressure drop operation.

1. The flow meter will be equipped with brass readout valves (with integral check valve) for taking differential pressure readings across the orifice of the flow meter.

2. The flow meter shall be designed to operate at a maximum working pressure of 300 psig at 250 degrees F.

3. The flow meter must be furnished with a calibrated nameplate for determining an accurate system flow rate.

4. Each flow meter shall be ITT Bell & Gossett Circuit Sensor Flow Meter model no. OP.

C. Circuit Setters: (1/2”-3”) Furnish and install as shown on Drawings and with manufacturer's recommendations Bell & Gossett® Circuit Setter® Plus calibrated balance valve Model CB or Model MC as manufactured by Xylem.

1. Valves to be designed to allow installing Contractor to pre-set balance points for proportional system balance prior to system start-up.

2. Valve body shall be constructed out of lead-free brass.

3. Valve shall include a ball valve constructed in 304 Stainless Steel.

4. Valve shall be AB1953 and CSA certified and compliant with Vermont 152S, Maryland House Bill HB372, Senate Bill S.3874, and NSF/ANSI-372.

5. Valve body shall include two pressure/temperature ports.

6. Valve body shall include an optional drain valve port.

7. Valve shall utilize a calibrated nameplate with a memory stop.

8. Valve shall utilize a reduced port design that provides velocity head recovery.

9. Valve temperature range shall be from -4°F (-20°C) to 250°F (121°C).

10. Model CB: Valve shall have either NPTF thread or SWTF end connections.

11. Model CB**:** Valves with NPT end connections shall be rated for 400 PSIG working pressure.

12. Model CB**:** Valves with SWTF end connections shall be rated for a maximum of 300 PSIG working pressure.

13. Model MC: Valve shall be rated for 300 PSIG working pressure.

14. Model MC: Valve shall include a SWTF or NPTF fixed end connection on the discharge end and a union tailpiece adapter with choice of SWTF, NPTF thread, or NPTM thread tailpiece connection on the supply end. The union tailpiece end should include a union nut that can secure the tailpiece to the body of the valve to create a water-tight seal.

15. Valves to have memory stop feature to allow valve to be closed for service and then reopened to set point without disturbing balance position. All valves to have calibrated nameplate to assure specific valve settings. Valves to be leak-tight at full rated working pressure. Valves 4-inch pipe size to be of cast iron body/brass vane construction with differential pressure read-out ports fitted with internal EPT insert and check valve.

16. Provide Extended Pressure/Temperature Ports and Drain Valve/Extended Drain Valve

D. Circuit Setters: (4”-12”) Furnish and install as shown on Drawings and with manufacturer's recommendations Bell & Gossett® Circuit Setter® Plus calibrated balance valve Model CB as manufactured by Xylem.

1. Valves to be designed to allow installing Contractor to pre-set balance points for proportional system balance prior to system start-up.

2. Valve body shall be constructed out of cast iron and rated for 175 PSIG working pressure (if flanged) or constructed out of ductile iron and rated for 300 PSIG working pressure (if grooved).

3. Valve shall be a multi-turn globe style valve.

4. Valve shall include a brass disc.

5. Valve disc shall have a soft seat design made of EPDM.

6. (If Flanged) Valves shall include ANSI Class 125# flanged connections.

7. (If Grooved) Valves shall include grooved end connections.

8. Valve body shall include two pressure/temperature ports.

9. Valve shall utilize a calibrated nameplate with position indicator from 0 to 100% open.

10. Valve shall include a memory button to allow for positioning the valve to the appropriate set position after closing.

11. Valve temperature range shall be from -4°F (-20°C) to 250°F (121°C).

12. Valves to have memory stop feature to allow valve to be closed for service and then reopened to set point without disturbing balance position. All valves to have calibrated nameplate to assure specific valve settings. Valves to be leak-tight at full rated working pressure. Valves 4-inch pipe size to be of cast iron body/brass vane construction with differential pressure read-out ports fitted with internal EPT insert and check valve.

E. Readout Meters: Provide a portable Readout Meter with provision for hanging, capable of indicating pressure differential across a system component. Unit to be complete with all necessary hoses, shut-off and vent valves, and carrying case. Reading range to be .5' to .16'. Read Out Kits to be ITT Bell & Gossett model no. RO-3.

2.9 CHEMICAL FEEDING EQUIPMENT

A. Chemical Feed System Description:

1. Closed-Loop System: One bypass feeder on each system with isolating and drain valves with inlet piping connecting to discharge of circulating pumps, and outlet side of feeder connected to suction side of pump unless otherwise indicated.
2. Introduce chemical treatment through bypass feeder when required or indicated by test.

B. Domed Bottom Bypass Feeder: Provide the quantity and capacity of feeder as shown on the construction drawings. Griswold Water Systems Model DB-SB-Series or approved equal.

1. The feeder shall be constructed of steel (or stainless steel where indicated) in the construction drawings.
2. Capacity 5 gallon.
3. Steel feeders shall have an enameled painted powder coat finish.
4. The feeder will be rated for a minimum of 350 psig at 250 degrees F.
5. Tank shall be provided with a wide mouth of not less than 4” inside diameter so that chemicals can be introduced without the need of a funnel.
6. Four ¾” access ports for flow, vent, and drain.
7. The enclosure shall be a grooved end cap. The retaining bolts are removable by a small adjustable wrench. Rotating cap closures or closures requiring special wrenches shall not be considered equal.
8. The feeder will include heavy legs, minimum 3/16” thick, welded to the sides of the vessel, with holes in the feet to allow floor mounting with anchor bolts.
9. ACCESSORIES:
    a) Stainless steel basket with 1/8” perforations to hold solid chemicals or optional filter bag.
    b) Filter Bag (where indicated) – The bypass feeder shall be provided with a 25 micron filter bag fully supported by a stainless steel filter basket.
    c) Cartridge Filter Kit (where indicated) with 25 micron element rated for the specified maximum temperature of 100, 170 or 250 degrees F as stated on the construction drawings.
    d) Plastic filling funnel kit with valve for introduction of liquid agents without opening the lid to the feeder. Valve in kit will include an integral vent valve to bleed off air or release pressure.
    e) Isolation valve kit includes two ¾” Griswold ball valves with integral ¼” drain/vent valves, minimizing installation time and cost by eliminating separate valves and piping components.

C. Provide automatic chemical by-pass feeder for new chiller plant.

1. Axiom industries ltd. model SF100-DS. System shall include 55 us gallon storage/mixing tank with cover; pump suction hose with inlet strainer; two pressure pumps with thermal cut-out, pump isolation valves, integral pressure switches; integral check valve; cord and plug; pre-charged accumulator tank with EPDM diaphragm, manual diverter valve for purging air and agitating contents of storage tank, pressure regulating valve adjustable (5 – 55 psig) complete with pressure gauge, integral replaceable strainer, built-in check valve; union connection, 12 mm (½”) x 900 mm (36”) long flexible connection hose with check valve; low level pump cut-out. pressure pumps shall be capable of running dry without damage. power supply 115V/60Hz/1Ph, 0.7 Amps. Unit shall be completely pre-assembled and certified by a recognized testing agency to CSA standard c22.2 no 68.

PART 3 - EXECUTION

3.1 INSPECTION

A. Inspect equipment space locations before beginning installation. Verify that the space is correct for entry and access. Do not proceed with installation of the equipment until unsatisfactory conditions have been corrected.

3.2 INSTALLATION

A. Comply with manufacturer's instructions and recommendations for installation of equipment, accessories and components.

B. All heating, ventilating and air conditioning equipment shall be carefully designed, constructed and installed so as to prevent any objectionable noise or vibration reaching any part of the building outside of the mechanical equipment room. Care shall also be taken to prevent transmission of noise or odor through ductwork into other spaces. The Contractor shall be required to rectify or replace at his own expense, any equipment not complying with the foregoing requirements

3.3 CLEANING

A. Clean interior and exterior surfaces promptly after installation of equipment and components. Take care to avoid damage to protective coatings and finishes. Remove excess sealants, lubrication, dirt and other foreign substances.

END OF SECTION 230200

SECTION 230280 - VARIABLE FREQUENCY DRIVES

PART 1 – GENERAL

Applicable provisions of the Conditions of the Contract and Division 1 General Requirements govern the work in this section. Submit shop drawings for checking and approval.

1.1 DESCRIPTION

A. This specification is to cover a complete Variable Frequency motor Drive (VFD) consisting of a pulse width modulated (PWM) inverter designed for use with a standard NEMA Design B induction motor.

B. The drive manufacturer shall supply the drive and all necessary options as herein specified. The manufacturer shall have been engaged in the production of this type of equipment for a minimum of twenty years. VFD's that are manufactured by a third party and "brand labeled" shall not be acceptable. All VFDs installed on this project shall be from the same manufacturer.

1.2 QUALITY ASSURANCE

A. Referenced Standards:

1. Institute of Electrical and Electronic Engineers (IEEE)
   a. Standard 519-1992, IEEE Guide for Harmonic Content and Control.

2. Underwriters laboratories
   a. UL508C

3. National Electrical Manufacturer's Association (NEMA)
   a. ICS 7.0, AC Adjustable Speed Drives

4. IEC 16800 Parts 1 and 2

5. National Electric Code (NEC)
   a. NEC 430.120, Adjustable-Speed Drive Systems

6. International Building Code (IBC)
   a. IBC 2006 Seismic – referencing ASC 7-05 and ICC AC-156

B. Qualifications:

1. VFDs and options shall be UL listed as a complete assembly. VFD's that require the customer to supply external fuses for the VFD to be UL listed are not acceptable. VFDs with red label UL stickers, requiring additional branch circuit protection are not acceptable. The base VFD shall be UL listed for 100 KAIC without the need for input fuses.
2. CE Mark – The VFD shall conform to the European Union ElectroMagnetic Compatibility directive, a requirement for CE marking. The VFD shall meet product standard EN 61800-3 for the First Environment restricted level.

3. The entire VFD enclosure, including the bypass shall be seismically certified and labeled as such in accordance with the 2006 International Building Code (IBC):

   a. VFD manufacturer shall provide Seismic Certification and Installation requirements at time of submittal.

   b. Seismic importance factor of 1.5 rating is required, and shall be based upon actual shake test data as defined by ICC AC-156.

   c. Seismic ratings based upon calculations alone are not acceptable. Certification of Seismic rating must be based on testing done in all three axis of motion.

4. Acceptable Manufactures

   a. ABB ACH Series.

   b. Alternate manufacturer's requests must be submitted in writing to the Engineer for approval at least 20 working days prior to bid. Approval does not relieve the supplier of specification requirements.

5. The VFD manufacturer shall have available a comprehensive, HVAC Drive Computer Based Training (CBT) product. The CBT product shall include detailed, interactive sections covering VFD unpacking, proper mechanical and electrical installation, and programming. The CBT product shall allow the user to provide just-in-time training to new personnel or refresher training for maintenance and repair personnel on the user's site. The CBT product shall be repeatable, precise and shall include record keeping capability. The CBT product shall record answers to simulations and tests by student ID number. The CBT product must be professionally produced and have interactive sections, student tests, and include video clips of proper wiring and installation.

1.3 SUBMITTALS

A. Submittals shall include the following information:

1. Outline dimensions, conduit entry locations and weight.

2. Customer connection and power wiring diagrams.

3. Complete technical product description includes a complete list of options provided. Any portions of this specification not meet must be clearly indicated or the supplier and contractor shall be liable to provide all additional components required to meet this specification.

4. Compliance to IEEE 519 – harmonic analysis for particular jobsite including total harmonic voltage distortion and total harmonic current distortion (TDD).
   a. The VFD manufacturer shall provide calculations; specific to this installation, showing total harmonic voltage distortion is less than 5%. Input filters shall be sized and provided as required by the VFD

manufacturer to ensure compliance with IEEE standard 519. All VFD's shall include a minimum of 5% impedance reactors, no exceptions.

PART 2 – PRODUCTS

2.1 VARIABLE FREQUENCY DRIVES

A. The VFD package as specified herein shall be enclosed in a UL Listed Type enclosure, exceeding NEMA enclosure design criteria (enclosures with only NEMA ratings are not acceptable), completely assembled and tested by the manufacturer in an ISO9001 facility. The VFD tolerated voltage window shall allow the VFD to operate from a line of +30% nominal, and -35% nominal voltage as a minimum.

1. Environmental operating conditions: VFDs shall be capable of continuous operation at 0 to 50^0 C (32 to 122^0 F) ambient temperature as per VFD manufacturers documented/submittal data or VFD must be oversized to meet these temperature requirements. Not acceptable are VFD's that can only operate at 40° C intermittently (average during a 24 hour period) and therefore must be oversized. Altitude 0 to 3300 feet above sea level, less than 95% humidity, non-condensing. All circuit boards shall have conformal coating.

2. Enclosure shall be rated UL Type 1 and shall be UL listed as a plenum rated VFD. VFD's without these ratings are not acceptable. NEMA only type 1 enclosures are not acceptable (must be UL Type 1).

3. Provide NEMA 3R enclosures where exposed to outside weather or wet conditions.

B. All VFDs shall have the following standard features:

1. All VFDs shall have the same customer interface, including digital display, and keypad, regardless of horsepower rating. The keypad shall be removable, capable of remote mounting and allow for uploading and downloading of parameter settings as an aid for start-up of multiple VFDs.

2. The keypad shall include Hand-Off-Auto selections and manual speed control. The drive shall incorporate "bumpless transfer" of speed reference when switching between "Hand" and "Auto" modes. There shall be fault reset and "Help" buttons on the keypad. The Help button shall include "on-line" assistance for programming and troubleshooting.

3. There shall be a built-in time clock in the VFD keypad. The clock shall have a battery back up with 10 years minimum life span. The clock shall be used to date and time stamp faults and record operating parameters at the time of fault. If the battery fails, the VFD shall automatically revert to hours of operation since initial power up. Capacitor back-up is not acceptable. The clock shall also be programmable to control start/stop functions, constant speeds, PID parameter sets and output Form-C relays. The VFD shall have a digital input that allows an override to the time clock (when in the off mode) for a programmable time frame.

There shall be four (4) separate, independent timer functions that have both weekday and weekend settings.

4. The VFD's shall utilize pre-programmed application macro's specifically designed to facilitate start-up. The Application Macros shall provide one command to reprogram all parameters and customer interfaces for a particular application to reduce programming time. The VFD shall have two user macros to allow the end-user to create and save custom settings.

5. The VFD shall have cooling fans that are designed for easy replacement. The fans shall be designed for replacement without requiring removing the VFD from the wall or removal of circuit boards. The VFD cooling fans shall operate only when required. To extend the fan and bearing operating life, the VFD shall cycle the cooling fans on and off as required.

6. The VFD shall be capable of starting into a coasting load (forward or reverse) up to full speed and accelerate or decelerate to set point without tripping or component damage (flying start).

7. The VFD shall have the ability to automatically restart after an over-current, over-voltage, under-voltage, or loss of input signal protective trip. The number of restart attempts, trial time, and time between attempts shall be programmable.

8. The overload rating of the drive shall be 110% of its normal duty current rating for 1 minute every 10 minutes, 130% overload for 2 seconds. The minimum FLA rating shall meet or exceed the values in the NEC/UL table 430.250 for 4-pole motors.

9. The VFD shall have internal 5% impedance reactors to reduce the harmonics to the power line and to add protection from AC line transients. The 5% impedance may be from dual (positive and negative DC bus) reactors, or 5% AC line reactors. VFD's with only one DC reactor shall add an AC line reactor.

10. The input current rating of the VFD shall be no more than 3% greater than the output current rating. VFD's with higher input current ratings require the upstream wiring, protection devices, and source transformers to be oversized per NEC 430.120. Input and output current ratings must be shown on the VFD nameplate.

11. The VFD shall include a coordinated AC transient surge protection system consisting of 4-120 joule rated MOV's (phase to phase and phase to ground), a capacitor clamp, and 5% impedance reactors.

12. The VFD shall provide a programmable loss-of-load (broken belt / broken coupling) Form-C relay output. The drive shall be programmable to signal the loss-of-load condition via a keypad warning, Form-C relay output, and / or over the serial communications bus. The loss-of-load condition sensing algorithm shall include a programmable time delay that will allow for motor acceleration from zero speed without signaling a false loss-of-load condition.

13. The VFD shall have user programmable underload and overload curve functions to allow user defined indications of broken belt or mechanical failure / jam condition causing motor overload.

14. The VFD shall include multiple “two zone” PID algorithms that allow the VFD to maintain PID control from two separate feedback signals (4-20mA, 0-10V, and / or serial communications). The two zone control PID algorithm will control motor speed based on a minimum, maximum, or average of the two feedback signals. All of the VFD PID controllers shall include the ability for “two zone” control.

15. If the input reference (4-20mA or 2-10V) is lost, the VFD shall give the user the option of either (1) stopping and displaying a fault, (2) running at a programmable preset speed, (3) hold the VFD speed based on the last good reference received, or (4) cause a warning to be issued, as selected by the user. The drive shall be programmable to signal this condition via a keypad warning, Form-C relay output and / or over the serial communication bus.

16. The VFD shall have programmable “Sleep” and “Wake up” functions to allow the drive to be started and stopped from the level of a process feedback signal.

17. Provide drive with circuit breaker option and remote panel mounting kit.

C. All VFDs to have the following adjustments:

1. Three (3) programmable critical frequency lockout ranges to prevent the VFD from operating the load continuously at an unstable speed. The lockout range must be fully adjustable, from 0 to full speed.

2. Two (2) PID Set point controllers shall be standard in the drive, allowing pressure or flow signals to be connected to the VFD, using the microprocessor in the VFD for the closed-loop control. The VFD shall have 250 ma of 24 VDC auxiliary power and be capable of loop powering a transmitter supplied by others. The PID set point shall be adjustable from the VFD keypad, analog inputs, or over the communications bus. There shall be two independent parameter sets for the PID controller and the capability to switch between the parameter sets via a digital input, serial communications or from the keypad. The independent parameter sets are typically used for night setback, switching between summer and winter set points, etc.

3. There shall be an independent, second PID loop that can utilize the second analog input and modulate one of the analog outputs to maintain the set point of an independent process (ie. valves, dampers, etc.). All set points, process variables, etc. to be accessible from the serial communication network.

4. Two (2) programmable analog inputs shall accept current or voltage signals.

5. Two (2) programmable analog outputs (0-20ma or 4-20 ma). The outputs may be programmed to output proportional to Frequency, Motor Speed, Output Voltage, Output Current, Motor Torque, Motor Power (kW), DC Bus voltage, Active Reference, Active Feedback, and other data.

6. Six (6) programmable digital inputs for maximum flexibility in interfacing with external devices. All digital inputs shall be programmable to initiate upon an application or removal of 24VDC or 24VAC.

7. Three (3) programmable, digital Form-C relay outputs. The relay outputs shall include programmable on and off delay times and adjustable hysteresis. The relays shall be rated for maximum switching current 8 amps at 24 VDC and 0.4 A at 250 VAC; Maximum voltage 300 VDC and 250 VAC; continuous current rating of 2 amps RMS. Outputs shall be true Form-C type contacts; open collector outputs are not acceptable.

8. Run permissive circuit - There shall be a run permissive circuit for damper or valve control. Regardless of the source of a run command (keypad, input contact closure, time-clock control, or serial communications), the VFD shall provide a dry contact closure that will signal the damper to open (VFD motor does not operate). When the damper is fully open, a normally open dry contact (end-switch) shall close. The closed end-switch is wired to a VFD digital input and allows VFD motor operation. Two separate safety interlock inputs shall be provided. When either safety is opened, the motor shall be commanded to coast to stop and the damper shall be commanded to close. The keypad shall display “start enable 1 (or 2) missing”. The safety input status shall also be transmitted over the serial communications bus.

9. The VFD control shall include a programmable time delay for VFD start and a keypad indication that this time delay is active. A Form C relay output provides a contact closure to signal the VAV boxes open. This will allow VAV boxes to be driven open before the motor operates. The time delay shall be field programmable from 0 – 120 seconds. Start delay shall be active regardless of the start command source (keypad command, input contact closure, time-clock control, or serial communications), and when switching from drive to bypass.

10. Seven (7) programmable preset speeds.

11. Two independently adjustable accel and decel ramps with 1 – 1800 seconds adjustable time ramps.

12. The VFD shall include a motor flux optimization circuit that will automatically reduce applied motor voltage to the motor to optimize energy consumption and reduce audible motor noise. The VFD shall have selectable software for optimization of motor noise, energy consumption, and motor speed control.

13. The VFD shall include a carrier frequency control circuit that reduces the carrier frequency based on actual VFD temperature that allows higher carrier frequency settings without derating the VFD.

14. The VFD shall include password protection against parameter changes.

D. The Keypad shall include a backlit LCD display. The display shall be in complete English words for programming and fault diagnostics (alpha-numeric codes are not acceptable). All VFD faults shall be displayed in English words. The keypad shall include a minimum of 14 assistants including:

1. Start-up assistant

2. Parameter assistants
   a. PID assistant
   b. Reference assistant
   c. I/O assistant
   d. Serial communications assistant
   e. Option module assistant
   f. Panel display assistant
   g. Low noise set-up assistant
3. Maintenance assistant
4. Troubleshooting assistant
5. Drive optimizer assistants

E. All applicable operating values shall be capable of being displayed in engineering (user) units. A minimum of three operating values from the list below shall be capable of being displayed at all times. The display shall be in complete English words (alpha-numeric codes are not acceptable):

1. Output Frequency
2. Motor Speed (RPM, %, or Engineering units)
3. Motor Current
4. Motor Torque
5. Motor Power (kW)
6. DC Bus Voltage
7. Output Voltage

F. The VFD shall include a fireman's override input. Upon receipt of a contact closure from the fire / smoke control station, the VFD shall operate in one of two modes: 1) Operate at a programmed predetermined fixed speed ranging from -500Hz (reverse) to 500Hz (forward). 2) Operate in a specific fireman's override PID algorithm that automatically adjusts motor speed based on override set point and feedback. The mode shall override all other inputs (analog/digital, serial communication, and all keypad commands), except customer defined safety run interlocks, and force the motor to run in one of the two modes above. "Override Mode" shall be displayed on the keypad. Upon removal of the override signal, the VFD shall resume normal operation, without the need to cycle the normal digital input run command.

G. Serial Communications

1. The VFD shall have an EIA-485 port as standard. The standard protocols shall be Modbus, Johnson Controls N2, Siemens Building Technologies FLN, and BACnet. [Optional protocols for LonWorks, Profibus, EtherNet, BACnet IP, and DeviceNet shall be available.] Each individual drive shall have the protocol in the base VFD. The use of third party gateways and multiplexers is not acceptable.

All protocols shall be “certified” by the governing authority (i.e. BTL Listing for BACnet). Use of non-certified protocols is not allowed.

2. The BACnet connection shall be an EIA-485, MS/TP interface operating at 9.6, 19.2, 38.4, or 76.8 Kbps. The connection shall be tested by the BACnet Testing Labs (BTL) and be BTL Listed. The BACnet interface shall conform to the BACnet standard device type of an Applications Specific Controller (B-ASC). The interface shall support all BIBBs defined by the BACnet standard profile for a B-ASC including, but not limited to:

   a. Data Sharing – Read Property – B.
   b. Data Sharing – Write Property – B.
   c. Device Management – Dynamic Device Binding (Who-Is; I-Am).
   d. Device Management – Dynamic Object Binding (Who-Has; I-Have).
   e. Device Management – Communication Control – B.

3. If additional hardware is required to obtain the BACnet interface, the VFD manufacturer shall supply one BACnet gateway per drive. Multiple VFDs sharing one gateway shall not be acceptable.

4. Serial communication capabilities shall include, but not be limited to; run-stop control, speed set adjustment, proportional/integral/derivative PID control adjustments, current limit, accel/decel time adjustments, and lock and unlock the keypad. The drive shall have the capability of allowing the DDC to monitor feedback such as process variable feedback, output speed / frequency, current (in amps), % torque, power (kW), kilowatt hours (resettable), operating hours (resettable), and drive temperature. The DDC shall also be capable of monitoring the VFD relay output status, digital input status, and all analog input and analog output values. All diagnostic warning and fault information shall be transmitted over the serial communications bus. Remote VFD fault reset shall be possible.

5. Serial communication in bypass shall include, but not be limited to; bypass run-stop control, the ability to force the unit to bypass, and the ability to lock and unlock the keypad. The bypass shall have the capability of allowing the DDC to monitor feedback such as, current (in amps), kilowatt hours (resettable), operating hours (resettable), and bypass logic board temperature. The DDC shall also be capable of monitoring the bypass relay output status, and all digital input status. All bypass diagnostic warning and fault information shall be transmitted over the serial communications bus. Remote bypass fault reset shall be possible.

6. The VFD / bypass shall allow the DDC to control the drive and bypass digital and analog outputs via the serial interface. This control shall be independent of any VFD function. The analog outputs may be used for modulating chilled water valves or cooling tower bypass valves. The drive and bypass’ digital (Form-C relay) outputs may be used to actuate a damper, open a valve or control any other device that requires a maintained contact for operation. In addition, all of the drive and bypass’ digital inputs shall be capable of being monitored by the DDC system. This allows for remote monitoring of which (of up to 4) safeties are open.

7. The VFD shall include an independent PID loop for customer use. The independent PID loop may be used for cooling tower bypass value control, chilled water value / hot water valve control, etc. Both the VFD PID control loop and the independent PID control loop shall continue functioning even if the serial communications connection is lost. As default, the VFD shall keep the last good set point command and last good DO & AO commands in memory in the event the serial communications connection is lost and continue controlling the process.

H. EMI / RFI filters. All VFD's shall include EMI/RFI filters. The onboard filters shall allow the VFD assembly to be CE Marked and the VFD shall meet product standard EN 61800-3 for the First Environment restricted level with up to 100 feet of motor cable. No Exceptions. Certified test reports shall be provided with the submittals confirming compliance to EN 61800-3, First Environment.

I. All VFD's through 75HP at 480 V shall be protected from input and output power mis-wiring. The VFD shall sense this condition and display an alarm on the keypad. The VFD shall not sustain damage from this power mis-wiring condition.

J. OPTIONAL FEATURES – Optional features shall be furnished and mounted by the drive manufacturer. All optional features shall be UL Listed by the drive manufacturer as a complete assembly and carry a UL508 label.

1. Door interlocked, pad-lockable disconnect switch that will disconnect all input power from the drive and all internally mounted options. Disconnect option shall be available with or without systems requiring bypass.

2. Field-bus adapters - Protocols such as BACnet IP shall be a plug in modules.

K. Bypass

1. A complete factory wired and tested bypass system consisting of a door interlocked, pad-lockable circuit breaker, output contactor, bypass contactor, and fast acting VFD input fuses. UL Listed motor overload protection shall be provided in both drive and bypass modes.

2. The bypass enclosure door and VFD enclosure must be mechanically interlocked such that the disconnecting device must be in the "Off" position before either enclosure may be accessed.

3. The VFD and bypass package shall have a UL listed short circuit current rating (SCCR) of 100,000 Amps and this rating shall be indicated on the UL data label.

4. The drive and bypass package shall be seismic certified and labeled to the IBC:
   a. Seismic importance factor of 1.5 rating is required and shall be based upon actual shake table test data as defined by ICC AC-156.

5. Drive Isolation Fuses - To ensure maximum possible bypass operation, fast acting fuses, exclusive to the VFD, shall be provided to allow the VFD to disconnect from the line prior to clearing upstream branch circuit protection. This maintains bypass operation capability in the event of a VFD failure. Bypass designs which have no such fuses, or that incorporate fuses common to both the VFD and the bypass, will not be accepted. Third contactor “isolation contactors” are not an acceptable alternative to fuses, as contactors could weld closed and are not an NEC recognized disconnecting device.

6. The bypass shall maintain positive contactor control through the voltage tolerance window of nominal voltage +30%, -35%. This feature is designed to avoid contactor coil failure during brown out / low line conditions and allow for input single phase operation when in the VFD mode. Designs that will not allow input single phase operation in the VFD mode are not acceptable.

7. Motor protection from single phase power conditions - the bypass system must be able to detect a single phase input power condition while running in bypass, disengage the motor in a controlled fashion, and give a single phase input power indication. Bypass systems not incorporating single phase protection in bypass mode are not acceptable.

8. The bypass system shall be designed for stand-alone operation and shall be completely functional in both Hand and Automatic modes even if the VFD has been removed from the system for repair / replacement. Serial communications shall remain functional even with the VFD removed. Bypass systems that do not maintain full functionality with the drive removed are not acceptable.

9. Serial communications – the bypass shall be capable of being monitored and / or controlled via serial communications. On-board communications protocols shall include ModBus RTU; Johnson Controls N2; Siemens Building Technologies FLN (P1); and BACnet MS/TP.

    a. Serial communication capabilities shall include, but not be limited to: bypass run-stop control, the ability to force the unit to bypass, and the ability to lock and unlock the keypad. The bypass shall have the capability of allowing the BAS to monitor feedback such as, current (in amps), kilowatt hours (resettable), operating hours (resettable), and bypass logic board temperature. The BAS shall also be capable of monitoring the bypass relay output status, and all digital input status. All bypass diagnostic warning and fault information shall be transmitted over the serial communications bus. Remote bypass fault reset shall be possible. The following additional status indications and settings shall be transmitted over the serial communications bus and / or via a Form-C relay output – keypad “Hand” or “Auto” selected, bypass selected, and broken belt indication. The BAS system shall also be able to monitor if the motor is running in the VFD mode or bypass mode over serial communications. A minimum of 50 field serial communications points shall be capable of being monitored in the bypass mode.

b. The bypass serial communications shall allow control of the drive/bypass (system) digital outputs via the serial interface. This control shall be independent of any bypass function or operating state. The system digital (relay) outputs may be used to actuate a damper, open a valve or control any other device that requires a maintained contact for operation. All system analog and digital I/O shall be capable of being monitored by the BAS system.

10. There shall be an adjustable motor current sensing circuit for the bypass and VFD modes to provide proof of flow (broken belt) indication. The condition shall be indicated on the keypad display, transmitted over the BAS and / or via a Form-C relay output contact closure. The broken belt indication shall be programmable to be a system (drive and bypass) indication. The broken belt condition sensing algorithm shall be programmable to cause a warning or system shutdown.

11. The digital inputs for the system shall accept 24VAC or 24VDC. The bypass shall incorporate an internally sourced power supply and not require an external control power source. The bypass power board shall supply 250 mA of 24 VDC for use by others to power external devices.

12. There shall be a run permissive circuit for damper or valve control. Regardless of the source of a run command (keypad command, time-clock control, digital input, or serial communications) the bypass shall provide a dry contact closure that will signal the damper to open before the motor can run. When the damper is fully open, a normally open dry contact (end-switch) shall close. The closed end-switch is wired to a bypass system input and allows motor operation. Up to four separate safety interlock inputs shall be provided. When any safety is opened, the motor shall be commanded to coast to stop, and the damper shall be commanded to close. This feature will also operate in Fireman's override / smoke control mode.

13. The bypass control shall monitor the status of the VFD and bypass contactors and indicate when there is a welded contactor contact or open contactor coil. This failed contactor condition shall be indicated on the bypass LCD display, programmed to activate a Form-C relay output, and / or over the serial communications protocol.

14. The bypass control shall include a programmable time delay bypass start including keypad indication of the time delay. A Form C relay output commands the VAV boxes open. This will allow VAV boxes to be driven open before the motor operates at full speed in the bypass mode. The time delay shall be field programmable from 0 – 120 seconds.

15. There shall be a keypad adjustment to select manual or automatic transfer to bypass. The user shall be able to select via keypad programming which drive faults will result in an automatic transfer to bypass mode and which faults require a manual transfer to bypass. The user may select whether the system shall automatically transfer from drive to bypass mode on the following drive fault conditions:

    a. Over current
    b. Over voltage
    c. Under voltage
    d. Loss of analog input

16. The following operators shall be provided:

    a. Bypass Hand-Off-Auto
    b. Drive mode selector
    c. Bypass mode selector
    d. Bypass fault reset

17. The bypass shall include a two line, 20 character LCD displays. The display shall allow the user to access and view:

    a. Energy savings – in US dollars
    b. Bypass motor amps
    c. Bypass input voltage– average and individual phase voltage
    d. Bypass power (kW)
    e. Bypass faults and fault logs
    f. Bypass warnings
    g. Bypass operating time (resettable)
    h. Bypass energy (kilowatt hours – resettable)
    i. I/O status
    j. Parameter settings / programming
    k. Printed circuit board temperature

18. The following indicating lights (LED type), or keypad display indications shall be provided. A test mode or push to test feature shall be provided.

    a. Power-on (Ready)
    b. Run enable
    c. Drive mode selected
    d. Bypass mode selected
    e. Drive running
    f. Bypass running
    g. Drive fault
    h. Bypass fault
    i. Bypass H-O-A mode
    j. Automatic transfer to bypass selected
    k. Safety open
    l. Damper opening
    m. Damper end-switch made

19. The Bypass controller shall have six programmable digital inputs, and five programmable Form-C relay outputs. This I/O allows for a total System (VFD and Bypass) I/O count of 24 points as standard. The bypass I/O shall be available to the BAS system even with the VFD removed.

20. The on-board Form-C relay outputs in the bypass shall be programmable for any of the following indications.

    a. System started
    b. System running
    c. Bypass override enabled
    d. Drive fault
    e. Bypass fault
    f. Bypass H-O-A position
    g. Motor proof-of-flow (broken belt)
    h. Overload
    i. Bypass selected
    j. Bypass run
    k. System started (damper opening)
    l. Bypass alarm
    m. Over temperature

21. The bypass shall provide a separate terminal strip for connection of freeze, fire, smoke contacts, and external start command. All external safety interlocks shall remain fully functional whether the system is in VFD or Bypass mode. The remote start/stop contact shall operate in VFD and bypass modes. The terminal strip shall allow for independent connection of up to four (4) unique safety inputs.

22. The bypass shall include a supervisory control mode. In this bypass mode, the bypass shall monitor the value of the VFD's analog input (feedback). This feedback value is used to control the bypass contactor on and off state. The supervisory mode shall allow the user to maintain hysteresis control over applications such as cooling towers and booster pumps even with the VFD out of service.

23. The user shall be able to select the text to be displayed on the keypad when an external safety opens. Example text display indications include "FireStat", "FreezStat", "Over pressure" and "Low suction". The user shall also be able to determine which of the four (4) safety contacts is open over the serial communications connection.

24. Smoke Control Override Mode (Override 1) – The bypass shall include a dedicated digital input that will transfer the motor from VFD mode to Bypass mode upon receipt of a dry contact closure from the Fire / Smoke Control System. The Smoke Control Override Mode action is not programmable and will always function as described in the bypass User's Manual documentation. In this mode, the system will ignore low priority safeties and acknowledge high priority safeties. All keypad control, serial communications control, and normal customer start / stop control inputs will be disregarded. This Smoke Control Mode shall be designed to meet the intent of UL864/UUKL.

25. Fireman's Override Mode (Override 2) – the bypass shall include a second, programmable override input which will allow the user to configure the unit to acknowledge some digital inputs, all digital inputs, ignore digital inputs or any combination of the above. This programmability allows the user to program the bypass unit to react in whatever manner the local Authority Having Jurisdiction (AHJ) requires. The Override 2 action may be programmed for "Run-to-Destruction". The user may also force the unit into Override 2 via the serial communications link.

26. Class 10, 20, or 30 (programmable) electronic motor overload protections shall be included.

PART 3 – EXECUTION

3.1 INSTALLATION

A. Installation shall be the responsibility of the mechanical contractor. The contractor shall install the drive in accordance with the recommendations of the VFD manufacturer as outlined in the VFD installation manual.

B. Power wiring shall be completed by the electrical contractor, to NEC code 430.122 wiring requirements based on the VFD input current. Caution: VFDs supplied without internal reactors have substantially higher input current ratings, which may require larger input power wiring and branch circuit protection. The contractor shall complete all wiring in accordance with the recommendations of the VFD manufacturer as outlined in the installation manual.

3.2 START-UP

A. Certified factory start-up shall be provided for each drive by a factory authorized service center. A certified start-up form shall be filled out for each drive with a copy provided to the owner, and a copy kept on file at the manufacturer.

3.3 PRODUCT SUPPORT

A. Factory trained application engineering and service personnel that are thoroughly familiar with the VFD products offered shall be locally available at both the specifying and installation locations. A toll free 24/365 technical support line shall be available.

B. A computer based training CD or 8-hour professionally generated video (VCR format) shall be provided to the owner at the time of project closeout. The training shall include installation, programming and operation of the VFD, bypass and serial communication.

3.4 WARRANTY

A. The VFD Product Warranty shall be 24 months from the date of certified start-up, not to exceed 30 months from the date of shipment. The warranty shall include all parts, labor, travel time and expenses. A toll free 24/365 technical support line shall be available.

END OF SECTION 230280

SECTION 230410 - PIPING, FITTINGS, VALVES AND NOTES (HOT WATER)

PART 1 - GENERAL

Applicable Provisions of the Conditions of the Contract and Division 1 General Requirements shall govern work in this section. Submit shop drawings for checking and approval.

1.1 PIPING NOTES

A. The Contractor shall erect all pipe, fittings, valves, hangers, anchors, expansion joints and all accessories specified, indicated on the Drawings or required to assure proper operation of all piping systems installed under this Contract. All piping shall be maintained at a proper level to assure satisfactory operation, venting and drainage. Piping and valves in any locality where possible shall be grouped neatly and shall be run so as to avoid reducing headroom or passage clearance.

B. All piping shall be new and of the material and weight specified under various services. Steel and wrought iron pipe 2" and larger shall be seamless or lap welded. All piping shall have the maker's name and brand rolled on each length of pipe.

C. All piping, fittings, valves and strainers shall be cleaned of grease, dirt and scale before installation. All temporary pipe openings shall be kept closed during the performance of the work. The ends of all piping shall be reamed smooth and all burrs removed before installation.

D. All piping shall be cut accurately to measurements taken on the job. Offset connections shall be installed alignment of vertical to horizontal piping and where required to make a true connection and to provide for expansion. Bent or sprung pipe shall not be installed where shown on Drawings and where necessary to provide for expansion of piping. Cold spring hot lines one-half estimated distance of maximum expansion. Suitable pipe anchors shall be installed where shown or required.

E. Piping connections shall have unions where necessary for replacement and repair of equipment. Gate valves and controls valves shall be installed where shown and where necessary for proper operation and service.

F. Vertical piping shall be plumb and horizontal piping shall be parallel to walls and partitions. Piping shall be supported as required to prevent the transmission of noise and vibration.

G. Work shall include all pipe, fittings, offsets and requirements for the installation of piping of other work including ducts and conduit. Reducing fittings shall be used where pipe changes size. All piping shall be installed with ample clearance to center accurately in sleeves through floors, and walls and partitions.

H. Piping shall be downgraded to drain connections at low points and upgraded to vent connections at high points unless otherwise noted. Drain connections shall be valved and piped to a floor drain. Vent connections on mains shall be equipped with air vent valves fitted with a copper tube drip line extended to a drain outlet. Vent connections on branches and equipment shall be fitted with key type manual vent cocks.

I. Drain piping shall be installed from all equipment as required. The Contractor shall extend drain piping and turn down over floor drains.

PART 2 - PRODUCTS

2.1 PIPING (ABOVEGROUND)

A. All piping installed under this Section of the Specifications shall be in accordance with the following schedule.

1. All piping, except where indicated differently, (i.e. underground piping) shall be standard weight black steel pipe Schedule 40, Grade A53, black steel. Pipe 2" and smaller, cast iron screwed fittings. Pipe 2-1/2" and larger, steel welding fittings. Pipe and fittings as manufactured by National, Wheeling, Bethlehem or equal, manufactured in accordance with ASTM current edition. All pipes must be reamed before installation.

2. Where the Contractor elects to use copper piping, it shall be rigid Type "L" copper, Chase, Anaconda or approved equal. Fittings shall be wrot copper, Nibco, Anaconda, Mueller or approved equal. Where copper piping is used, make all additional provisions for expansion. All condensate piping shall be Type "M" copper, rigid, full size of unit drain tapping, or larger as shown on Drawings.

3. All drainage pipe lines, 2" larger except where galvanized screw pipe is shown on the Drawings or specified hereafter, shall be extra heavy cast iron soil pipe and fittings.

B. Piping installation shall be arranged for draining through accessible valves at low points.

C. Threaded short and close nipples shall be Schedule 80, extra heavy weight of the same material as pipe in system in which they are installed.

D. All bare copper pipe, tubing and fittings shall be cleaned with steel wool and all excess solder shall be removed.

2.2 UNDERGROUND PRE-INSULATED PIPING SYSTEM

A. General: Pipe shall be manufactured from a PP-R or PP-RP(RCT) resin, as manufactured by Aquatherm or approved equal. Pipe shall meet the short-term properties and long-term strength requirements of ASTM F 2389. The pipe shall contain no rework or recycled materials except that generated in the manufacturer'sown plant from resin of the same specification from the same raw material. All pipe shall be made in an extrusion process. All pipe shall comply with the rated pressure requirements of ASTM F 2389. All pipe shall be certified by NSF International as complying with NSF 14, NSF 61, and ASTM F 2389 or CSA B137.11.

B. Fittings: Pipe fittings shall be manufactured from a PP-R resin meeting the short-term properties and long-term strength requirements of ASTM F 2389. The fittings shall contain no rework or recycled materials except that generated in the manufacturer's own

plant from resin of the same specification from the same raw material. All fittings shall be certified by NSF International as complying with NSF 14, NSF 61, and ASTM F 2389 or CSA B137.11

C. Accessories: End seals, gland seals and anchors shall be designed and factory fabricated to prevent the ingress of moisture into the system.

D. Insulation: Insulation shall be polyurethane foam either spray applied or injected with one shot into the annular space between carrier pipe and jacket with a minimum thickness of one inch. Insulation shall be rigid, 90-95% closed cell polyurethane with a 2.0 to 3.0 pounds per cubic foot density and coefficient of thermal conductivity (K-Factor) of 0.16 and shall conform to ASTM C-591. To ensure no voids are present, all insulation shall be inspected by visually checking prior to application of the jacket. The insulation shall be applied to the minimum thickness specified below. The insulation thickness shall not be less than indicated in these Specifications.

Pipe Size (in.)	Insulation Thickness (in.)
1-3	1
4-6	1.5
8-14	2

E. Protective Jacket: Jacketing material shall be extruded, black, high-density polyethylene (HDPE), having a minimum wall thickness of 100 mils for jacket sizes less than or equal to 12”, and 125 mils for jacket sizes larger than 12” to 24”. All fittings of the insulated piping system shall be prefabricated to minimize field joints and jacketed in a chopped spray up, polyester resin/fiberglass reinforcement composite, directly applied onto the insulating foam to a thickness related to the filament wound jacket thickness.

F. Field Joints: After the internal pipe has been hydrostatically hammer tested to 150 psig of 1-1/2 times the operating pressure, whichever is greater. Insulation shall then be poured in place into the field weld area. All field applied insulation shall be placed only in straight sections. Field insulation of fittings shall not be acceptable. The mold for the polyurethane shall be made of clear adhesive backed polyester film. The installer shall seal the field joint area with a heat shrinkable adhesive backed wrap or with wrappings of glass reinforcement full saturated with a catalyzed resin identical in properties to the factory applied resin. Backfilling shall no begin unit the heat shrink wrap has cooled or until the FRP lay-up has cured. All insulation and coating materials for making the field joint shall be furnished by the piping manufacturer.

G. Backfilling: A 4-inch layer of sand of fine gravel shall be placed and tamped in the trench to provide a uniform bedding for the pipe. The entire trench width shall be evenly backfilled with a similar material as the bedding in 6-inch compacted layers to a minimum of 12-18 inches for light traffic areas and 24 inches for heavy traffic areas above the top of the insulated piping system. The remaining trench shall be evenly and continuously backfilled in uniform layers with suitable excavated soil. Coordinate these requirements with the excavating and backfilling Contractor.

2.3 VALVES

A. All valves, unless specified or noted otherwise, shall be designed for a working pressure of not less than 200 p.s.i. water or 125 p.s.i. steam with name and pressure rating of valve cast in body. All valves shall be of the same manufacturer, unless specified otherwise. Valves for cut-off shall be gate valves, unless otherwise specified.

B. All valves of same manufacturer: similar to Jenkins Bros., Walworth, Kennedy or approved equal.

C. Four inch and larger, flanged; smaller sizes, screwed.

D. All Gate and Globe valves shall be installed with handle in an upright position.

E. The Contractor shall furnish and install all valves shown on Drawings and all valves that are necessary for proper operation and maintenance of systems and equipment. All piping connections to each piece of equipment and all branch connections to mains shall have cut-off valves.

F. The following schedule of valves for steam condensate, hot water, etc. is based on Jenkins Brothers, Inc. catalog numbers (except as noted); equivalent Lukenheimer, Walworth, O-I-C, Crane Fairbanks Company valves will be acceptable.

G. Ball Valves

1. 1/4" to 2-1/2” rated for 600 p.s.i wog, with brass body, chrome plated brass ball, virgin PTFE seats, and full port with threaded or solder connections.

2. 2-1/2” and larger rated for 200 p.s.i with carbon steel body, stainless steel full port ball, RTFE seats, lever operated to 4” gear operated 6” and above, with flanged end connections.

H. Gate Valves

1. Up to 2" : Bronze gate solid wedge, inside screw traveling stem union bonnet, -Fig. 47U

2. 2-1/2" and 3" : Iron body, bronze-mounted gate, solid wedge, OS&Y rising stem, -Fig. 650-A

3. 4" and larger: Iron body, bronze-mounted gate, solid wedge, OS&Y rising stem, -Fig. 651-A

I. Globe Valves

1. Up to 2" : Bronze body, regrinding seat ring and plug, union bonnet, -Fig. 546P

2. 2-1/2" and 3" : Iron body, bronze-mounted globe and angle, regrinding disc and seat ring, OS&Y -Fig. 613

3. All gate valves 6" and larger: Fitted 3/4" by-pass globe valve.

J. Plug Valves
   1. Up to 2" : Lubricated, semi-steel short pattern wrench operated, -Fig. 142

   2. 2-1/2" and larger: Lubricated, semi-steel short pattern wrench operated, -Fig. 143

   3. Similar to Rockwell Mgd. Co., Jenkins, Kennedy or approved equal.

K. Butterfly Valves used for chilled water, condenser water and hot water shall be the following:
   1. 2-1/2" to 12" rated for 175 p.s.i bubble tight close off, 14" and larger for 150 p.s.i close-off.

   2. Full lug cast iron body, aluminum bronze disc, stainless steel stem EPDM peroxide cured seat.

   3. 2-14" to 6" valves to be equipped with 10 position notch plate and lever lock handle. 8" and larger with handwheel gear operator.

   4. On installation, valves to be in full open position when flange bolts are tightened and stem in a horizontal position except when equipped with a chainwheel gear operator.

   5. Provide chain wheel gear operator on all valves installed 7 feet or higher.

   6. Valves to be designed with replaceable seat and parts kits.

   7. Valve to be Bray series 31, Dezurik 637 or Demco.

L. Check Valves
   1. 150 p.s.i. WSP class.

   2. Up to 2" : Bronze, regrinding bronze disc, screw-in cap, -Fig. 762A

   3. 2-1/2" and 3" : Iron body, bronze mounted regrinding bronze seat ring and disc, -Fig. 623

   4. 4" and larger: Iron body, bronze mounted regrinding bronze seat ring and disc, -Fig. 624

M. Drain Valves: All low points shall have drain valves, with hose ends. Where 1/2" and 3/4" sizes are indicated, "Standard" hose end drain valves shall be used. Provide brass hose end drain caps at each drain valve. Where larger than 3/4" drains are shown, gate valve shall be used. Provide brass nipples and reducer from drain valve size to 3/4" terminating with 3/4" hose end drain valve and cap.

2.4 FITTINGS

A. Nipples

1. All nipples shall have clean cut threads and shall be made from new pipe, standard weight for all lengths, except that close and shoulder nipples shall be extra heavy.

2. Fittings - 2-1/2 and Smaller: All fittings shall be standard weight steam pattern gray cast iron, Grinnell, Stockholm or equal approved.

3. Fitting - 3" and Larger: The Contractor has the option to use screwed, flanged or welded fittings so long as all ASME requirements are met.

B. Joints and Unions

1. Threaded joints shall be full and clean cut. The ends of pipe shall be reamed to the full inside diameter, all burrs shall be removed and no more than three threads shall be exposed beyond fittings when made up. Joints shall be made up tight with graphite base pipe joint compound. Exposed threads of ferrous pipe shall be painted with acid-resisting paint after caulking, lampwick or other material will be allowed for correction of defective joints.

2. Flange joints shall be made up perfectly square and tight. Screwed flanges and loose flanges shall be cast iron and welding flanges shall be steel. Flanges shall be faced true and bolted up tight with 1/16" Carlock ring type gasket.

3. Bolts shall be high quality steel with hexagon nuts and heads. The Contractor shall apply grease to threads of bolt.

4. Welded joints in piping shall be by the electric or oxyacetylene process using welding rods if the characteristics similar to pipe material and as recommended by the pipe manufacturer and shall be done in accordance with the ASME Code for pressure piping. Welding shall be done by qualified welders under the requirements of the ASME Boiler and Pressure Vessel Code.

5. The pipe lengths shall be aligned with welding rings and the abutting pipe ends shall be concentric. Prior to welding, the groove and adjacent surfaces shall be thoroughly cleaned of all grease, scale, or rust. During welding, all slag, or flux remaining on the bead shall be removed before laying down the next bead. The welding metal shall be thoroughly fused with the base metal at all sections of the weld. Short lengths of pipe may be beveled on the job with oxyacetylene torch, provided all scale and oxides are removed.

6. Joints shall be butt-welded, single V-type. All fittings shall be steel welding fittings. Elbows and fittings formed with coupling or welded cut pipe sections shall not be acceptable.

7. Bonney Weldolets or welding saddles may be used for branch connections, which are less than one-half the size of the main to which they connect.

8. Ground Joint Unions, Flange Connections, Reaming & Filling Ground joint unions shall be 200 lb. s.w.p. for brass. Flanges shall be 150 lb. s.w.p. for brass, 125 lb. s.w.p. for cast iron.

9. Ground joint unions of flanges shall be used only on exposed accessible piping. Where concealed, right and left nipples and couplings must be used. Where flanged connections are used, full size gaskets must be inserted.

C. Threads: Shall be standard, clean cut and tapered. All piping shall be reamed free from burrs. All piping shall be kept free of scale and dirt. Caulking of threads will not be permitted. All piping shall be threaded and made up in accordance with the current edition of the ASA Standard Specifications for pipe threads.

D. Unions

1. Unions for use on ferrous pipe 2" and smaller shall be malleable iron with brass to iron ground joint spherical seat and threaded connections. Unions 2 1/2" and over shall be flanged type with gasket.

2. Unions for copper tubing shall be cast bronze conforming to ASA B16. The Contractor shall furnish adapters where required for copper pipe.

3. Where copper pipe connects to ferrous pipe or metals, the Contractor shall furnish EPCO isolating type dielectric unions. Plastic type isolating bushings are not acceptable.

4. Unions shall be installed wherever necessary for repair or replacement of equipment, valves, strainers, etc. Final connections to equipment shall be made in a manner that will permit removal without cutting of pipelines.

E. Solder

1. All sweat joints shall be made up with 95/5 solder.
2. Solder shall be National Lead or approved equal. Flux shall be non-toxic and non-corrosive.
3. All copper tubing ends shall be reamed, filed and cleared of burrs and rough edges. All pipes shall be reamed after cutting and threading.

F. Expansion

1. The entire piping installation shall be installed with adequate provision for expansion. No rigid connections will be permitted.

2. Branches shall be of sufficient length and have 3 elbow swings to allow for pipe expansion.

3. Provide expansion joints, guides and anchors equal to “Metra-Flex MetraLoops” where indicated on Drawings or where necessary for proper expansion compensation. Submit shop drawing.

4. Any breaks in the piping within the guarantee period due to improper provision for expansion must be replaced at the expense of this Contractor, and the conditions corrected to prevent future recurrence.

5. Any damages to surrounding areas and equipment due to this failure shall also be repaired and paid for at the expense of the Contractor.

6. Joints to have 150 psi rating, ANSI-B16.5 with liner and cover.

2.5 PIPING SLEEVES

A. Furnish sleeves built into place for all piping passing through walls, floors or building construction. Sleeves, not less than 1/2" larger in diameter than piping and its covering, if any, and extending full depth of construction pierced. Pack sleeves through walls/floors in accordance with Underwriters' Requirements.

B. Sleeves piercing exterior walls, integral waterproofed walls shall be standard weight steel piping. Furnish welded center flange buried in construction for sleeves through exterior walls below grade. At exterior walls, make pipes watertight in sleeves using modular link type pipe wall penetration seals, Metraflex or equal. The seal shall consist of interlocking elastomer and shall be suitable for installation into core drilled wall openings or into a wall sleeve. All other sleeves: Galvanized sheet steel with lockseam joints, #22 USSG for 3" or under. Sleeves for piping 4" and larger, #18 USSG.

C. Pipes passing through interior membrane waterproofed floors, cast iron flashing sleeve, with integral flashing flange and clamping ring, similar to Josam Series #1880. Adjust sleeves to floor construction with steel or wrought iron pipe nipples top and bottom, extending 3" above finished floor. Burn & J.R. Smith are equal.

D. Pipes passing through membrane waterproofed walls, cast iron flashing sleeve with internal flashing flange and clamping ring similar to Josam Series #1870. Make pipes watertight in sleeves using modular link type pipe wall penetration seals, Metraflex or equal. The seal shall consist of interlocking elastomer and shall be suitable for installation into core drilled wall openings or into a wall sleeve.

E. For flashing sleeves specified in Pars. C and D, lead flashing extended at least 10" around flashing sleeves, securely held in place by clamping device.

PART 3 - EXECUTION

3.1 GENERAL NOTES - PIPING NOTES, DRAINING, VENTING AND MISCELLANEOUS WATER SPECIALTIES

A. Piping shall be installed as indicated on Drawings. Elevations and dimensions are indicated as a guide only and are subject to change with actual job conditions.

B. Except for drainage piping, which shall pitch down with flow, mains shall pitch upward or be installed dead level as indicated. Horizontal runs shall be parallel to walls.

C. In general, all branch connections shall be top of bottom 45 degree or 90 degree, pitching up or down from mains.

D. Where indicated, flexible connectors shall be installed. All final connections to equipment, pumps, units, etc. shall have companion flanged, flange unions or ground joint unions. (125 lbs.)

E. All piping shall be adequately supported with approved type hangers so as to prevent absolutely any sagging of lines, or any undue strain on pipes or fittings. All pipe lines shall be capped during construction to prevent entry of dirt or other foreign material. All piping lines after erection shall be blown or flushed out to render the piping system as clean as possible before system water is added for operation.

F. Clean interior and exterior surfaces promptly after installation of equipment and components. Take care to avoid damage to protective coatings and finishes. Remove excess sealants, lubrication, dirt and other foreign substances.

G. Comply with manufacturer's instructions and recommendations for installation of equipment, accessories and components.

H. All heating, ventilating and air conditioning equipment shall be carefully designed, constructed and installed so as to prevent any objectionable noise or vibration reaching any part of the building outside of the mechanical equipment room. The Contractor shall be required to rectify or replace at his own expense, any equipment not complying with the foregoing requirements.

3.2 DRAINING

A. All low points shall have drain valves with hose ends. Where 1/2" and 3/4" sizes are indicated, "Standard" hose end drain valves shall be used. Provide brass hose end drain caps at each drain valve. Where larger than 3/4" drains are shown, gate valve shall be used. Provide brass nipple and reducer from drain valve size to 3/4" terminating with 3/4" hose end drain valve and cap.

3.3 VENTING (For Hot Water)

A. All high points in piping shall be vented automatically with float vents. At all high points of piping, whether specifically indicated or not, provide Maid-o-Mist or B&G No. 7 or 27 Air Eliminators with shut off cock, auxiliary key vent and copper tubing overflow carried to floor along wall as indicated or directed.

3.4 WATER SPECIALTIES

A. Air Vents: Install at all high points automatic air vents to eliminate air binding. All automatic air vents shall be approved heavy duty type equipped with petcocks and tubing for manual venting. All vents installed in coils, etc. shall be of manual key operated type. All vents concealed from view shall be accessible through access doors. Vents shall be by Hoffman, Anderson or Bell & Gossett, 125 p.s.i.g. rated.

B. Pressure Gauge: Furnish and install pressure gauges on suction and discharge sides of each pump and as required to check operation of equipment; pressure gauges shall have 4-1/2"diameter dials, Ashton, Ashcroft or approved equal.

C. Install thermometers at all locations in piping system as noted on Drawings and as required to check system performance. Thermometers shall be installed at the supply and return of coils and 3-way diverting valves as manufactured by Trerice, Weksler or Moeller, with 4-1/2 inch face, cast aluminum case, chrome plated steel ring, white background with black embossed markings, glass window, stainless steel pointer, brass movement, 316 stainless steel bulb. Provide separable, universal angle sockets for all thermometers.

END OF SECTION 230410

SECTION 230420 - SUPPORTS, SLEEVES AND PLATES

PART 1 - GENERAL

Applicable Provisions of the Conditions of the Contract and Division 1 General Requirements govern work in this section. Submit shop drawings for checking and approval.

1.1 DESCRIPTION OF WORK

A. This Contractor shall furnish and install all plates, hangers and supports for his equipment including piping, headers, fans expansion tank, ductwork, etc.

B. All ductwork, piping and equipment shall be hung or supported from structural members only.

PART 2 - PRODUCTS

2.1 PIPING, DUCTWORK AND EQUIPMENT

A. All piping shall be supported from building structure in a neat and workmanlike manner wherever possible, parallel runs of horizontal piping shall be grouped together on trapeze hangers. Vertical risers shall be supported at each floor line with steel pipe clamps. Use of wire perforated metal to support pipes will not be permitted. Hanging pipes from other pipes will not be permitted.

B. Necessary structural members, hangers and supports of approved design to keep piping in proper alignment and prevent transmission of injurious thrusts and vibrations shall be furnished and installed. In all cases where hangers, brackets, etc., are supported from concrete construction, care shall be taken not to weaken concrete or penetrate waterproofing.

C. All hangers and supports shall be capable of screw adjustment after piping is erected. Hangers supporting piping expanding into loops, bends and offsets shall be secured to the building structure in such a manner that horizontal adjustment perpendicular to the run of piping supported may be made to accommodate displacement due to expansion. All such hangers shall be finally adjusted, both in the vertical and horizontal direction, when the supported piping is hot.

D. Pipe hangers shall be as manufactured by Grinnell, whose catalog numbers are given herein, or equivalent Carpenter and Paterson, or F&S Mfg. Co.

E. Piping shall be supported as follows unless otherwise indicated on the Drawings:

1. Heating piping shall be 1-1/2 " and smaller Fig. #260 adjustable clevis hanger. 2" and larger Fig. #174 one-rod swivel roll hanger.

2. Two-rod hangers shall be used for piping close to the ceiling slab or where conditions prohibit use of other hanger types.

3. Anchors for hanger rods shall be Phillips "Red Head" self-drilling type. Anchors shall be placed only in vertical surfaces.

4. Spacing of pipe supports shall not exceed 8 feet for pipes up to 1-1/2" and 10 feet on all other piping.

5. Hangers shall pass around insulation and a 16 gauge steel protective cradle; 12" long shall be inserted between hangers and insulation. Insulation under cradle shall be high density calcium silicate or approved equal to prevent crushing.

6. All piping shall be supported to allow free movement where expanding or contracting. Pipe shall be anchored as required or directed.

7. All lateral runs of piping shall be securely supported on hangers, rolls, brackets, etc. and in manner to allow for proper expansion and elimination of vibration.

8. 2" and smaller pipe, where run on walls, shall be supported on wrought iron "J" hook brackets with anchor bolts.

9. All horizontal pipes, where run overhead or on walls, shall be supported as follows unless otherwise indicated:

   a. On adjustable steel clevis type hangers suspended on hanger rods, pipe sizes up to and including 4".

F. Space limitations in hung ceilings spaces and conditions in other locations may require use of other type of hangers than those specified above. Suitable and approved pipe hangers shall be provided for such job conditions.

G. All supports shall be fastened to structural members or additional steel supports furnished by this Contractor.

H. Hanger rods shall be steel, threaded with nuts and lock nuts sizes in accordance with the following schedule:

Pipe Size	Rod Size
3/4" to 2" inclusive	3/8"
2-1/2" and 3' inclusive	1/2"
4" and 5" inclusive	5/8"
6"	3/4"
8" to 12" inclusive	7/8"

I. Hangers for copper tubing shall be tacked up with formed lead sheet on which tubing or pipe shall be placed.

J. Where pipes pass through masonry, concrete walls, foundations, or floors, this Contractor shall set sleeves as are necessary for passage of pipes. These sleeves shall be of sufficient size to permit insulation where required to be provided around pipe passing through. This Contractor shall be responsible for exact location of these sleeves.

K. Sleeves shall not be used in any portion of building where use of same would impair strength of construction features of the building. Inserts for supporting lateral pipes and equipment shall be placed and secured to form work, and all sleeves inserts locations shall be thoroughly checked with Architect so as not to conflict with other trades.

L. Where pipes pass through floor or walls, they shall be provided with chromium plated escutcheons.

M. Anchor horizontal piping where indicated and wherever necessary to localize expansion or prevent undue strain on branches. Anchors: Heavy forged construction entirely separate from supports.

N. Anchor vertical piping wherever indicated and wherever necessary to prevent undue strain on offsets and branches. Anchors, unless otherwise noted: Heavy steel clamps securely bolted and welded to pipes. Extension ends shall bear on building construction.

O. Ducts shall be hung with 1" x 1/8" metal straps. When width of duct is less than 48", hangers shall be fastened to side of ducts. Auxiliary steel supports that may be required for all mechanical equipment shall be furnished and installed by this Contractor. All operating equipment including fans, piping, etc. shall be supported so as to produce minimum amount of noise transmission.

P. Refer to "General Conditions" as well.

PART 3 - EXECUTION

3.1 INSPECTION

A. Inspect equipment space locations before beginning installation. Verify that the space is correct for entry and access. Do not proceed with installation of the equipment until unsatisfactory conditions have been corrected.

3.2 INSTALLATION

A. Comply with manufacturer's instructions and recommendations for installation of equipment, accessories and components.

B. All heating, ventilating and air conditioning equipment shall be carefully designed, constructed and installed so as to prevent any objectionable noise or vibration reaching any part of the building outside of the mechanical equipment room. Care shall also be taken to prevent transmission of noise or odor through ductwork into other spaces. The Contractor shall be required to rectify or replace at his own expense, any equipment not complying with the foregoing requirements.

3.3 CLEANING

A. Clean interior and exterior surfaces promptly after installation of equipment and components. Take care to avoid damage to protective coatings and finishes. Remove excess sealants, lubrication, dirt and other foreign substances.

END OF SECTION 230420

SECTION 230430 - INSULATION AND COVERINGS

PART 1 - GENERAL

Applicable Provisions of the Conditions of the Contract and Division 1 General Requirements govern work in this section. Submit shop drawings for checking and approval.

1.1 DESCRIPTION OF WORK

A. Furnish insulation for all piping, equipment and sheetmetal work as noted.

B. Insulate no piping, ducts or equipment until tested and approved for tightness. All piping and ducts shall be dry when covered. Where existing insulation has been damaged, altered of removed during the course of the work, it shall be replaced with new insulation in a neat manner to match the adjacent insulation.

C. All insulation must be done by an approved Sub-Contractor or by mechanics skilled in this line of work.

D. Fire hazard classification shall be 2550 per ASTM E-84, NFPA 255 and UL 723. Insulation shall be rated non-combustible type classified flame spread - 25, smoke developed - 50.

PART 2 - PRODUCTS

2.1 PIPING / EQUIPMENT (INDOOR)

A. All new or altered heating and chilled water system supply and return piping shall be covered with Manville Micro-Lok or equal approved fiberglass insulation with all service (factory applied) vapor retardant jacket. Seal with type H mastic.

B. Fittings shall be insulated with same material and thickness as adjoining pipe insulation and shall be pre-molded fittings or mitre cut segmental insulation wired on. Over the insulation, apply a wrapper of OCF glass cloth sealed with type H mastic. Apply aluminum bands on pipe covering in addition to self-sealing feature.

C. Insulation Material: Molded fibrous glass insulation, density not less than 4 lbs. per cubic foot.

D. Insulation Thickness: Shall be in accordance with the latest edition of the New York State Energy Conservation Construction Code C403.11.

E. Jacket and Finish: White flame retardant type, meeting all requirements of "Fire Hazard Classification" of NFPA, similar to "Fiberglass" Type FRJ, Insul-Coustic, Johns-Manville or approved equal.

F. Insulation and Finishes for Fittings, Valves and Flanges

1. Valves, fittings and flanges other than vapor seal insulation: Insulated in same manner and same thickness as piping in which installed.

2. Use pre-molded sectional covering where available; otherwise use mitered segments of pipe covering.

3. Obtain written approval prior to using other than molded sectional covering.

G. Vapor seal Insulation for Valves, Fittings and Flanges: Same as above, except joints sealed with vapor barrier adhesive and wrapped with glass mesh tape. Each fitting shall be finished with two coats of vapor seal mastic adhesive.

H. Jacket and Finishes: Exposed fittings - 6 oz. canvas jacket adhered with lagging adhesive.

I. Concealed fittings: Standard weight canvas jacket adhered with lagging adhesive and with bands of 18 gauge copper coated steel - 2 bands at elbows, 3 at tee.

J. Insulation at Pipe Hangers

1. Where shields are specified at hangers on piping with fibrous glass covering, provide load bearing calcium silicate between shields and piping as follows:

a. For pipe covering without vapor barrier jacket, furnish at each shield 12" - long calcium silicate section with canvas section with canvas jacket continuous between shield and insulation.
b. For pipe covering with vapor barrier jacket, furnish at each shield 12" - long vapor barrier jacket section with section of fibrous glass replaced with section of calcium silicate. Vapor barrier jacket, continuous between shield and insulation for continuous vapor barrier.

K. Condensate drain piping shall be insulated with 1/2” Armacell or approved equal closed cell insulation.

L. Equipment Refrigerant piping shall be insulated with Armacell or approved equal closed cell insulation. Thickness shall be in accordance with the latest edition of the New York State Energy Conservation Code C403.11.

1. Secure fibrous glass block or board insulation in place with wire or galvanized steel bands.

a. Small Areas: Secure insulation with 16 gauge wire on maximum 6” centers.
b. Large Areas: Secure insulation with 14 gauge wire or .015” thick by 1/2” wide galvanized steel bands on maximum 10” centers. Stagger insulation joints.

c. Irregular Surfaces: Where application of block or board insulation is not practical insulate with insulating cement built-up to same thickness as adjoining insulation.

2. Fill joints, voids and irregular surfaces with insulating cement to a uniform thickness.

3. Stretch wire mesh over entire insulated surface and secure to anchors with wire edges laced together.

4. Apply finishing cement, total of 1/2" thick, in 1/4" thick coats. Trowel second coat to a smooth hard finish.

5. Neatly bevel insulation around handholes, cleanouts, ASME stamp, manufacturer's nametag and catalog number.

M. Insulated Covers for Pumps

1. Do not extend pump insulation beyond or interfere with stuffing boxes or interfere with adjustment and servicing of parts regular maintenance or operating attention.

2.2 PIPING (OUTDOOR)

A. All supply and return piping shall be or approved equal covered with insulation in accordance with the latest edition of the New York Energy Conservation code C403.11.

B. Insulation shall be complete elastomeric insulation system coupled with a multi-layered covering, resistant to ultraviolet rays and atmospheric agents. The plastic / aluminum cladding provides a secondary moisture vapor barrier to the inherently moisture-resistant closed cell foam core. The insulation cladding shall be a minimum of .016" thick. Provide 2" wide tape for seams and 8" wide tape for edges and corner with matching cladding covering. All seams and joints shall be weatherproof.

C. Insulation shall conform with ASTM C 534 Type 1, Grade 1 and shall be manufactured by K-Flex USA Model K-FLEX CLAD AL, (K-FLEX CLAD IN for extreme environmental conditions), Armacell Model ARMATUFF SA or approved equal.

D. Refrigerant piping shall be insulated with 1/2" Armacell or approved equal closed cell insulation.

PART 3 - EXECUTION

3.1 INSPECTION

A. Inspect equipment space locations before beginning installation. Verify that the space is correct for entry and access. Do not proceed with installation of the equipment until unsatisfactory conditions have been corrected.

3.2 INSTALLATION

A. Comply with manufacturer's instructions and recommendations for installation of equipment, accessories and components.

B. All heating, ventilating and air conditioning equipment shall be carefully designed, constructed and installed so as to prevent any objectionable noise or vibration reaching any part of the building outside of the mechanical equipment room. Care shall also be taken to prevent transmission of noise or odor through ductwork into other spaces. The Contractor shall be required to rectify or replace at his own expense, any equipment not complying with the foregoing requirements.

3.3 CLEANING

A. Clean interior and exterior surfaces promptly after installation of equipment and components. Take care to avoid damage to protective coatings and finishes. Remove excess sealants, lubrication, dirt and other foreign substances.

END OF SECTION 230430

SECTION 230460 - AUTOMATIC TEMPERATURE CONTROLS

PART 1 - GENERAL

Applicable provisions of the conditions of the Contract and Division 1 General Requirements govern the work in this section. Submit shop drawings for checking and approval.

1.1 QUALIFICATIONS OF BIDDER

A. All bidders must be building automation contractors in the business of installing direct digital control building automation systems for a minimum of 10 years.

B. All bidders must have an office in the within 50 miles of jobsite.

C. All bidders must be authorized distributors or branch offices of the manufacturers specified.

D. All bidders must have a trained staff of application Engineers, who have been certified by the manufacturer in the configuration, programming and service of the automation system.

1.2 SCOPE OF WORK

A. This Contractor shall furnish an electronic system of temperature controls. The Library has standardized on Allerton Controls. All submitted controls shall be directly compatible with existing hardware and software without patch panels or translators or any kind. The ATC Sub-Contractor shall be subject to the Library's approval. Communications between the Library is via their Ethernet LAN and remote access is via the Web or Local Intranet. The intent of this specification is to extend and interoperate with this system and to provide a peer-to-peer, networked, distributed control system for the temperature control work that is part of this project. All components, software and operation shall be interoperable with the existing building automation system in the Library. The installed system will interface directly with the existing proprietary as well as open protocol systems, including the existing Library network, dynamic color graphics software and programming software. The existing software and database will be modified to accept the new equipment being installed under this project to maintain integrity for centralized scheduling, trending, programming and alarming. PC Desktop icons that "link" to a separate EMS system are not acceptable. Any costs associated with connecting to the existing energy management system, including licensed software, programming, training etc. shall be part of the controls contractor's bid. The contractor must demonstrate their ability to perform the integration to the existing Allerton Controls systems prior to submittal acceptance and invoicing.

B. Only licensed software toolsets will be acceptable for integration work. All systems as described in the sequence of operation will be shown via dynamic Web based graphics with all pertinent system alarms for proper operation and maintenance. The use of separate PC workstations, gateways, metalinks, replacement of existing controllers and control devices and additional software graphic packages to accomplish this integration will not be accepted.

C. Prospective bidders shall visit the Library to verify existing DDC controls equipment and Contractor's ability to be compatible with these controls before bid. Contact the Supt. of Buildings and Grounds for details. Contractor shall provide Web based graphics for controlled equipment that matches the functionality and appearance of the graphics already in use on the existing system. Contractor shall configure graphic display to meet Owner and Engineer requirements.

D. The Temperature Controls Contractor (TCC) shall provide each of the following portions of the complete EMCS as a standalone system that can communicate with any other DDC system which is following the same protocol.

1. Operator Workstations: Upgrade software and Databases in the Library and provide guaranteed seamless two way communications via the Internet and Library LAN, including full control, with both all existing DDC systems currently under control and the DDC system provided as a part of this project.
   The OWS's shall monitor, display, and control information from the DDC systems through one software package. Rebooting of the OWS to access the existing building's multiple systems is not acceptable. Use of separate ": Icons" to access multiple DDC systems is not acceptable. The existing database shall be modified to incorporate the work of this project.

   a. The system OWS's shall meet the hardware and performance requirements of this specification.
   b. The OWS's shall allow customization of the system as described in this specification.

2. The OWS's shall:

   a. Provide new color graphic control screens for all equipment provided or modified as part of this project, as outlined below and on the drawings.
   b. Allow operators to view and work (read and write) all DDC points associated with all DDC equipment provided or modified as part of this project, including all existing DDC points.
   c. Allow for custom graphics and/or control programming generation for any existing or new equipment.
   d. Provide seamless continuity of graphics and existing functionality for all existing Owner's equipment currently under DDC control.

E. All proposed controls contractors that intend on interoperating with the existing DDC system utilizing DDC controls other than those presently installed in the Library, shall submit a Technical Proposal, complete with the diagrams, Specifications Compliance Reports, product information, and supporting documentation outlined below. The technical proposal will be utilized to evaluate the methodology that will be used to implement the interoperation and integration of the new controls of this project into the existing Library wide energy management system. It will also be used as a basis for vendor qualification on for the project. Arrange the Technical Proposal in order of the specification article numbers.

1. Provide a list of local jobs (three minimum) of similar type and size the bidder has installed, utilizing the products proposed for this project, with owner's representatives' names and telephone numbers for reference. This list should directly reflect:

   a. Projects that include direct integration to third party microprocessor controllers of the type specified within the scope where an integration and interoperation of Lon Works controls has been successfully achieved between two different manufacturers' controls systems.
      - EMCS network wiring diagram showing interconnection of all panels, workstations, system printer(s) etc. A diagram describing system architecture for this project with product code numbers for workstation, network controllers, application specific controllers, transducers, sensors, communication network, etc.

2. Provide information on owner training provided as part of the bid package as well as additional opportunities and factory schools available with associated cost. Include details of operator HVAC Training System as specified herein.

3. Specification Compliance Report. Provide specification compliance report that addresses every paragraph within this specification section utilizing an outline format, as follows:

   a. Comply-bid package complies without exception;

   b. Exception – bid package meets the functional intent, but not the letter of the specification. For each paragraph that an exception is taken, identify all deviations from what is specified in the given paragraph and provide a description of what is excluded, what is included, and how the contractor intends to meet the functional intent;

   c. Does not comply – bid package cannot meet specified function and will not be provided.

   d. For all paragraphs in this specification section, indicates as "Comply" or "Exception" or "Does not comply". Provide and reference factory product documentation to substantiate compliance.

4. Provide a statement that all products used on this project are of current manufacture and are readily available through multiple distribution channels. Products in “field testing” status are not acceptable.

F. The BAS Contractor shall review and study all HVAC Drawings and the entire Specification to familiarize himself with the equipment and system operation and to verify the quantities and types of dampers, operators, alarms, etc. to be provided.

G. Prior to commencement of schedule programming meet with Owner to discuss block/individual scheduling of system/equipment and alarm protocols. Review equipment designations and graphics screens to be provided. Take minutes of this meeting and issue them to the Construction Manager/Owner’s representative.

H. All temperature control wiring regardless of voltage shall be done by this Contractor. This shall include power wiring of control panels/components from available spare circuits in electrical panels. The automatic temperature control manufacturer shall provide wiring diagrams, field supervision and one (1) year guarantee on the installed DDC system and three (3) year factory warrantee on all control equipment manufactured by the DDC manufacturer.

I. Thermostats, temperature sensors, heating control devices, etc. are indicated on the Drawings in general. Provide any additional devices required to carry out project intent as herein described.

J. Thermostats/Temperature sensors in areas subject to vandalism shall have in addition separately mounted extra heavy guards. Submit sample.

K. Contractor shall include all new heating control devices, thermostats, etc. indicated on Drawings or that is part of a new system.

L. Contractor shall furnish all necessary electrical controls, motor starters, switches, etc. for proper operation of equipment furnished by him under this Contract, and as herein noted.

M. Point and component lists are to be used as a guide. If the sequence of operation requires additional points/control devices, this Contractor shall be responsible for providing same.

N. All control system components installed shall be manufactured by the DDC system manufacturer.

O. Communications cabling shall be run in hallways above hung ceiling with plenum cable and wiremold where exposed.

P. Removals shall include switches, relays, electric components not required for the new intent. Do not leave behind items with no function. Provide appropriate blanking plates/patching where removals occur in finished spaces.

Q. Provide services and manpower necessary for commissioning of system in coordination with the HVAC Contractor, Balancing Contractor, Owner’s representative, and Commissioning Authority.

1.3 SOFTWARE CODE

A. Owner shall be furnished with a complete, hard-bound copy of all installed software code. Final payment shall be contingent upon this requirement being met.

1.4 CODE COMPLIANCE

A. Provide components and ancillary equipment, which are UL-916 listed and labeled.

B. All equipment or piping used in conditioned air streams, spaces or return air plenums shall comply with NFPA 90A Flame/Smoke/Fuel contribution rating of 25/50/0 and all applicable building codes or requirements.

C. All wiring shall conform to the National Electrical Code.

D. Comply with FCC rules, Part 15 regarding Class A radiation for computing devices and low power communication equipment operating in commercial environments.

E. Comply with FCC, Part 68 rules for telephone modems and data sets.

1.5 SUBMITTALS

A. All shop drawings shall be prepared in Visio Professional or AutoCAD software. In addition to the Drawings, the Contractor shall furnish a CD containing the identical information. Drawings shall be B size or larger.

B. Shop drawings shall include a riser diagram depicting locations of all controllers and workstations, with associated network wiring. Also included shall be individual schematics of each mechanical system showing all connected points with reference to their associated controller. Typical will be allowed where appropriate.

C. Submittal data shall contain manufacturer's data on all hardware and software products required by the Specification. Valve damper and airflow station schedules shall indicate size, configuration, capacity and location of all equipment.

D. Software submittals shall contain narrative descriptions of sequences of operation, program listings, point lists, and a complete description of the graphics, reports, alarms and configuration to be furnished with the workstation software. Information shall be bound or in a three ring binder with an index and tabs.

E. Submit submittal data and shop drawings to the Engineer for review prior to ordering or fabrication of the equipment. The Contractor prior to submitting shall check all Documents for accuracy.

F. The Engineer will make corrections, if required, and return to the Contractor. The Contractor will then resubmit with the corrected or additional data. This procedure shall be repeated until all corrections are made to the satisfaction of the Engineer and the submittals are fully approved.

1.6 SYSTEM STARTUP AND COMMISSIONING

A. Each point in the system shall be tested for both hardware and software functionality. In addition, each mechanical and electrical system under control of the BAS will be tested against the appropriate sequence of operation specified herein. Successful completion of the system test shall constitute the beginning of the commissioning phase. A written report will be submitted to the Owner indicating that the installed system has been started and balanced in accordance with the Drawings and Specifications.

B. The ATC Contractor shall set in operating condition all major equipment and systems, such as heating, cooling, heat recovery and all air handling systems, in the presence of the equipment manufacturer's representatives, as applicable, and the Owner and Architect's representatives. The ATC contractor shall work with the Commissioning Authority as required until all associated HVAC equipment is fully commissioned to the satisfaction of the Commissioning Authority.

C. The ATC Contractor shall provide all manpower and engineering services required to assist the HVAC Contractor, Balancing Contractor, and Commissioning Authority in testing, adjusting, and balancing all systems in the building Scope of Work. The Contractor shall have a trained technician available on request during the balancing and commissioning of the systems. The Contractor shall coordinate all requirements to provide a complete air balance with the Balancing Contractor and Commissioning Authority and shall include all labor and materials in his Contract.

D. Refer to specification section 23 0485 HVAC Systems Commissioning.

1.7 OPERATING AND MAINTENANCE MANUALS

A. The operation and maintenance manuals shall contain all information necessary for the operation, maintenance, replacement, installation and parts procurement for the entire system. This documentation shall include specific part numbers and software versions and dates. A complete list of recommended spare parts shall be included with the lead-time and expected frequency of use of each part clearly identified.

B. Following project completion and testing, the Contractor will submit As-Built Drawings reflecting the exact installation of the system. The as-built documentation shall also include a copy of all application software both in written form and on CD.

1.8 WARRANTY

A. The Contractor shall provide system warranty for 12 months after system acceptance or beneficial use by the Owner. During the warranty period, the Contractor shall be responsible for all necessary revisions to the software as required to provide a complete and workable system consistent with the letter and intent of the Sequence of Operation section of the Specification.

B. Updates to the manufacturer's software shall be provided at no charge during the warranty period.

1.9 SPECIFICATION NOMENCLATURE

A. Acronyms used in this specification are as follows:

1.	EMCS	Energy Management and Control System
2.	NAC	Network Area Controller
3.	IDC	Interoperable Digital Controller
4.	FUI	Full User Interface
5.	BUI	Browser User Interface
6.	POT	Portable Operator's Terminal
7.	PMI	Power Measurement Interface
8.	DDC	Direct Digital Controls
9.	LAN	Local Area Network
10.	WAN	Wide Area Network
11.	OOT	Object Oriented Technology
12.	PICS	Product Interoperability Compliance Statement

PART 2 - PRODUCTS

2.1 GENERAL

A. The Energy Management Control System (EMCS) shall be comprised of a network of interoperable, stand-alone digital controllers, a computer system, graphical user interface software, portable operator terminals, printers, network devices and other devices as specified herein.

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

2.2 OPEN, INTEROPERABLE, INTEGRATED ARCHITECTURES

A. The intent of this specification is to provide a peer-to-peer networked, stand-alone, distributed control system with the capability to integrate Lon Works and Schneider Electric Network 8000 technology communication protocols in one open, interoperable system.

B. The programming computer software shall employ object-oriented technology (OOT) for representation of all data and control devices within the system. In addition, adherence to industry standards including ANSI / ASHRAE™ Standard 135-1995, to assure interoperability between all system components is required. For each Lon Works device that does not have Lon Work certification, the device supplier must provide an XIF file for the device. All components and controllers supplied under this contract shall be true "peer-to-peer" communicating devices. Components or controllers requiring "polling" by a host to pass data shall not be acceptable.

C. The supplied system must incorporate the ability to access all data using Java enabled browsers without requiring proprietary operator interface and configuration programs. An Open Database Connectivity (ODBC) or Structured Query Language (SQL) compliant server database is required for all system database parameter storage. This data shall reside on a supplier-installed server for all database access. Systems requiring proprietary database or proprietary user interface programs shall not be acceptable.

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

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

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

2.3 NETWORKS

A. The Local Area Network (LAN) shall be either a 10 or 100 Megabits/sec Ethernet network supporting, Java, XML, HTTP, and CORBA IIOP for maximum flexibility for integration of building data with enterprise information systems and providing support for multiple Network Area Controllers (NACs), Browser User Interfaces (BUIs) and/or Full User Interfaces (FUIs).

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

1. Ethernet; IEEE standard 802.3

2. Cable; 10 Base-T, UTP-8 wire, category 5

3. Minimum throughput; 10 Mbps, with ability to increase to 100 Mbps

2.4 NETWORK ACCESS

A. Remote Access

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

2. Where no Local Area Network exists, EMCS supplier shall provide the following:
   a. 8 Port Ethernet hub (3Com, or equal)
   b. Ethernet router (Cisco or equal)

3. The owner shall provide a connection to the Internet to enable this access via high-speed cable modem, asynchronous digital subscriber line (ADSL) modem, ISDN line or T1 Line. Owner agrees to pay monthly access charges for connection and ISP.

2.5 NETWORK AREA CONTROLLER (NAC)

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

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

B. The Network Area Controller must provide the following hardware features as a minimum:

1. One Ethernet Port -10 / 100 Mbps.
2. One RS-232 port.
3. One Lon Works Interface Port – 78KB FTT-10A.
4. Battery Backup.
5. Flash memory for long term data backup (If battery backup or flash memory is not supplied, the controller must contain a hard disk with at least 1 gigabyte storage capacity)
6. The NAC must be capable of operation over a temperature range of 0 to 55°C.
7. The NAC must be capable of withstanding storage temperatures of between 0 and 70°C.
8. The NAC must be capable of operation over a humidity range of 5 to 95% RH, non-condensing.

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

D. The NAC shall support standard Web browser access via the Intranet/Internet. It shall support a minimum of 16 simultaneous users.

E. Event Alarm Notification and Actions

1. The NAC shall provide alarm recognition, storage; routing, management, and analysis to supplement distributed capabilities of equipment or application specific controllers.
2. The NAC shall be able to route any alarm condition to any defined user location whether connected to a local network or remote via dial-up, telephone connection, or wide-area network.
3. Alarm generation shall be selectable for annunciation type and acknowledgement requirements including but limited to:
   a. To alarm
   b. Return to normal
   c. To fault

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

F. Control equipment and network failures shall be treated as alarms and annunciated.

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

1. Screen message text

2. Email of the complete alarm message to multiple recipients. Provide the ability to route and email alarms based on:
   a. Day of week
   b. Time of day
   c. Recipient
3. Pagers via paging services that initiate a page on receipt of email message
4. Graphic with flashing alarm object(s)
5. Printed message, routed directly to a dedicated alarm printer

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

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

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

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

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

L. Provide a “query” feature to allow review of specific alarms by user-defined parameters.

M. A separate log for system alerts (controller failures, network failures, etc.) shall be provided and available for review by the user.

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

2.6 DATA COLLECTION AND STORAGE

A. The NAC shall have the ability to collect data for any property of any object and store this data for future use.

B. The data collection shall be performed by log objects, resident in the NAC that shall have, at a minimum, the following configurable properties:

1. Designating the log as interval or deviation.

2. For interval logs, the object shall be configured for time of day, day of week and the sample collection interval.

3. For deviation logs, the object shall be configured for the deviation of a variable to a fixed value. This value, when reached, will initiate logging of the object.

4. For all logs, provide the ability to set the maximum number of data stores for the log and to set whether the log will stop collecting when full, or rollover the data on a first-in, first-out basis.

5. Each log shall have the ability to have its data cleared on a time-based event or by a user-defined event or action.

C. All log data shall be stored in a relational database in the NAC and the data shall be accessed from a server (if the system is so configured) or a standard Web Browser.

D. All log data, when accessed from a server, shall be capable of being manipulated using standard SQL statements.

E. All log data shall be available to the user in the following data formats:

1. HTML
2. XML
3. Plain Text
4. Comma or tab separated values

F. Systems that do not provide log data in HTML and XML formats at a minimum shall not be acceptable.

G. The NAC shall have the ability to archive its log data either locally (to itself), or remotely to a server or other NAC on the network. Provide the ability to configure the following archiving properties, at a minimum:

1. Archive on time of day.
2. Archive on user-defined number of data stores in the log (buffer size).
3. Archive when log has reached its user-defined capacity of data stores.
4. Provide ability to clear logs once archived.

2.7 AUDIT LOG

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

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

2.8 DATABASE BACKUP AND STORAGE

A. The NAC shall have the ability to automatically backup its database. The database shall be backed up based on a user-defined time interval.

B. Copies of the current database and, at the most recently saved database shall be stored in the NAC. The age of the most recently saved database is dependent on the user-defined database save interval.

C. The NAC database shall be stored, at a minimum, in XML format to allow for user viewing and editing, if desired. Other formats are acceptable as well, as long as XML format is supported.

2.9 INTEROPERABLE DIGITAL CONTROLLER (IDC)

A. Controls shall be microprocessor based Interoperable Lon Mark™ or Lon Works Controllers (IDC). Where possible, all Interoperable Digital Controllers shall bear the applicable Lon Mark™ interoperability logo on each product delivered.

B. HVAC control shall be accomplished using Lon Mark™ based devices where the application has a Lon Mark profile defined. Where Lon Mark devices are not available for a particular application, devices based on Lon Works shall be acceptable. For each Lon Works device that does not have Lon Mark certification, the device supplier must provide an XIF file for the device. Publicly available specifications for the Applications Programming Interface (API) must be provided for each Lon Works / Lon Mark controller defining the programming or setup of each device. All programming, documentation and programming tools necessary to set up and configure the supplied devices per the specified sequences of operation shall be provided.

C. The Lon Works network trunk shall be run to the nearest Network Area Controller (NAC). A maximum of 126 devices may occupy any one Lon Works trunk and must be installed in buss architecture using the appropriate trunk termination device. All Lon Works and Lon Mark devices must be supplied using FTT-10A Lon Works communications transceivers.

D. The Network Area Controller will provide all scheduling, alarming, trending, and network management for the Lon Mark / Lon Works based devices.

E. The IDCs shall communicate with the NAC at a baud rate of not less than 78.8K baud. The IDC shall provide LED indication of communication and controller performance to the technician, without cover removal.

F. All IDCs shall be fully application programmable and shall at all times maintain their LONMARK certification. Controllers offering application selection only (non-programmable), require a 10% spare point capacity to be provided for all applications. All control sequences within or programmed into the IDC shall be stored in non-volatile memory, which is not dependent upon the presence of a battery, to be retained.

G. The supplier of any programmable IDC shall provide one copy of the manufacturer's programming tool, with documentation, to the owner.

2.10 FULL USER INTERFACE SOFTWARE

A. Operating System: The FUI shall run on Microsoft Windows NT Workstation 4.0, Service Pack 4 or later.

B. The FUI shall employ browser-like functionality for ease of navigation. It shall include a tree view (similar to Windows Explorer) for quick viewing of, and access to, the hierarchical structure of the database. In addition, menu-pull downs, and toolbars shall employ buttons, commands and navigation to permit the operator to perform tasks with a minimum knowledge of the HVAC Control System and basic computing skills. These shall include, but are not limited to, forward/backward buttons, home button, and a context sensitive locator line (similar to a URL line), that displays the location and the selected object identification.

C. Real-Time Displays. The FUI, shall at a minimum, support the following graphical features and functions:

1. Graphic screens shall be developed using any drawing package capable of generating a GIF, BMP, or JPG file format. Use of proprietary graphic file formats shall not be acceptable. In addition to, or in lieu of a graphic background, the FUI shall support the use of scanned pictures.

2. Graphic screens shall have the capability to contain objects for text, real-time values, animation, color spectrum objects, logs, graphs, HTML or XML document links, schedule objects, hyperlinks to other URL's, and links to other graphic screens.

3. Graphics shall support layering and each graphic object shall be configurable for assignment to a layer. A minimum of six layers shall be supported.

4. Modifying common application objects, such as schedules, calendars, and set points shall be accomplished in a graphical manner.
   a. Schedule times will be adjusted using a graphical slider, without requiring any keyboard entry from the operator.
   b. Holidays shall be set by using a graphical calendar, without requiring any keyboard entry from the operator.

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

6. Adjustments to analog objects, such as set points, shall be done by right-clicking the selected object and using a graphical slider to adjust the value. No entry of text shall be required.

D. System Configuration: At a minimum, the FUI shall permit the operator to perform the following tasks, with proper password access:

1. Create, delete or modify control strategies.
2. Add/delete objects to the system.
3. Tune control loops through the adjustment of control loop parameters.
4. Enable or disable control strategies.
5. Generate hard copy records or control strategies on a printer.
6. Select points to be alarmable and define the alarm state.
7. Select points to be trended over a period of time and initiate the recording of values automatically.

E. On-line Help: Provide a context sensitive, on-line help system to assist the operator in operation and editing of the system. On-line help shall be available for all applications and shall provide the relevant data for that particular screen. Additional help information shall be available through the use of hypertext. All system documentation and help files shall be in HTML format.

F. On-line Documentation: Provide a context sensitive, on-line documentation system to assist the operator in operation and trouble shooting of each integrated system. On-line help shall be available for all applications and shall provide the relevant data for that particular monitoring screen. As a minimum, provide a link to the Sequence of Operation, input/output summary, and cut sheets in either Adobe Acrobat™ or HTML format.

G. Security: Each operator shall be required to log on to that system with a username and password in order to view, edit, add, or delete data. System security shall be selectable for each operator. The system administrator shall have the ability to set passwords and security levels for all other operators. Each operator password shall be able to restrict the operators' access for viewing and/or changing each system application, full screen editor, and object. Each operator shall automatically be logged off of the system if no keyboard or mouse activity is detected. This auto log-off time shall be set per operator password. All system security data shall be stored in an encrypted format.

H. System Diagnostics: The system shall automatically monitor the operation of all workstations, printers, modems, network connections, building management panels, and controllers. The failure of any device shall be annunciated to the operator.

I. Alarm Console

1. The system will be provided with a dedicated alarm window or console. This window will notify the operator of an alarm condition and allow the operator to view details of the alarm and acknowledge the alarm. The use of the Alarm Console can be enabled or disabled by the system administrator.

2. When the Alarm Console is enabled, a separate alarm notification window will supersede all other windows on the desktop and shall not be capable of being minimized or closed by the operator. This window will notify the operator of new alarms and un-acknowledged alarms. Alarm notification windows or banners that can be minimized or closed by the operator shall not be acceptable.

2.11 BROWSER USER INTERFACE SOFTWARE

A. The system shall be capable of supporting an unlimited number of clients using a standard Web browser such as Internet Explorer™ or Netscape Navigator™. Systems requiring additional software (to enable a standard Web browser) to be resident on the client machine, or manufacture-specific browsers shall not be acceptable.

B. The Web browser software shall run on any operating system and system configuration that is supported by the Web browser. Systems that require specific machine requirements in terms of processor speed, memory, etc., in order to allow the Web browser to function with the EMCS, shall not be acceptable.

C. The Web browser shall provide the same view of the system, in terms of graphics, schedules, calendars, logs, etc., and provide the same interface methodology as is provided by the Full User Interface. Systems that require different views or that require different means of interacting with objects such as schedules, or logs, shall not be permitted.

D. The Web browser client shall support at a minimum, the following functions:

1. User log-on identification and password shall be required. If an unauthorized user attempts access, a blank web page shall be displayed. Security using Java authentication and encryption techniques to prevent unauthorized access shall be implemented.
2. Graphical screens developed for the FUI shall be the same screens used for the Web browser client. Any animated graphical objects supported by the FUI shall be supported by the Web browser interface.
3. HTML programming shall not be required to display system graphics or data on a Web page. HTML editing of the Web page shall be allowed if the user desires a specific look or format.
4. Storage of the graphical screens shall be in the Network Area Controller (NAC), without requiring any graphics to be stored on the client machine. Systems that require graphics storage on each client are not acceptable.
5. Real-time values displayed on a Web page shall update automatically without requiring a manual “refresh” of the Web page.
6. Users shall have administrator-defined access privileges. Depending on the access privileges assigned, the user shall be able to perform the following:
    a. Modify common application objects, such as schedules, calendars, and set points in a graphical manner.
        - Schedule times will be adjusted using a graphical slider, without requiring any keyboard entry from the operator.
        - Holidays shall be set by using a graphical calendar, without requiring any keyboard entry from the operator.

b. Commands to start and stop binary objects shall be done by right-clicking the selected object and selecting the appropriate command from the pop-up menu. No entry of text shall be required.
c. View logs and charts
d. View and acknowledge alarms

7. The system shall provide the capability to specify a user's (as determined by the log-on user identification) home page. Provide the ability to limit a specific user to a pre-defined home page. From the home page, links to other views, or pages in the system shall be possible, if allowed by the system administrator.
8. Graphic screens on the Web Browser client shall support hypertext links to other locations on the Internet or on Intranet sites, by specifying the Uniform Resource Locator (URL) for the desired link.

2.12 SYSTEM PROGRAMMING

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

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

1. Provide the capability to copy objects from the supplied libraries, or from a user-defined library to the user's application. Objects shall be linked by a graphical linking scheme by dragging a link from one object to another. Object links will support one-to-one, many-to-one, or one-to-many relationships. Linked objects shall maintain their connections to other objects regardless of where they are positioned on the page and shall show link identification for links to objects on other pages for easy identification. Links will vary in color depending on the type of link; i.e., internal, external, hardware, etc.
2. Configuration of each object will be done through the object's property sheet using fill-in the blank fields, list boxes, and selection buttons. Use of custom programming, scripting language, or a manufacturer-specific procedural language for configuration will not be accepted.
3. The software shall provide the ability to view the logic in a monitor mode. When on-line, the monitor mode shall provide the ability to view the logic in real time for easy diagnosis of the logic execution. When off-line (debug), the monitor mode shall allow the user to set values to inputs and monitor the logic for diagnosing execution before it is applied to the system.

4. All programming shall be done in real-time. Systems requiring the uploading, editing, and downloading of database objects shall not be allowed.
5. The system shall support object duplication within a customer's database. An application, once configured, can be copied and pasted for easy re-use and duplication. All links, other than to the hardware, shall be maintained during duplication.

2.13 OBJECT LIBRARIES

A. A standard library of objects shall be included for development and setup of application logic, user interface displays, system services, and communication networks.

B. The objects in this library shall be capable of being copied and pasted into the user's database and shall be organized according to their function. In addition, the user shall have the capability to group objects created in their application and store the new instances of these objects in a user-defined library.

C. In addition to the standard libraries specified here, the supplier of the system shall maintain an on-line accessible (over the Internet) library, available to all registered users to provide new or updated objects and applications as they are developed.

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

1. Lon Mark/Lon Works devices. These devices shall include, but not be limited to, devices for control of HVAC, lighting, access, and metering. Provide Lon Mark manufacturer-specific objects to facilitate simple integration of these devices. All network variables defined in the Lon Mark profile shall be supported. Information (type and function) regarding network variables not defined in the Lon Mark profile shall be provided by the device manufacturer.

2. For devices not conforming to the Lon Mark standard, provide a dynamic object that can be assigned to the device based on network variable information provided by the device manufacturer. Device manufacturer shall provide an XIF file and documentation for the device to facilitate device integration.

2.13 LONWORKS NETWORK MANAGEMENT

A. The Full User Interface software (FUI) shall provide a complete set of integrated Lon Works network management tools for working with Lon Works networks. These tools shall manage a database for all Lon Works devices by type and revision, and shall provide a software mechanism for identifying each device on the network. These tools shall also be capable of defining network data connections between Lon Works devices, known as "binding". Systems requiring the use of third party Lon Works network management tools shall not be accepted.

B. Network management shall include the following services: device identification, device installation, device configuration, device diagnostics, device maintenance and network variable binding.

C. The Network configuration tool shall also provide diagnostics to identify devices on the network, to reset devices, and to view health and status counters within devices.

D. These tools shall provide the ability to “learn” an existing Lon Works network, regardless of what network management tool(s) were used to install the existing network, so that existing Lon Works devices and newly added devices are part of a single network management database.

E. The network management database shall be resident in the Network Area Controller (NAC), ensuring that anyone with proper authorization has access to the network management database at all times. Systems employing network management databases that are not resident, at all times, and within the control system shall not be accepted.

2.14 OTHER CONTROL SYSTEM HARDWARE

A. Motorized Control Dampers: Coordinate with the other trades for the exact quantity, size and location of all dampers. Dampers shall be black enamel finish or galvanized, with nylon bearings. Blade edge and tip seals shall be included for all dampers. Blades shall be 16-gauge minimum and 6 inches wide maximum and frame shall be of welded channel iron. Dampers with both dimensions less than 18 inches may have strap iron frames. Ruskin CD-46 or Equal.

B. Control Damper and Valve Actuators: Coordinate with other trades for exact quantity, size and location of all dampers. Provide all dampers unless Two-position or proportional electric actuators shall be direct-mount type. All actuators shall be spring return type. Provide one actuator per damper minimum.

C. Control Valves: Control valves shall be 2-way or 3-way pattern as shown constructed for tight shutoff and shall operate satisfactorily against system pressures and differentials. Two-position valves shall be ‘line’ size. Proportional control valves shall be sized for a maximum pressure drop of 5.0 psi at rated flow (except as may be noted on the drawings). Valves with sizes up to and including 2 inches shall be “screwed” configuration and 2-1/2 inch and larger valves shall be “flanged” configuration. Electrically controlled valves shall include spring return type actuators sized for tight shut-off against system pressures and furnished with integral switches for indication of valve position (open-closed). Three-way butterfly valves, when utilized, shall include a separate actuator for each butterfly segment.

D. Wall Mount Room Thermostats: Each room thermostat shall provide temperature indication to the digital controller; provide the capability for a software-limited set point adjustment and operation override capability. An integral LCD shall annunciate current room temperature and set point as well as override status indication. In addition, the thermostat shall include a port for connection of the portable operator’s terminal described elsewhere in this specification.

E. Duct Mount, Pipe Mount and Outside Air Temperature Sensors: 10,000-ohm thermistor temperature sensors with an accuracy of ± 0.2ºC. Outside air sensors shall include an integral sun shield.

F. Current Sensitive Switches: Solid state, split core current switch that operates when the current level (sensed by the internal current transformer) exceeds the adjustable trip point. Current switch to include an integral LED for indication of trip condition and a current level below trip set point.

G. Water Flow Meters (when required): Water flow meters shall be axial turbine style flow meters which translate liquid motion into electronic output signals proportional to the flow sensed. Flow sensing turbine rotors shall be non-metallic and not impaired by magnetic drag. Flow meters shall be 'insertion' type complete with 'hot-tap' isolation valves to enable sensor removal without water supply system shutdown. Accuracy shall be ±2% of actual reading from 0.4 to 20 feet per second flow velocities.

H. Temperature Control Panels: Furnish temperature control panels of code gauge steel with locking doors for mounting all devices as shown. Control panels shall meet all requirements of Title 24, California Administrative Code. All electrical devices within a control panel shall be factory wired. All external wiring shall be connected to terminal strips mounted within the panel. Provide engraved phenolic nameplates identifying all devices mounted on the face of control panels. A complete set of 'as-built' control drawings (relating to the controls within that panel) shall be furnished within each control panel.

2.15 INPUT DEVICES

A. System accuracy of sensed conditions shall be as follows:

1. +/- .5°F for space temperature in the 0-130°F range
2. +/- .5°F for duct temperatures in the 40-130°F range
3. +/- 1.0°F for outside air temperatures in the (-30)-230°F range
4. +/- 1.0°F for water temperatures in the 30-230°F range
5. +/- .1 inch for filter status differential over a 0-2 inch range

B. The system shall maintain the specified analog end-to-end accuracy throughout the warranty period from sensor to controller readout.

C. Packaging: Sensors (transducers) will be appropriately packaged for the location.

1. Architectural housing for space mounting.
2. Weatherproof/sunshield housing for outdoors.
3. Thermal well housing for water applications.
4. Protective housing for duct mounting.

D. Environmental Ratings - The sensor/transducer shall be selected to withstand ambient conditions where:

1. Moisture or condensation is a factor.
2. Vibration exists from ductwork, equipment, etc.
3. Reasonably expected transient conditions exist for temperatures, pressures, humidity's, etc. outside the normal sensing range.

E. Temperature Sensors

1. Temperature sensors will be by the use of thermistors (10K ohm at 77°F) or RTDs (PT100 curve).

2. Sensors in the return or discharge duct shall be of the single point type. Sensors in the mixed air will be of the average type.
3. Thermowells shall be brass or stainless steel for non-corrosive fluids below 250°F and 300 series stainless steel for all other applications.
4. Room temperature sensors: Sensing element only.

F. Digital Sensors

1. All digital inputs will be provided by dry contacts. The contacts will be wired normally open or normally closed as required.
2. Motor status (pumps, fans, etc.) shall be determined by current-operated switch.

2.16 OUTPUT DEVICES

A. The use of multiplexers will not be accepted.

B. Relays and Contactors

1. All digital outputs will be electrically isolated from the digital controller by interface relays.
2. Field relays shall have a minimum life of 1 million cycles without failure.
3. Contactors shall have a minimum life of ten thousand cycles without failure.

2.17 ACTUATORS

A. Standard manufacturer damper and valve actuators, proportional or two-position as required, sized to properly operate device. Damper actuators shall be of the direct coupled type, Belimo or equal.

2.18 WIRING AND CONDUIT

A. Where different wiring classes terminate within the same enclosure, maintain clearances and install barriers per the National Electric Code.

B. Where wiring is required to be installed in conduit, EMT shall be used. Conduit shall be minimum 1/2 inch galvanized EMT. Set screw fittings are acceptable for dry interior locations. Watertight compression fittings shall be used for exterior locations and interior locations subject to moisture. Provide conduit seal-off fitting where exterior conduits enter the building or between areas of high temperature/moisture differential.

C. Flexible metallic conduit (max. 3 feet) shall be used for connections to motors, actuators, controllers, and sensors mounted on vibration producing equipment. Liquid-tight flexible conduit shall be use in exterior locations and interior locations subject to moisture.

D. Junction boxes shall be provided at all cable splices, equipment terminations, and transitions from EMT to flexible conduit. Interior dry location J-boxes shall be galvanized pressed steel, nominal four-inch square with blank cover. Exterior and damp location JH-boxes shall be cast alloy FS boxes with threaded hubs and gasketed covers.

E. Where the space above the ceiling is a supply or return air plenum, the wiring shall be plenum rated. Teflon wiring can be run without conduit above suspended ceilings. EXCEPTION: Any wire run in suspended ceilings that is used to control outside air dampers or to connect the system to the fire alarm system shall be in conduit.

2.19 ENCLOSURES

A. All controllers and field interface panels shall be mounted in new enclosures unless otherwise stated in this specification.

B. All outside mounted enclosures shall meet the NEMA-4 rating.

C. Wiring within all enclosures shall be run in plastic track. Wiring within controllers shall be wrapped and secured.

2.20 CONTROL VALVES

A. Control Valves: Factory fabricated, of type, body material, and pressure class indicated. Where type or body material is not indicated, make selection as determined by manufacturer for installation requirements and pressure class, based on maximum pressure and temperature rating of piping system.

B. Globe Pattern: As follows:

1. Up to 2 inches: Bronze body, bronze trim, rising stem, renewable composition disc, screwed ends with backseating capacity re-packable under pressure.

2. Over 2 inches: Iron body, bronze trim, rising stem, plug-type disc, flanged ends, renewable seat and disc.

3. Hydronic Systems: As follows:

a. Rating: Service at 125 psi WSP and 250°F.
b. Internal Construction: Replaceable plugs and seats of stainless steel or brass.
   - Single-Seated Valves: Cage trim provides seating and guiding surfaces for plug on top and bottom of guided plugs.
   - Double-Seated Valves: Balanced plug; cage trim provides seating and guiding surfaces for plugs on top and bottom of guided plugs.
c. Sizing: 3-psi maximum pressure drop at design flow rate.
d. Flow Characteristics: 2-way valves have equal percentage characteristics; 3-way valves have linear characteristics. Select operators to close valves against pump shutoff head.

C. Terminal Unit Control Valves: Bronze body, bronze trim, 2 or 3 port as indicated, replaceable plugs and seats, union and threaded ends.

1. Rating: Service at 125 psi WSP and 250°F.

2. Sizing: 3-psi maximum pressure drop at design flow rate, to close against pump shutoff head.

3. Flow Characteristics: 2-way valves have equal percentage characteristics; 3-way valves have linear characteristics.

4. Operators (2 Position): Synchronous motor with enclosed gear train, dual-return springs, valve-position indicator. Valves spring return to normal position for temperature protection.

5. Operators (Modulating): Self-contained, linear motor, actuator with 60-second full travel, with transformer and single-throw, double-pole contacts.

2.21 DAMPERS

A. Dampers: AMCA-rated, parallel or opposed blade design; form frames from not less than 0.1084-inch galvanized steel with mounting holes for duct mounting; damper blades not less than 0.0635-inch galvanized steel, with maximum blade width of 8 inches.

1. Blades secured to 1/2-inch diameter, zinc-plated axles using zinc-plated hardware, with nylon blade bearings, blade-linkage hardware of zinc-plated steel and brass. Ends sealed against spring-stainless-steel blade bearings. Thrust bearings at each end of every blade.

2. Operating Temperature Range: From -40 to 200°F.

3. For standard applications as indicated, (as selected by manufacturer's sizing techniques) with optional closed-cell neoprene edging.

4. Provide low-leakage parallel or opposed blade design (as selected by manufacturer's sizing techniques) with inflatable seal blade edging, or replaceable rubber seals, rated for leakage at less than 10 cfm/sq.ft. of damper area, at differential pressure of 4 inches wg when damper is being held by torque of 50 inch-pounds; test in accordance with AMCA 500. Ruskin CD-46 or equal.

2.22 ACTUATORS

A. Electronic Actuators: The actuator shall be direct coupled over the shaft, enabling it to be mounted directly to the damper shaft without the need for connecting linkage. The actuator shall have electronic overload circuitry to prevent damage. For power-failure/safety applications, an internal mechanical, spring return mechanism shall be built into the actuator housing. Non-spring return actuators shall have an external manual gear release to allow positioning of the damper when the actuator is not powered.

B. All valves shall be fully proportioning, unless otherwise specified, quiet in operation, and shall be arranged to fail safe, in either a normally open or normally closed position, in the event of power failure. The open of closed position shall be as specified or as required to suit job conditions. All valves shall be capable of operating at varying rates of speed to correspond to the exact dictates of the controller and variable load requirements.

C. Where valves operate in sequence with other valves or damper operators, provide on each valve a pilot positioner to provide adjustable operating ranges and starting points and positive close off at the required control signal pressure. Positioners must be directly connected to the valve stem. Ratio relays are not acceptable.

D. Valves shall be sized by the Temperature Control Manufacturer and guaranteed to meet the heating or requirements as specified and indicated on the Drawings. Unless otherwise specified, all shall conform to the requirements herein specified for the piping system in which they are installed.

2.23 CENTRAL CONTROL PANEL

A. Integrate new controls into existing central control touch screen panel. This central panel will allow for time clock scheduling, setpoints, monitoring of points and alarm. All freezestats will be reset manually at the central panel. All alarms will be displayed and reset manually at central panel.

B. All exhaust fans shall be controlled by the central control panel.

C. Central control panel shall be connected to existing Library IT Network. Library shall provide data drop.

2.24 AUXILIARY EQUIPMENT/DEVICES

A. Analog Sensors

1. Duct sensors (greater than four square feet): Monitoring range to suit application. Platinum or nickel wound RTD Type + 0.1% of range. Factory calibration point – 70 Deg. F at 1000 OHMS.

2. Space Temperature Sensors: Space Temperature Sensors shall be 5,000 or 10,000 ohm thermistor with wall plate adapter and blank cover assembly. The sensor shall include an integral occupancy override button and shall also include a RJ11 communications port. Space Temperature Sensors shall include space temperature adjustment slides where shown on the plans. The Space Temperature Sensors shall be mounted approximately 60” above the floor.

3. Hydronic Well Temperature Sensors: Water Temperature Sensors shall be well mounted 5,000 or 10,000 ohm thermistors.

4. Status Indication- Status indication for fans and pumps shall be provided by a current sensing sensor. The sensor shall be installed at the motor starter or motor to provide load indication. The unit shall consist of a current transformer, a solid state current sensing circuit (with adjustable set point) and a solid state switch. A red light emitting diode (LED) shall indicate the on off status of the unit. The switch shall provide a N.O. contact for wiring back to the Field Installed Controller.

5. Combination CO2 and Space Temperature Sensors: CO2 and space sensors are comprised of two sensors housed in one unit designed to measure both CO2 in the air and the building air temperature. Combination sensor shall have the following features:

a. Self Calibration CO_2 sensor with 5 year calibration interval.
b. Push button over ride.
c. CO_2 sensitivity +/- 20 ppm.
d. CO_2 accuracy +/- 100 ppm.
e. Space sensor: 5 or 10K thermistor.

2.25 DDC SENSORS AND POINT HARDWARE

A. Temperature Sensors

1. All temperature devices shall use precision thermistors accurate to +/- 1 degree F over a range of –30 to 230 degrees F. Space temperature sensors shall be accurate to +/- .5 degrees F over a range of 40 to 100 degrees F.

2. Standard space sensors shall be available in an off white enclosure for mounting on a standard electrical box.

3. Where manual overrides are required, the sensor housing shall feature both an optional sliding mechanism for adjusting the space temperature setpoint, as well as a push button for selecting after hours operation.

4. Where a local display is specified, the sensor shall incorporate either an LED or LCD display for viewing the space temperature, setpoint and other operator selectable parameters. Using built in buttons; operators shall be able to adjust setpoints directly from the sensor.

5. Duct temperature sensors shall incorporate a thermistor bead embedded at the tip of a stainless steel tube. Probe style duct sensors are useable in air handling applications where the coil or duct area is less than 14 square feet.

6. Averaging sensors shall be employed in ducts, which are larger than 14 square feet. The averaging sensor tube must contain at least one thermistor for every 3 feet, with a minimum tube length of 12 feet.

7. Immersion sensors shall be employed for measurement of temperature in all chilled and hot water applications as well as refrigerant applications. Thermal wells shall be brass or stainless steel for non-corrosive fluids below 250 degrees F. and 300 series stainless steel for all other applications.

8. A pneumatic signal shall not be allowed for sensing temperature.

B. Humidity Sensors

1. Humidity devices shall be accurate to +/- 5% at full scale for space and +/- 3% for duct and outside air applications. Suppliers shall be able to demonstrate that accuracy is NIST traceable.

2. Provide a hand held field calibration tool that both reads the output of the sensor and contains a reference sensor for ongoing calibration.

C. Pressure Sensors

1. Air pressure measurements in the range of 0 to 10” water column will be accurate to +/- 1% using a solid-state sensing element. Acceptable manufacturers include Modus Instruments and Mamac.

2. Differential pressure measurements of liquids or gases shall be accurate to =/- 0.5% of range. The housing shall be NEMA 4 rated.

D. Current and KW Sensors

1. Current status switches shall be used to monitor fans, pumps, motors and electrical loads. Current switches shall be available in solid and split core models, and offer either a digital or an analog signal to the automation system. Acceptable manufacturer is Veris or approved equal.

2. Measurement of three-phase power shall be accomplished with a kW/kWH transducer. This device shall utilize direct current transformer inputs to calculate the instantaneous value (kW) and a pulsed output proportional to the energy usage (kWH). Provide Veris Model 6000 Power Transducer or approved equal.

E. Flow Sensors

1. Provide an insertion vortex flow meter for measurement of liquid or gas flows in pipe sizes above 3 inches.
2. Install the flow meter on an isolation valve to permit removal without process shutdown.
3. Sensors shall be manufactured by EMCO or approved equal.

F. Carbon Dioxide Sensors

1. Non-Dispersive Infrared (NDIR), 0-2000 PPM.
2. Power Requirement, 18-30 VDC.
3. Voltage output, 0-10- VDC Full Scale.
4. Current output, 4-20 mA

2.26 AIRFLOW MEASURING STATIONS

A. Provide a thermal anemometer using instrument grade self heated thermistor sensors with thermistor temperature sensors. The flow station shall operate over a range of 0 to 5,000 feet/min with an accuracy of +/- 2% over 500 feet/min and +/- 10 ft/min for reading less than 500 feet/min.

B. The output signal shall be linear with field selectable ranges including 0-5 VDC, 0-10VDC and 4-20 mA.

C. Furnish Ebtron Series 3000 airflow stations or approved equal.

PART 3 - EXECUTION

3.1 GENERAL

A. All DDC Controllers shall be networked to Central Communications controller.

B. Existing Front End Workstation in B & G office shall be configured for High School Addition access. Text/Graphic screens for each system shall match existing.

C. Communications cabling shall be run in hallways above hung ceiling with plenum cable and wiremold where exposed.

3.2 CONTRACTOR RESPONSIBILITIES

A. General: The Contractor or a Sub-Contractor shall perform installation of the building automation system. However, all installations shall be under the personal supervision of the Contractor. The Contractor shall certify all work as proper and complete.

B. Demolition: Remove controls, which do not remain as part of the building automation system, all associated abandoned wiring and conduit and all associated pneumatic tubing. The Owner will inform the Contractor of any equipment, which is to be removed, that will remain the property of the Owner. The Contractor will dispose of all other equipment that is removed.

C. Access to Site: Unless notified otherwise, entrance to building is restricted. No one will be permitted to enter the building unless their names have been cleared with the Owner or the Owner's representative.

D. Code Compliance: All wiring shall be installed in accordance with all applicable electrical codes and will comply with equipment manufacturer's recommendations. Should any discrepancy be found between wiring Specifications in Division 26 and Division 22, wiring requirements of Division 26 will prevail for work specified in Division 26.

E. Cleanup: At the completion of the work, all equipment pertinent to this Contract shall be checked and thoroughly cleaned, and all other areas shall be cleaned around equipment provided under this Contract. Clean the exposed surfaces of tubing, hangers, and other exposed metal of grease, plaster, or other foreign materials.

3.3 WIRING, CONDUIT, TUBING AND CABLE

A. All wire will be copper and meet the minimum wire size and insulation class listed below:

Wire Class	Wire Size	Isolation Class
Power	12 Gauge	600 Volt
Class One	14 Gauge Std.	600 Volt
Class Two	18 Gauge Std.	300 Volt
Class Three	18 Gauge Std.	300 volt
Communications	Per Mfr.	Per Mfr.

B. Power and Class One wiring may be run in the same conduit. Class Two and Three wiring and communications wiring may be run in the same conduit.

C. Where different wiring classes terminate within the same enclosure, maintain clearances and install barriers per the National Electric Code.

D. Where wiring is required to be installed in conduit, EMT shall be used. Conduit shall be minimum 1/2 inch galvanized EMT. Setscrew fittings are acceptable for dry interior locations. Watertight compression fittings shall be used for exterior locations and interior locations subject to moisture. Provide conduit seal off fitting where exterior conduits enter the building or between areas of high temperature/moisture differential.

E. Flexible metallic conduit (max. 3 feet) shall be used for connections to motors, actuators, controllers, and sensors mounted on vibration producing equipment. Liquid-tight flexible conduit shall be use in exterior locations and interior locations subject to moisture.

F. Junction boxes shall be provided at all cable splices, equipment termination, and transitions from EMT to flexible conduit. Interior dry location J-boxes shall be galvanized pressed steel, nominal four-inch square with blank cover. Exterior and damp location JH-boxes shall be cast alloy FS boxes with threaded hubs and gasket covers.

G. Where the space above the ceiling is a supply or return air plenum, the wiring shall be plenum rated. Teflon wiring can be run without conduit above suspended ceilings. EXCEPTION: Any wire run in suspended ceilings that is used to control outside air dampers or to connect the system to the fire management system shall be in conduit.

H. Coaxial cable shall conform to RG62 or RG59 rating. Provide plenum rated coaxial cable when running in return air plenums.

3.4 HARDWARE INSTALLATION

A. Installation Practices for Wiring and Tubing

1. All controllers are to be mounted vertically and per the manufacturer's installation documentation.
2. The 120 VAC power wiring to each Ethernet or Remote Site controller shall be a dedicated run, with a separate breaker. Each run will include a separate hot, neutral and ground wire. The ground wire will terminate at the breaker panel ground. This circuit will not feed any other circuit or device.
3. A true earth ground must be available in the building. Do not use a corroded or galvanized pipe, or structural steel.
4. Wires are to be attached to the building proper at regular intervals such that wiring does not drop. Wires are not to be affixed to or supported by pipes, conduit, etc.
5. Wiring in finished areas will be concealed in ceiling cavity spaces, plenums, and furred spaces and wall construction. Exception; metallic surface raceway may be used in finished areas on masonry walls. All surface raceway in finished areas must be color matched to the existing finish within the limitations of standard manufactured colors.
6. Wiring, in non-finished areas where possible, will be concealed in ceiling cavity spaces, plenums, furred spaces, and wall construction. Exposed conduit will run parallel to or at right angles to the building structure.
7. Wires are to be kept a minimum of three (3) inches from hot water or condense piping.

8. Where sensor wires leave the conduit system, they are to be protected by a plastic insert.

B. Installation Practices for Field Devices

1. Well-mounted sensors will include thermal conducting compound within the well to insure good heat transfer to the sensor.
2. Actuators will be firmly mounted to give positive movement and linkage will be adjusted to give smooth continuous movement throughout 100 percent of the stroke.
3. Relay outputs will include transient suppression across all coils. Suppression devices shall limit transients to 150% of the rated coil voltage.
4. Water line mounted sensors shall be removable without shutting down the system in which they are installed.
5. For duct static pressure sensors, the high-pressure port shall be connected to a metal static pressure probe inserted into the duct pointing upstream. The low-pressure port shall be left open to the plenum area at the point that the high-pressure port is tapped into the ductwork.
6. For building static pressure sensors, the high-pressure port shall be inserted into the space via a metal tube. Pipe the low-pressure port to the outside of the building.

C. Enclosures

1. For all I/O requiring field interface devices, these devices, where practical, will be mounted in a field interface panel (FIP). The Contractor shall provide an enclosure, which protects the device(s) from dust, moisture, conceals integral wiring and moving parts.
2. FIP’s shall contain power supplies for sensors, interface relays and Contractors, safety circuits, and I/P transducers.
3. The FIP enclosure shall be of steel construction with baked enamel finish; NEMA 1 rated with a hinged door and keyed lock. The enclosure will be sized for 20% spare mounting space. All locks will be keyed identically.
4. All wiring to and from the FIP will be to screw type terminals. Analog or communications wiring may use the FIP as a raceway without terminating. The use of wire nuts within the FIP is prohibited.
5. All outside mounted enclosures shall meet the NEMA-4 rating.
6. The wiring within all enclosures shall be run in plastic track. Wiring within controllers shall be wrapped and secured.

D. Identification

1. Identify all control wires with labeling tape or sleeves using either words, letters, or numbers that can be exactly cross-referenced with As-Built Drawings.
2. All field enclosures, other than controllers, shall be identified with a Bakelite nameplate. The lettering shall be in white against a black or blue background.
3. Junction box covers will be marked to indicate that they are a part of the BAS system.
4. All I/O field devices (except space sensors) that are not mounted within FIP's shall be identified with nameplates.
5. All I/O field devices inside FIP's shall be labeled.

E. Control System Switch-Over

1. Demolition of the existing control system will occur after the new temperature control system is in place including new sensors and new field interface devices.
2. Switch over from the existing control system to the new system will be fully coordinated with the Owner. A representative of the Owner will be on site during switch over.
3. The Contractor shall minimize control system downtime during switch over. Sufficient installation mechanics will be on site so that the entire switch over can be accomplished in a reasonable time frame.

F. Location

1. The location of sensors is per Mechanical and Architectural Drawings.
2. Outdoor air sensors will be mounted on the north building face directly in the outside air. Install these sensors such that the effects of heat radiated from the building or sunlight is minimized.
3. Field enclosures shall be located immediately adjacent to the controller panel(s) to which it is being interfaced.

3.5 SOFTWARE INSTALLATION

A. General: The Contractor shall provide all labor necessary to install, initialize, start-up and debug all system software as described in this section. This includes any operating system software or other third party software necessary for successful operation of the system.

B. Database Configuration: The Contractor will provide all labor to configure those portions of the database that are required by the points list and sequence of operation.

C. Color Graphic Slides: Unless otherwise directed by the Owner, the Contractor will provide color graphic displays as depicted in the Mechanical Drawings for each system and floor plan. For each system or floor plan, the display shall contain the associated points identified in the point list and allow for set point changes as required by the Owner.

D. Reports - The Contractor will configure a minimum of 6 reports for the Owner as listed below:

1. Central Plant Status Report
2. Air Handler Status Report
3. Energy Consumption Report
4. Space Temperature Report
5. Specialty Equipment Status Report

E. Documentation - As-Built software documentation will include the following:

1. Descriptive point lists
2. Application program listing
3. Application programs with comments
4. Printouts of all reports
5. Alarm list
6. Printouts of all graphics

3.6 COMMISSIONING AND SYSTEM STARTUP

A. Point-to-Point Checkout: Each I/O device (both field mounted as well as those located in FIP's) shall be inspected and verified for proper installation and functionality. A checkout sheet itemizing each device shall be filled out, dated and approved by the Project Manager for submission to the Owner or Owner's representative.

B. Controller and Workstation Checkout: A field checkout of all controllers and miscellaneous equipment shall be conducted to verify proper operation of both hardware and software. A checkout sheet itemizing each device and a description of the associated tests shall be prepared and submitted to the Owner or Owner's representative by the completion of the project.

C. System Acceptance Testing

1. All application software will be verified and compared against the sequences of operation. Control loops will be exercised by inducing a setpoint shift of at least 10% and observing whether the system successfully returns the process variable to setpoint. Record all test results and attach to the Test Results Sheet.

2. Test each alarm in the system and validate that the system generates the appropriate alarm message, that the message appears at all prescribed destinations (workstations or printers), and that any other related actions occur as defined (i.e. graphic panels are invoked, reports are generated, etc.). Submit a Test Results Sheet to the Owner.

3. Perform an operational test of each unique graphic display and report to verify that the item exists, that the appearance and content are correct, and that any special features work as intended. Submit a Test Results Sheet to the Owner.

4. Perform an operational test of each third party interface that has been included as part of the automation system. Verify that all points are properly polled, that alarms have been configured, and that any associated graphics and reports have been completed. If the interface involves a file transfer over Ethernet, test any logic that controls the transmission of the file, and verify the content of the specified information.

3.7 SEQUENCES OF OPERATION

A. Chiller with Associated Pumps and Appurtenances

1. Point List

a. CHW Supply Temperature
b. CHW Return Temperature
c. Outside Air Temperature
d. Chiller Start/Stop (4)
e. Chiller Isolation Valve (8)
f. Chiller Water Primary Pump Start/Stop (2)
g. Chilled Water Primary Pump Status (2)
h. Chilled Water Differential Pressure

i. Chiller Capacity (4)
j. Chiller Alarm (4)
k. Chiller KW (4)
l. Flow through Chiller (4)
m. Chiller Status (4)
n. Chane over value for Dual Temperature System

2. Sequence of Operation

a. This system will consist of four outdoor air-cooled scroll chillers (one future) with two primary chilled water pumps. The pumps shall operate in parallel with VFD control.

b. When the building is in the occupied mode of operation and the outside air is above 58 degrees F. (adjustable), the chilled water system will be activated in the following order.

c. First, the lead chiller's chilled water valve will open, when this valve end switch proves that the valve is open the lead primary chilled water pump will start. After a 30 second time delay, if flow is proven by the chilled water flow switch, then the lead chiller will start. If one chiller is not capable of maintaining the desired chilled water temperature, then another chiller will be started in the following order.

d. First, the lag primary chilled water will be started, and then the lag chiller's chilled water valve will open. When this valve's end switch proves that the valve is open, then the lag chiller will be started if its flow switch proves flow.

e. The lag secondary chilled water pump can then be started if the differential pressure on the secondary system is below setpoint. At no time will the lag primary pump operate without two primary chilled water pumps operating.

f. When the demand for chilled water is reduced, or the system is switched to unoccupied the pumps and chillers will be shut down in reverse order. During chiller shutdown mode the chiller will be shut down first, then after a 90 second time delay the primary chilled water pumps will sequence off.

g. If one or more Chillers need to be isolated from the system, the automatic shut-off valves will be activated on the inlet and outlet of each module to disconnect it from the system.

h. Chilled Water Differential Controller
   i. A differential pressure transmitter will modulate the secondary chilled water pump VFD to maintain desired secondary chilled water differential pressure.
   ii. If the lead secondary pump is at full speed and the chilled water differential is below setpoint for more than 5 minutes, then the lag secondary chilled water pump will be sequenced on.
   iii. A software lead/lag switch will once weekly switch the primary pumps, and chillers (only when the system is off and in unoccupied mode).

3.8 CONTROL DIAGRAMS

A. Complete new control diagrams showing type of apparatus, cycles of operation and details of all equipment must be submitted for checking and be approved before installation is started.

B. Submit three (3) preliminary copies of the control diagrams, sequence descriptions, and equipment shop drawings for checking and submit six (6) copies, complete for final approval.

C. At the completion of installation, control manufacturer shall furnish non-fading original; plastic laminated copies of all control diagrams as they apply to the particular instruments thereon. One complete set of non-fading plastic laminated diagrams shall be mounted on wall as directed.

3.9 CERTIFICATION

A. After completion of installation and after equipment has been placed on operation, the temperature control manufacturer shall submit in writing, a complete and detailed report and certification that the entire installation is operating exactly as specified and shall be guaranteed for one year. Report shall state temperature and throttling range readings and settings of all control instruments. Submit to the Engineer preliminary for checking and approval.

3.10 INSTALLATION

A. All work under the automatic temperature control Sub-Contract shall be done by competent skilled mechanics regularly in the employ of the temperature control manufacturer.

B. Bidder must be a control manufacturer currently involved in the production of commercial pneumatic/electric temperature controls. Franchises and associations are not considered control manufacturers.

3.11 TRAINING

A. The Contractor shall supply personnel to train key customer personnel in the operation and maintenance of the installed system. The training program shall be designed to provide a comprehensive understanding and basic level of competence with the system. It shall be sufficiently detailed to allow customer personnel to operate the system independent of any outside assistance. On-line context sensitive HELP screens shall be incorporated into the system to further facilitate training and operation.

B. The training plan shall include detailed session outlines and related reference materials. The customer personnel shall be able to utilize these materials in the subsequent training of their co-workers.

1. Training time shall not be less than a total of 40 hours, and shall consist of:

a. 16 hours during normal day shift periods for system operators. Specific schedules shall be established at the convenience of the customer.

b. 24 hours of system training shall be provided to customer supervisory personnel so that they are familiar with system operation.

c. The specified training schedule shall be coordinated with the customer and will follow the training outline submitted by the Contractor as part of the submittal process.

d. Provide an as built Video training tape, showing and explaining all animated graphics in detail, all controllers and equipment the FMS operates (Four (4) Copies shall be supplied).

e. If further training is needed, the Contractor shall provide another 40 hours at no extra cost.

2. All training sessions shall be scheduled by the Construction Manager. The Contractor shall provide sign-in sheets and distribute minutes of each session prior to the subsequent session. This documentation shall be included in the Operation and Maintenance manuals.

END OF SECTION 230460

SECTION 230470 - TESTING, START-UP AND ADJUSTMENTS

PART 1 - GENERAL

Applicable Provisions of the Conditions of the Contract and Division 1 General Requirements govern work in this section.

1.1 TESTING, START-UP AND ADJUSTMENTS

A. Furnish all materials, supplies, labor and power required for testing. Make preliminary tests and prove work satisfactory. Notify Architect and all authorities having jurisdiction in ample time to be present for final testing of all piping. Test before insulating or concealing any piping. Repair defects disclosed by tests, or if required by Architect, replace defective work with new work without additional cost to Owner. Make tests in stages if so ordered by Architect to facilitate work of others. Use of wicking in tightening leaking joints not permitted.

B. HVAC Contractor is responsible for work of other trades disturbed or damaged by tests and/or repair and replacement of his work, and shall cause work so disturbed or damaged to be restored to its original condition at his own expense.

C. Unless otherwise specified, all piping systems shall be hydrostatically tested to 150 p.s.i.g. Tests shall be of four (4) hour duration during which time piping shall show no leaks and during time no sealing of leaks will be permitted.

D. HVAC Contractor shall balance out system and submit test reports showing operating data to include the following:

1. C.F.M. of all air handling equipment.
2. C.F.M. at each air outlet.
3. G.P.M. for equipment.
4. R.P.M. for each fan and fan motor.
5. Motor power consumption.
6. Air temperature readings before and after coils.
7. Water temperature readings in and out of coils and through equipment.
8. Pressure gauge readings before and out of all pertinent equipment.

E. If the performance of the systems does not conform to the design parameters the Contractor shall return to the site until the systems perform as designed.

F. HVAC Contractor shall furnish services of qualified personnel, thoroughly familiar with job, to operate and make all adjustments so that system and control equipment shall operate as intended. This shall include adjustment/replacement of sheaves/impellers to achieve design performance. Adjustments shall be made including balancing of water and air systems in cooperation with qualified representatives of mechanical equipment manufacturers and temperature control manufacturer. This shall include any required adjustment/replacement of sheaves, belts, impellers, etc. to achieve design performance. Architect/Engineer is to be notified when this balancing is to be performed.

G. When all work is in an acceptable operating condition, furnish operating and maintenance manuals as specified in General Requirements.

H. All HVAC equipment shall be carefully designed, constructed and installed so as to prevent any objectionable noise or vibration reaching any part of the building outside of the mechanical equipment room. Care shall also be taken to prevent transmission of noise or odor through ductwork into other spaces.

I. Contractor shall include in his Bid, adjustment of air quantity below scheduled C.F.M. for air systems deemed “noisy” by Owner subsequent to initial balancing.

J. The Contractor shall be required to rectify of replace at his own expense, any equipment not complying with the foregoing requirements.

K. Final inspection and approval shall be made only after proper completion of all of above requirements.

END OF SECTION 230470

SECTION 230480 - GENERAL LABELING, VALVE CHARTS AND PIPING IDENTIFICATION

PART 1 - GENERAL

Applicable Provisions of the Conditions of the Contract and Division 1 General Requirements govern work in this section. Submit shop drawings for checking and approval.

1.1 GENERAL LABELING AND VALVE CHARTS

A. This Contractor shall have appropriate descriptive labels, identification tags and nameplates of equipment, valves, etc. furnished and installed under this Contract and shall be properly placed and permanently secured to (or adjacent to) the item being installed. All such labels, identifications, tags, nameplates, etc. shall be selected by the Architect/Engineer.

B. In general, labels shall be the lamacoid type of sufficient size to permit easy identification, black coated, white edged, with letters 3/16" high. Major equipment, apparatus, control panels, etc. shall have 8" x 4" lamacoid plates with lettering of appropriate size.

C. Provide tags for all valves, automatic and manual dampers. Tags shall be Type #2020 anodized aluminum of #1420 lamacoid engraved. Tags may not necessarily be standard. Fasten tags to valve or damper with brass chain.

D. All nameplates, labels, identifications and tags shall be as manufactured by the Seton Name Plate Co., of New Haven, CT or approved equal. Submit complete schedules, listings and descriptive data together with samples for checking and approval before purchasing. Labeling shall include the "number" of the equipment, valve, dampers, switch, etc. and service of the valve.

E. Mount on laminated plastic boards with transparent surface all valves, wiring diagrams, control diagrams, instruction charts, permits, etc. Valve chart shall be non-fading with original copies laminated.

1.2 IDENTIFICATION OF PIPING

A. This Contractor shall provide on all piping, semi-rigid, wrap around plastic identification markers equal to Seton Snap-Around and/or Seton Strap-On pipe markers.

B. Each marker background is to be appropriately color coded with a clearly printed legend to identify the contents of the pipe. Directions of flow arrows are to be included on each marker.

C. Identification of all piping shall be adjacent to each valve, at each pipe passage through wall, floor and ceiling construction and at each branch and riser take-off.

D. Identification shall be on all horizontal pipe runs, marked every 15 ft. as well as at each inlet outlet of equipment.

END OF SECTION 230480

SECTION 230490 - GUARANTEE

PART 1 - GENERAL

Applicable Provisions of the Conditions of the Contract and Division 1 General Requirements govern work in this section.

1.1 GUARANTEE

A. The Contractor shall remove, replace and/or repair at his own expense and at the convenience of the Owner, any defects in workmanship, materials, ratings, capacities and/or characteristics occurring in the work within one (1) year or within such longer period as may be provided in the Drawings and/or Section of the Specifications, which guarantee period shall commence with the final acceptance of the entire Contract in accordance with the guarantee provisions stated in the General Conditions, and the Contractor shall pay for all damage to the system resulting from defects in the work and all expenses necessary to remove, replace, and/or repair any other work which may be damaged in removing, replacing and/or repairing the work.

END OF SECTION 230490

SECTION 260100 - GENERAL CONDITIONS

PART 1 - GENERAL

Applicable provisions of the conditions of the Contract and Division 1 General Requirements govern the work in this section.

1.1 DESCRIPTION OF WORK

A. It is the intention of the Specification and Drawings to call for finish work, tested and ready for operation.

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

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

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

E. Small scale drilling through walls and floors which may contain asbestos shall be performed by a person with a “restricted asbestos handler allied trades certificate” and shall have a copy of it in his possession at all times while working of the project.

1.2 DRAWINGS

A. Drawings are diagrammatic and indicate the general arrangement of the system and work included in the Contract. (Do not scale the drawings). Consult the Architectural Drawings and details for exact location of fixtures and equipment; where same are not definitely located, obtain this information from the general construction supervisor.

B. Work under each section shall closely follow Drawings in layout of work; check Drawings of other Divisions to verify spaces in which work will be installed. Maintain maximum headroom; do not begin work until unsatisfactory conditions are corrected.

C. Make reasonable modifications in the layout as needed to prevent conflict with work of other Sections of the Specifications or for proper execution of the work.

D. It shall be understood that the right is reserved by the Architect/Engineer to change the location of equipment and apparatus to a reasonable extent as building conditions may dictate, prior to their installation without extra cost to the Owner.

1.3 SURVEYS AND MEASUREMENTS

A. Base all measurements, both horizontal and vertical, from established benchmarks. All work shall agree with these established lines and levels. Verify all measurements at site and check the correctness of same as related to the work.

B. Before proceeding with the work resolve discrepancies between actual measurements and those indicated, which prevent following good practice or intent of the Drawings or Specifications.

1.4 CODES AND STANDARDS – Coordinate with Division 1

A. The Codes and Standards listed below apply to all Electrical work codes or standards that are mentioned in these Specifications; the latest edition or revision shall be followed:

1. NEMA - Standards
2. ANSI CI - National Electrical Code (NFPA 70)
3. ANSI C50.13 - Rotating Electrical Machinery
4. NEMA MG2 - Construction and guide for selection, installation and use of electric motors.
5. NEMA MG1 - Motors and Generators

B. The following State and Local Codes shall apply: New York State Uniform Fire Prevention and Building Code, and Local Building Codes.

C. The following abbreviations are used within this Division of the Specifications:

1. IES - Illuminating Engineering Society.
2. NEC - National Electrical Code
3. ANSI - American National Standards Institute
4. ASTM - American Society for testing and materials
5. EPA - Environmental Protection Agency
6. IEEE - Institute of Electrical and Electronic Engineers
7. NEMA - National Electrical Manufacturers Association
8. NFPA - National Fire Protection Association.
9. OSHA - Occupational Safety and Health Administration
10. UL - Underwriter's Laboratories

1.5 PERMITS AND FEES

A. Give all necessary notices, obtain all permits and pay all Government and State sales taxes and fees where applicable, and other costs, including utility connections or extensions in connection with work of this Division. File all necessary plans, prepare all documents and obtain all necessary approvals of all Governmental and State departments having jurisdiction; obtain all necessary certificates of inspections for his work and deliver a copy to the Architect before request for acceptance and final payment for the work. Pay fees for utility construction/connections.

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

C. All materials furnished and all work installed shall comply with the rules and recommendations of the National Fire Protection Association, with the requirements of the local utility companies, with the recommendations of fire insurance rating organization having jurisdiction and with the requirements of all governmental departments having jurisdiction.

D. All materials and equipment for the electrical portion of the mechanical systems shall bear the approval label of or shall be listed by the Underwriter's Laboratories, Inc.

1.6 TEMPORARY LIGHT AND POWER – See Division 1

A. The Contractor shall furnish, install, maintain and, upon direction to do so, remove system of temporary lighting and power for the use of all construction trades.

B. The Electrical Contractor shall provide adequate electrical service for the needs of all Contracting Trades.

C. Wiring shall be provided for temporary use during building construction, including grounding and fused main cut-off switches. Temporary electric lines with branch switches shall be provided for lighting and for taps for electric tools, pumps and other temporary equipment; all connected to a main line looped through floor spaces and up stair wells or shafts. All power outlets shall be grounded to an equipment ground wire in an approved manner. Electric lines shall be extended to power tools, which cannot be located within reach of extension cords.

D. Light bulbs shall be provided in sufficient quantity to light the building for safety purposes. Extension cords shall be provided as may be essential to the proper execution of the work. Temporary lighting shall be provided for all stairs and other locations where needed for safety or the proper execution of the work.

E. The Electrical Contractor shall maintain temporary lighting and power systems in good working condition, including the relocation and reinstallation when required to avoid interference with the progress of construction.

F. Provide ground-fault personnel ampere protection for all single phase, 15 and 20 ampere receptacles. All receptacles and portable cord connectors shall have NEMA standard locking type configurations.

G. The Electrical Contractor shall turn lights on and off at the beginning and end of each working day of any trade unless otherwise directed. He shall arrange for all temporary light and power for all trades which do not have holidays (days off) similar to the electrical trade. The Electrical Contractor shall patch and repair all openings left damaged by the installation and removal of the temporary light and power.

1.7 MANUFACTURER'S IDENTIFICATION

A. Manufacturer's nameplate, name or trademark and address shall be attached permanently to all equipment and materials furnished under this Division. The nameplate of a contractor or distributor may not be used.

1.8 SHOP DRAWINGS – See Division 1

A. Submit for approval detailed shop drawings of all equipment and materials in accordance with working procedures.

B. Furnish all necessary templates and patterns for installation work and for the purpose of making adjoining work conform; furnish setting plans and shop details to other trades as necessary.

C. Submit shop drawings for the following:

1. Overcurrent protective devices.
2. Panelboards.

1.9 MATERIALS AND WORKMANSHIP

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

B. Furnish the services of an experienced Superintendent who shall be constantly in charge of the installation of the work, together with all skilled workmen, helpers, and labor to unload, transfer, erect, connect up, adjust, start, operate and test each system.

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

1.10 PROTECTION

A. Work under each Section shall include protecting the work and materials of all other Sections from damage from work or workmen, and shall include making good all damage thus caused. Be responsible for work and equipment until finally inspected, tested, and accepted; protect work against theft, injury or damage; and carefully store material and equipment received on site, which is not immediately installed. Close open ends of work with temporary covers or plugs during construction to prevent entry of obstructing or other foreign material.

B. Work under each section includes receiving, unloading, uncrating, storing, protecting, setting in place and connecting up completely of any equipment supplied under each section. Work under each section shall also include exercising special care in handling and protecting equipment and fixtures, and shall include the cost of replacing any of the above equipment and fixtures which are missing or damaged by reason of mishandling of failure to protect on the part of the Contractor.

1.11 BASES AND SUPPORTS

A. Unless specifically noted otherwise, provide all necessary supports, pads, bases, and piers required for all equipment under this Division. Provide all temporary bases and supports as required.

B. All equipment, unless shown otherwise, shall be securely attached to the building structure. Attachments shall be of a strong and durable nature; any attachments that are, insufficient, shall be replaced as directed by the Architect.

1.12 SLEEVES, INSERTS AND ANCHOR BOLTS

A. All conduits passing through floors, walls or partitions shall be provided with sleeves having an internal diameter one inch larger than the outside diameter of the conduit, or insulation enclosing the conduit.

B. Furnish all sleeves, inserts, and anchor bolts necessary to be installed under other sections of the Specifications to accommodate work of this section.

C. Sleeves through outside walls shall be cast iron sleeves with intermediate integral flange. Sleeves shall be set with ends flush with each face of wall. The remaining space shall be packed with oakum to within 2 inches of each face of the wall. The remaining shall be packed and made watertight with a waterproof compound.

D. Sleeves through concrete floors or interior masonry walls shall be schedule 40 black steel pipe, set flush with finished walls or ceiling surfaces but extending 2 inches above finished floors.

E. Sleeves through interior partitions shall be 22 gauge galvanized sheet steel, set flush with finished surfaces or partitions.

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

G. Penetrations through fire-rated walls, ceilings and floors in which cables, conduits pass, shall be sealed by a UL approved fire stop fitting classified for an hourly rating equal to the fire rating of the floor, wall or ceiling shall be Gedney Fire Seal Type CFSF of CAPS.

1.13 PAINTING – See Division 1; all work required shall be performed by this Contractor.

A. All finish painting in finished areas shall be performed by others.

B. All materials shipped to the job site under the Division, such as panels and plates, shall have a prime coat and standard manufacturer's finish unless otherwise specified.

C. Inaccessible conduits, hangers, supports and anchors and ducts shall be coated prior to installing.

D. All components of the fire alarm system raceway shall be painted red. This includes but is not limited to conduit, junction boxes, pull boxes.

1.14 CUTTING AND PATCHING – See Division 1

A. All cutting and patching required for the work of this Division shall be done by this Division.

B. Work under this Division shall include furnishing, locating and setting inserts and/or sleeves. Do all drilling and cutting necessary for the installation.

C. All holes cut through concrete slabs and structural steel shall be punched or drilled from the underside. No structural member shall be cut without the written acceptance of the Architect and all such cutting shall be done in a manner directed by him.

D. Refer to Division 1 for additional requirements.

1.15 SCAFFOLDING, RIGGING AND HOISTING – Coordinate with Division 1

A. Furnish all scaffolding, rigging, hoisting, and services necessary for erection and delivery into the premises of any equipment and apparatus furnished under this Division. Remove same from premises when no longer needed.

1.16 EXCAVATING AND BACKFILLING

A. All excavation and backfilling for the work of this Division shall be performed by Division 2.

1.17 WATERPROOFING

A. Where any work penetrates waterproofing, including waterproof concrete and floors in wet areas. Submit proposed method of installation for review by the Architect before beginning work. Furnish all necessary sleeves, caulking and flashing necessary to make opening absolutely watertight.

1.18 ACCESSIBILITY AND ACCESS PANELS

A. Be responsible for the sufficiency of the size of shafts and chases, the adequate thickness of partitions, and the adequate clearance in double partitions and hung ceilings for the proper installation of the work of this Division.

B. Locate all equipment, which must be serviced, operated or maintained in fully accessible positions. Minor deviations from Drawings may be allowed for better accessibility with approval of the Architect.

1.19 SHUTDOWNS – See Division 1

A. When installation of a new system necessitates the temporary shutdown of an existing utility operating system the connection of the new system shall be performed at such time as designated by and in consultation with the Utility Company. Work required after normal business hours shall be done so at no additional cost to the Owner.

1.20 CLEANING - Coordinate with Division 1

A. Thoroughly clean all equipment of all foreign substances inside and out before being placed in operation.

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

C. Upon completion of work remove from the premises all rubbish, debris, and excess materials. Any oil or grease stains on floor areas caused by work of this Division shall be removed and floor areas left clean.

1.21 RECORD DRAWINGS – Work shall be governed by requirements set forth in Division 1

A. Maintain at the job site a record set of Electrical Drawings on which any changes in location of equipment, panels, devices, and major conduits shall be recorded. Indicate dimensions of all items installed underground or in concrete.

1.22 OPERATING INSTRUCTIONS – Coordinate with requirements set forth in Division 1

A. Upon completion of all work and all tests, the Contractor shall furnish the necessary skilled labor and helpers for operating his system and equipment for a period specified under each applicable Section of this Division. During this period, he shall instruct the Owner or his representative fully in the operation, adjustment and maintenance of all equipment furnished. Give at least 7 days notice to the Owner in advance of this period.

B. The manufacturer shall attest in writing that his equipment has been properly installed prior to start. The following is some of the equipment necessary for this inspection: fire alarm system. These letters will be bound into the operating and maintenance books.

1.23 ADJUSTING AND TESTING

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

B. This particular work shall include the services of a factory engineer to inspect the installation and assist in the initial startup and adjustment to the equipment. The period of these services shall be for such time as necessary to secure proper installation and adjustments. After the equipment is placed in permanent operation, there shall be furnished the service of said engineer for the purpose of supervising the initial operation of the equipment and to instruct the personnel responsible for operation and maintenance of the equipment.

C. At the completion of the job when all panels, devices, etc. are at full working load the Contractor shall provide infrared scan thermographic inspection test of all connection points, terminals, etc. of wires #8 AWG and larger to detect "hot-spots" in the electrical current flow. Correct all hot-spots.

1.24 UNDERWRITER'S LABEL

A. All electrical equipment and materials shall be new and shall comply with the standards of and shall bear the label of the Underwriter's Laboratories.

1.25 ELECTRICAL SAFETY INSPECTION

A. Electrical Contractor shall arrange for an Electrical Safety Inspection to be performed by the Local Inspection Agency (i.e.: New York Electrical Inspection Services, Atlantic Inland, Middle Department Inspection Agency). A Certificate of Compliance “Underwriter’s Certificate” shall be issued to the Owner. All costs and coordination required shall be included in this Contractors Base Bid.

1.26 REMOVALS – Coordinate with Division 1 and Division 2

A. The scope of removals shown on the Drawings are diagrammatic only and indicate the intent of the work to be performed and not the complete scope of demolition and/or removal work. It shall be the responsibility of this Contractor to remove any electrical devices even if not specifically indicated to be removed on these Drawings in order to accommodate new work.

B. All power conductors, control wiring and conduit associated with mechanical equipment such as fans, pumps, etc. designated for removal on the HVAC Drawings shall be removed clear back to the source of power and disconnected. All motor starters, disconnect switches, control devices, etc. shall be removed. Refer to HVAC Drawings for extent of HVAC removals.

C. Any device removed shall include (but shall not be limited to) the removal of all associated wiring, conduit, boxes, and auxiliary devices back to the previous device on the circuit, or back to the panelboard or origin of the circuit or any other items that are not incorporated in new layout, until such removal is complete. If the removal of any device interrupts service of any other device that is to remain, the Contractor shall provide all materials and labor to ensure continuity of service to those devices to remain.

D. Junction boxes, pullboxes, wireways, conduits, or any other devices required to reconnect circuitry shall be installed concealed within the ceilings, partitions and/or walls, floors, no surface or exposed circuiting shall be permitted, unless specifically indicated.

E. The Electrical Contractor shall patch all openings in walls, ceilings or roof that are left open as a result of removals. Refer to cutting and patching section.

F. Any electrical device removed including but not limited to disconnect switches, panelboards, etc. shall be cleaned, protected and turned over to the Owner or disposed of as directed by Owner.

END OF SECTION 260100

SECTION 260125 - SCOPE OF WORK

PART 1 - GENERAL

Applicable Provisions of the Conditions of the Contract and Division 1 General Requirements govern work in this section.

1.1 SCOPE OF WORK

A. The work under this section includes all labor, materials, equipment, tools, transportation and the performance of all work necessary and required for furnishing and installing all Electrical work shown on the Contract Documents, as specified herein and as otherwise required by job conditions or reasonably implied, including, but not necessarily limited to the following:

1. Modifications to existing electrical distribution system as indicated on the Drawings.

2. Service switchboards, distribution panelboard, circuit breaker panelboards, feeder, conduit, cables and branch circuit wiring with all connections complete.

3. Conduit, conduit fittings, junction and pull boxes and all appurtenances necessary for the raceway systems including necessary supports and fasteners.

4. Electrical conductors, connectors, fittings and connection lugs.

5. Branch circuit devices, outlet boxes, pull boxes, motor disconnect switches, etc.

6. Power wiring to HVAC and Plumbing equipment including disconnect switches as shown and/or required by NEC.

7. Core drilled holes for conduit passing through walls, ceilings and floors.

8. All necessary cutting, patching and core drilling incidental to the electrical work.

9. Temporary light and power.

10. Licenses, permits, inspection and approvals.

11. Grounding as required as per NEC.

12. Sleeves for conduit and watertight caulking between conduit and sleeve.

13. Testing.

14. Cutting, patching and drilling.

15. Excavation and backfill by others. Minimum 4" Sand bedding on all sides by Electrical Contractor.

B. Coordination Drawings (if applicable): Attention is directed to Division 1 for coordination drawing requirements for this project. These drawings are critical to the proper execution of the work and failure to honor these requirements may become the basis for denial of any and all claims for either or both “time” and “money”.

1.2 WORK NOT INCLUDED

A. The following related items will be done by others:

1. Furnishing motors and controllers.

2. Concrete work.

3. Excavation and backfill.

END OF SECTION 260125

SECTION 260150 - APPROVED MANUFACTURERS

PART 1 - GENERAL

Applicable provisions of the Conditions of the Contract and Division 1 General Requirements govern work in this section.

1.1 APPROVED MANUFACTURERS

A. The following list of manufacturers constitutes an approved list:

1.	Panelboards	Siemens, Square D, GE, Precision Switchgear
2.	Disconnect Switches	Siemens, Square D, GE
3.	Conduit (steel)	Wheatland, Allied, Republic Conduit
4.	Conduit Fittings (steel)	Appleton, Crouse-Hind, O-Z, T&B, M&W
5.	Wire and Cable	General, South Wire, Rome, Cerro
6.	Splicing Connectors	3M, O-Z, Thomas & Betts
7.	Outlet Boxes	Appleton, National, Steel City, Raco
8.	Wiring Devices	Arrow-Hart, Hubbell, P & S
9.	Fuses	Bussman, Ferraz-Shawmut, Littlefuse

B. All materials and appliances shall have listing of Underwriters Laboratories, Inc. and be so labeled, or shall conform to their requirements, in which case certified statements to that effect shall be furnished by the manufacturer with a copy of an examination report by a recognized independent testing laboratory acceptable to the Architect and his Engineer. Use new materials and appliances throughout.

C. Where several types or makes of materials are specified, the Contractor has the option of using any of these, but after a type or make has been selected and has received the approval of the Architect, it shall be used throughout.

D. The Contractor shall provide all structural supports for the proper attachment of equipment supplied by him and also for all equipment supplied to him under other sections of the Specifications for mounting and connections.

E. Secure all equipment to the building structure independently. Do not secure to work of other trades such as ceiling lath, piping racks, etc., unless specified or noted otherwise.

F. Wall mounted equipment shall be directly secured to wall by means of steel bolts. Maintain at least 1/4" air space between equipment and supporting wall. Pre-fabricated steel channels providing a high degree of mounting flexibility, such as those manufactured by Kindorf and Unistrut, shall be used for mounting arrays of equipment.

G. All fastening, supports, hangers, anchors, etc., shall be of a type made for the specific purpose. On masonry walls, metallic expansion shield and machine screws shall be used. Screws with wooden plugs or anchors will not be acceptable on any part of the work.

END OF SECTION 260150

SECTION 260200 - CONDUIT

PART 1 - GENERAL

Applicable provisions of the conditions of the Contract and Division 1 General Requirements govern the work in this section. Submit shop drawings for checking and approval.

1.1 WORK INCLUDED

A. The work under this section shall include the furnishing of all material, labor, tools and services necessary to install rigid metal conduit, electrical metallic tubing and liquid tight flexible metal conduit, including all fittings to complete all work shown on the Drawings or specified herein.

1.2 RELATED WORK

A. Cutting and patching.

B. Trenching: Excavation and backfill for conduit and utility on site.

C. Sheet metal flashing and trim.

1.3 REFERENCE FOR METAL RACEWAY

A. UL 5 - Surface Metal Raceways and Fittings.

B. UL 870 - Wireways, Auxiliary Gutters, and Associated Fittings.

PART 2 - PRODUCTS

2.1 RIGID STEEL CONDUIT

A. Industry standard heavy wall conduit.

B. Minimum 3/4" trade size.

C. Threaded.

D. Hot dipped galvanized finish by means of plating after cutting of threads.

2.2 INTERMEDIATE METAL CONDUIT

A. Industry standard steel conduit.

B. Minimum 3/4" trade size.

C. Threaded.

D. Hot dipped galvanized finish by means of plating after cutting of threads.

2.3 ELECTRICAL METALLIC TUBING

A. Industry standard thin wall conduit of galvanized steel only.

B. Minimum 3/4" trade size.

C. Maximum 4" trade size.

2.4 FLEXIBLE METAL CONDUIT

A. Galvanized steel tape formed into an industry standard interlocking coil.

B. Minimum 3/4" trade size except for connection of lighting fixtures.

C. Grounding type.

D. Separate ground conductor.

E. Use for short connections to motor terminal box, other vibrating equipment using a minimum length of 18" with 50% slack and a maximum of 6'.

F. From outlet box to recessed lighting fixtures with a maximum length of 6'.

2.5 WIREWAYS

A. Lay-in type, UL listed as wireway or auxiliary gutter.

B. Wireway shall be of code gauge steel construction (UL standard for Wireway Auxiliary Gutters and Associated Fittings) with removable cover. Tamperproof screws shall be provided for sealing covers to prevent access by unauthorized personnel. Wireway shall be provided with knockouts.

C. Connector and covers shall be attached so that removal of connectors is not necessary to utilize the lay-in feature.

D. Finish: All sheet metal parts shall be provided with a rust inhibiting phosphating coating and baked enamel finish. All hardware shall be plated to prevent corrosion. All screws extending into the wireway shall be protected by spring nuts or otherwise guarded to prevent wire insulation damage.

2.6 CONDUIT SUPPORTS

A. Conduit clamps, straps and supports: Steel or malleable iron.

2.7 CONDUIT FITTINGS

A. Use compression fittings for all EMT in exposed areas. Utilize set screw fittings only above hung ceilings and concealed areas.

2.8 SURFACE METAL RACEWAY

A. Metal raceway shall be of a two-piece design with a base and snap-on cover.

B. Raceway and all components shall be listed by Underwriters Laboratories

C. Single Channel: Steel, zinc plated, off-white finish suitable for repainting. Two piece design with metal base and snap-on cover. Wire Mold V700, Hubbell Inc. 750 Series, or Panduit PMR5/PMR7

D. Dual Channel: Steel, galvanized, off-white finish but suitable for repainting. Two-piece design with metal base and snap-on cover, minimum 0.04" thick base and cover. Base shall be divided by a removable barrier section. Provide duplex receptacles mounted in top cell and communication outlets in the bottom cell. Coordinate communications jack requirements with owner's IT personnel. Wiremold V4000, Wiremold DS4000 Series, Hubbell Inc. 4000 Series or Panduit PMR40.

PART 3 - EXECUTION

3.1 CONDUIT SIZING, ARRANGEMENT AND SUPPORT

A. Minimum size - 3/4". Provide grounding bushings on all conduits 1-1/4" and larger.

B. Arrange conduit to maintain headroom and present a neat appearance.

C. Route exposed conduit and conduit above accessible ceilings parallel and perpendicular to walls and adjacent piping.

D. Draw up couplings and fittings full and tight. Protect threads cut in field from corrosion. Paint newly threaded joints of steel conduit with T & B "Kopershield" compound before installation. Running threads prohibited; use three-piece unions or split couplings instead. Use only compression fittings for all EMT in areas where it will be exposed in finished and unfinished areas. Provide set screw fittings only when installed above hung ceilings.

E. Maintain minimum 6-inch clearance between conduit and piping. Maintain 12-inch clearance between conduit and heat sources such as flues; steam pipes and heating appliances.

F. Arrange conduit supports to prevent distortion of alignment by wire pulling operations. Fasten conduit using galvanized straps, lay-in adjustable hangers, clevis hangers, or bolted split stamped galvanized hangers.

G. Group conduit in parallel runs where practical and use conduit rack constructed of steel channel with conduit straps or clamps. Provide space for 25 percent additional conduit.

H. Do not fasten conduit with wire or perforated pipe straps. Remove all wire used for temporary conduit support during construction, before conductors are pulled.

I. Exposed conduit on ceiling shall be parallel or perpendicular to wall and vice versa to ceiling when installed on wall. Secure conduit clamps and supports to masonry materials by toggle bolt, expansion bolt or steel insert. Spacing or conduit supports shall not exceed 7 feet.

3.2 CONDUIT INSTALLATION

A. Cut conduit square using a saw or pipe cutter, Deburr cut ends.

B. Bring conduit to the shoulder of fittings and couplings and fasten securely.

C. Use conduit hubs or sealing locknuts for fastening conduit to cast boxes and for fastening conduit to sheet metal boxes in damp or wet locations.

D. Install no more than the equivalent of three 90-degree bends between boxes.

E. Use conduit bodies to make sharp changes in direction, as around beams.

F. Use hydraulic one-shot conduit bender or factory elbows for bends in conduit larger than 2-inch size.

G. Avoid moisture traps where possible; where unavoidable, provide junction box with drain fitting at conduit low point.

H. Use suitable conduit caps to protect installed conduit against entrance of dirt and moisture.

I. Provide No. 12 AWG insulated conductor or suitable pull string in empty conduit, except sleeves and nipples.

J. Install expansion-deflection joints where conduit crosses building expansion or seismic joints.

K. Where conduit penetrates fire-rated walls and floors, provide pipe sleeves two sizes larger than conduit; Pack void around conduit with fire-stop fittings with UL listed fire rating equal to wall or floor ratings; Seal opening around conduit with UL listed foamed silicone elastomer compound.

L. Installation of conduit in slab shall comply with ACI 318.

M. Route conduit through roof openings for piping and duct work where possible; otherwise, route through roof with pitch pocket.

N. Maximum size conduit in slabs above grade: 1 inch. Do not route conduits to cross each other in slabs above grade. Conduits crossing each other may not be larger than 3/4 inch.

O. For Surface Metal Raceway

1. When installing surface metal raceway contractor shall provide boxes from the same manufacturer of the surface metal raceway.

2. Install separate grounding conductor. Grounding conductors for surface metal raceways.

3. Surface metallic raceways in close proximity of other trades, shall be arranged to allow for proper clearance for servicing and headroom. Surface metallic raceway shall be installed parallel to walls, floors and ceilings in a neat workmanlike manner.

3.3 CONDUIT INSTALLATION OF SCHEDULE

A. Underground installations: PVC minimum Schedule 40, unless otherwise noted on Drawings.

B. Installations in or under concrete slab: PVC minimum Schedule 40, unless otherwise noted on Drawings.

C. Exposed outdoor locations: Rigid galvanized steel conduit.

D. Wet interior locations: Rigid galvanized steel conduit.

E. Concealed dry interior locations and above accessible ceiling for receptacle and lighting branch wiring: Electrical metallic tubing up to first junction box and flexible metallic tubing (MC cable only) thereafter.

F. Concealed dry interior locations other than receptacle and lighting branch wiring: Electrical metallic tubing.

G. Concealed dry interior locations and above accessible ceiling for fire alarm runs: Fire alarm armored cable type MC with red stripe as manufactured by AFC series 1800.

H. Concealed and exposed dry interior location for feeder runs: Electric metallic tubing.

I. Exposed dry interior in unfinished locations other than Boiler Rooms: Electric metallic tubing.

J. Final connections to motors: Flexible metallic tubing (MC cable). Minimum of 10” to maximum of 6’ for connections to motors.

K. Existing exposed dry interior locations (finished spaces), for branch wiring and fire alarm wiring, one-piece steel raceway (similar to Wiremold V-500, V-700).

L. Final connections to motors: Flexible metallic tubing (MC cable). Minimum of 18” to maximum of 6’ for connections to motors.

M. All conduit installed in boiler room up to 10’-0” AFF and lower shall be rigid galvanized steel conduit. All conduit above 10’-0” shall be electric metallic tubing.

N. Final connections to equipment and/or motors in boiler room, outdoors and potentially wet indoor areas: liquid tight, flexible; minimum of 18” to maximum 6’-0” connections.

END OF SECTION 260200

SECTION 260250 - DUCT BANK

PART 1 - GENERAL

Applicable provisions of the conditions of the Contract and Division 1 General Requirements govern the work in this section. Submit shop drawings for checking and approval.

1.1 SECTION INCLUDES

A. PVC conduit.

B. Duct.

C. Manholes.

1.2 REFERENCES

A. ANSI C80.1 - Rigid Steel Conduit, Zinc-Coated.

B. ASTM A48 - Gray Iron Castings.

C. ASTM C857 - Minimum Structural Design Loading for Underground Precast Concrete Utility Structures.

D. ASTM C858 - Underground Precast Concrete Utility Structures.

E. ASTM C891 - Installation of Underground Precast Utility Structures.

F. ASTM C1037 - Inspection of Underground Precast Utility Structures.

G. IEEE C2 - National Electrical Safety Code.

H. NEMA FB 1 - Fittings, Cast Metal Boxes, and Conduit Bodies for Conduit and Cable Assemblies.

I. NEMA TC 2 - Electrical Plastic Tubing (EPT) and Conduit (EPC-40 and EPC-80).

J. NEMA TC 3 - PVC Fittings for Use with Rigid PVC Conduit and Tubing.

K. NEMA TC 6 - PVC and ABS Plastic Utilities Duct for Underground Installation.

L. NEMA TC 9 - Fittings for ABS and PVC Plastic Utilities Duct for Underground Installation.

M. NEMA TC 10 - PVC and ABS Plastic Communications Duct and Fittings for Underground Installation.

N. NEMA TC 14 - Filament-Wound Reinforced Thermosetting Resin Conduit and Fittings.

O. NFPA 70 - National Electrical Code.

P. UL 651A - Type EB and A PVC Conduit and HDPE Conduit.

1.3 QUALIFICATIONS

A. Manufacturer: Company specializing in manufacturing the Products specified in this section with minimum three (3) years documented experience, and with service facilities within 100 miles of Project.

1.4 REGULATORY REQUIREMENTS

A. Conform to requirements of NFPA 70.

B. Products: Listed and classified by Underwriters Laboratories, Inc.

1.5 FIELD MEASUREMENTS

A. Verify that field measurements are as indicated.

B. Verify routing and termination locations of duct bank prior to excavation for rough-in.

C. Verify locations of manholes prior to excavating for installation.

D. Duct bank routing is shown in approximate locations unless dimensions are indicated. Route as required to complete duct system.

E. Manhole locations are shown in approximate locations unless dimensions are indicated. Locate as required to complete ductbank system.

PART 2 - PRODUCTS

2.1 PVC CONDUIT

A. Manufacturers:

1. Carlon.

B. Rigid Plastic Conduit: NEMA TC 2, Schedule 40 PVC, with fittings and conduit bodies to NEMA TC 3.

C. Rigid Plastic Underground Conduit: UL 651A, Type A PVC High-density polyethylene, Schedule 40.

2.2 PRECAST CONCRETE MANHOLES

A. Manufacturers:

1. A.C. Miller or equal.

B. Description: Precast manhole designed in accordance with ASTM C858, comprising modular, interlocking sections complete with accessories.

C. Loading: ASTM C857, Class A-16.

D. Shape: Rectangular with truncated corners.

E. Nominal Inside Dimensions: 10 feet x 6 feet.

F. Corner Panel Dimensions: 3 feet wide.

G. Inside Depth: 6 feet.

H. Wall Thickness: 6 inches.

I. Base Section: Include 3 inches deep x 14 inches round sump with cast sleeve, and two 1 inch ground rod openings. Provide 4 inches diameter hole in bottom of manhole.

J. Top Section: Include 39 inches diameter grooved opening for frame and cover.

K. Riser Casting: 12 inches with manhole step cast into frame.

L. Frames and Covers: ASTM A48; Class 30B gray cast iron, 30 inches size, machine finished with flat bearing surfaces. Provide cover marked ELECTRIC OR TELEPHONE.

M. Duct Entry Provisions: Window knockouts.

N. Duct Entry Locations: As indicated.

O. Duct Entry Size: 6 inches.

P. Cable Pulling Irons: Use galvanized rod and hardware. Locate opposite each duct entry. Provide watertight seal.

Q. Cable Rack Inserts: Minimum load rating of 800 pounds. Locate on center.

R. Cable Rack Mounting Channel: 1-1/2 x 3/4 inch steel channel, 48 inch length. Provide cable rack arm mounting slots on 1-1/2 inch centers.

S. Cable Racks: Steel channel, 1-1/2 x 3/4 x 14 inches, with fastener to match mounting channel.

T. Cable Supports: Porcelain clamps and saddles.

U. Manhole Steps: Cast steps at 12 inches on center vertically.

V. Sump Covers: ASTM A48; Class 30B gray cast iron.

W. Source Quality Control: Inspect manholes in accordance with ASTM C1037.

2.3 ACCESSORIES

A. Underground Warning Tape: 4 inch wide plastic tape, detectable type, colored red with suitable warning legend describing buried electrical lines.

B. Install a 6" deep bed of 3/4" crushed stone under each manhole.

2.4 CAST-IN-PLACE MANHOLE ACCESSORIES

A. Sump Covers: ASTM A48; Class 30B gray cast iron.

PART 3 - EXECUTION

3.1 DUCT BANK INSTALLATION

A. Install duct to locate top of ductbank at depths as indicated on drawings.

B. Install duct with minimum slope of 4 inches per 100 feet. Slope duct away from building entrances.

C. Cut duct square using saw or pipe cutter; de-burr cut ends.

D. Insert duct to shoulder of fittings; fasten securely.

E. Join nonmetallic duct using adhesive as recommended by manufacturer.

F. Wipe nonmetallic duct dry and clean before joining. Apply full even coat of adhesive to entire area inserted in fitting. Allow joint to cure for 20 minutes, minimum.

G. Install no more than equivalent of three 90-degree bends between pull points.

H. Provide suitable fittings to accommodate expansion and deflection where required.

I. Terminate duct at manhole entries using end bell.

J. Stagger duct joints vertically in concrete encasement 3 inches minimum.

K. Use suitable separators and chairs installed not greater than 5 feet on centers.

L. Band ducts together before placing concrete.

M. Securely anchor duct to prevent movement during concrete placement.

N. Place 3000 p.s.i. concrete around PVC conduits. Use mineral pigment to color concrete red.

O. Provide minimum 3” concrete cover at bottom, top, and sides of ductbank.

P. Provide two (2) No. 4 steel reinforcing bars in top of bank under paved areas.

Q. Connect to manhole wall using dowels.

R. Provide 2 at pull rope in each empty duct except sleeves and nipples.

S. Swab duct. Use suitable caps to protect installed duct against entrance of dirt and moisture.

T. Backfill trenches with clean tamped soil.

U. Interface installation of underground warning tape with backfilling. Install tape 6 inches below finished surface.

3.2 PRE-CAST MANHOLE INSTALLATION

A. Excavate for manhole installation.

B. Install and seal precast sections in accordance with ASTM C891.

C. Install manholes plumb.

D. Use precast neck and shaft sections to bring manhole cover to finished elevation.

E. Attach cable racks to inserts after manhole installation is complete.

F. Install 4" diameter drains in manholes and connect to site drainage system 4 inch pipe terminating in 1/3 cu yd crushed gravel bed.

G. Damp-proof exterior surfaces, joints, and interruptions of manholes after concrete has cured 28 days.

H. Backfill manhole excavation.

END OF SECTION 260250

SECTION 260300 - WIRE AND CABLE

PART 1 - GENERAL

Applicable provisions of the conditions of the Contract and Division 1 General Requirements govern the work in this section. Submit shop drawings for checking and approval.

1.1 WORK INCLUDED

A. The work under this section shall include the furnishing of all material, labor, tools and services necessary to wire and cable in raceway specified in other sections to complete all work shown on the Drawings or specified herein.

PART 2 - PRODUCTS

2.1 BUILDING WIRE

A. Thermoplastic-insulated building wire: Type THHN.

B. Rubber insulated building wire: NEMA WC 3.

C. Feeders and branch circuits larger than number 6 AWG: Copper, stranded conductor, 600 volt insulation, type THHN.

D. Feeder and branch circuits 6 AWG and smaller: Copper conductor, 600 volt insulation, THWN/THHN, 6 and 8 AWG, stranded conductor; Smaller than 8 AWG, solid conductor.

E. Service feeders and branch circuits in conduit in contact with earth shall be type XHHW.

F. Control circuits: Copper, stranded conductor 600 volt insulation, THHN.

2.2 ARMORED CABLE

A. BX or pre-manufactured cables are not acceptable except for Type MC for branch wiring after the first junction box (for receptacle and lighting branch circuits) and final connections to motors in interior dry accessible locations, minimum length shall be 18” with a maximum length of 6’ for motors. Except for outdoor and boiler room equipment and/or motors. Provide flexible liquid tight conduit.

B. Type MC fire alarm cable with red stripe for concealed fire alarm wiring as manufactured by AFC series 1800.

C. Armored cable, Type MC size 14 through 6 AWG: Copper conductor, 600 volt thermoplastic insulation, rated 90 degrees C., with separate green ground conductor.

2.3 REMOTE CONTROL AND SIGNAL CABLE

A. Control cable for class 2 or class 3 remote control and signal circuits:

1. Copper conductor, 300 volt insulation, rated 60 degree C, individual conductors twisted together shielded and covered with a nonmetallic jacket; UL listed for use in air handling ducts, hollow spaces used as ducts and plenums. Verify wiring type with manufacturer.

2.4 COLOR CODING

A. All wiring shall be color-coded. Neutral wire shall be white throughout and each phase wire shall be identified any place in the system by its color code. All conductors in panel boxes and junction boxes shall be properly tagged with red non-flammable tags properly attached.

B. Wire shall be color coded as follows:

120/208 volt system

A Phase	Black
B Phase	Red
C Phase	Blue

C. Equipment ground wires or ground jumpers shall be Green.

D. In addition to the basic color-coding described the following additional identification and tagging shall apply.

1. The switch legs for the local wall switches and in switch panel shall have distinctive stripes. In instances where color-coding is not practicable, such as short runs of heavy feeder cables, taping the ends of the cable with coded colors as indicated above or tagging will be permitted.

2. Cables shall be tagged in all pull boxes, wireways and wiring gutters of panels.

3. Where two (2) or more circuits run to or through a control device, outlet box or junction box, each circuit shall be tagged as a guide in making connections.

4. Tags shall identify wire or cable by number and/or piece of equipment served as shown on the Drawings.

PART 3 - EXECUTION

3.1 GENERAL WIRING METHODS

A. Use no wire smaller than 12 AWG for power and lighting circuits, and no smaller than 14 AWG for control wiring.

B. Use 10 AWG conductor for 20 ampere, 120 volt branch circuit home runs longer than 75 feet and for 20 ampere.

C. Place an equal number of conductors for each phase of a circuit in same raceway or cable. No more than one of each phase shall be supported by a single neutral.

D. Splice only in junction or outlet boxes.

E. Neatly tag, identify, train and lace wiring inside boxes, equipment and panelboards.

F. Make conductor lengths for parallel circuits equal.

3.2 WIRING INSTALLATION IN RACEWAYS

A. Pull all conductors into a raceway at the same time. Use UL listed wire pulling lubricate for pulling 4 AWG and larger wires.

B. Completely and thoroughly swab raceway system before installing conductors.

C. Install wire in raceway after interior of building has been physically protected from the weather and all mechanical work likely to injure conductors has been completed.

3.3 CABLE INSTALLATION

A. Support cables above accessible ceilings; do not rest on ceiling tiles. Use spring metal clips or metal cable ties to support cables from structure (not ceiling suspension system). Include bridle rings or drive rings.

B. Use suitable cable fitting and connectors.

3.4 WIRING CONNECTIONS AND TERMINATIONS

A. Splice only in accessible junction boxes.

B. Use solderless pressure connections with insulating covers for copper wire splices and tape, 8 AWG and smaller. For 10 AWG and smaller, use insulated spring wire connectors with plastic caps.

C. Provide extended gutters and tap blocks or pull boxes with tap rail systems similar to Burndy MT Series or Burndy Electrorail system for wire splices 6 AWG and larger.

D. Tape uninsulated conductors with electrical tape to 150 percent of the insulation value of conductor.

E. Thoroughly clean wires before installing lugs and connectors.

F. Make splices, taps and terminations to carry full ampacity of conductors without perceptible temperature rise.

G. Terminate spare conductors with electrical tape.

3.5 FIELD QUALITY CONTROL

A. Field inspection and testing will be performed under provisions of the Specifications.

B. Inspect wire and cable for physical damage and proper connection.

C. Torque test conductor connections and terminations to manufacturer's recommended values.

D. Perform continuity test on all power and equipment branch circuit conductors. Verify proper phasing connections.

3.6 WIRE AND CABLE INSTALLATION SCHEDULE

A. All wiring and cable shall be installed in conduit unless otherwise noted. Refer to conduit section 26 02 00 for conduit types at various locations.

END OF SECTION 260300

SECTION 260320 - OVERCURRENT PROTECTIVE DEVICES

PART 1 - GENERAL

Applicable Provisions of the Conditions of the Contract and Division 1 General Requirements govern the work in this section. Submit shop drawings for checking and approval.

1.1 WORK INCLUDED

A. Work of this section includes all labor, materials, equipment and services necessary to complete the electrical work as shown of the Drawings and specified herein, including, but not limited to, the following:

B. Fuses

1. Current limiting cartridge fuses.
2. Time delay cartridge fuses.

C. Circuit Breakers

1. Standard molded case circuit breakers "bolted in" type.
2. Solid state circuit breakers.
3. Current limiting circuit breakers.
4. Enclosed circuit breakers.

1.2 SUBMITTALS

A. Shop drawings showing dimensions, location of equipment and method of installation.

B. Product Data: Manufacturer’s printed data, catalog cuts.

1.3 DISCONNECT SWITCHES

A. Fusible switch assemblies: Quick-make, quick-break, load interrupter enclosed knife switch with externally operable handle interlocked to prevent opening front cover when switch is in ON position. Handle lockable in OFF position. Fuse clips shall be designed to accommodate Class R, J fuses.

B. Non-fusible switch assemblies: Quick-make, quick-break, load interrupter enclosed knife switch with externally operable handle interlocked to prevent opening front cover when switch is in ON position. Handle lockable in OFF position.

C. Enclosures: NEMA Type 1, 3R or 4 as required.

1.4 FUSES

A. Voltage ratings of fuses shall be suitable for the supply characteristics to which they are applied.

B. Fuse type and size shall be suitable for installation in related disconnect switch or circuit breaker.

C. Current limiting fuses shall be as follows:

1. Regardless of actual available fault current, they shall, at full recovery voltage, be capable of safely interrupting fault currents of 200,000 amperes RMS symmetrical or 280,000 amperes RMS asymmetrical, deliverable at the line side of the fuse.

2. They shall have average melting time-current characteristics to meet the Underwriters' Laboratories requirements for "Class RK-1" 0-600 amp fuses.

D. Regardless of actual available fault current, they shall be capable of limiting peak let through current to the following values based on 200,000 amperes RMS symmetrical or 280,000 amperes asymmetrical being available:

Rating In Amperes	Peak Let Through Current In Amps
15-30	6,000
35-50	8,000
70-100	12,000
125-200	20,000
225-601	38,000

E. Fuses shall be rejection type. Fuse clip shall be rejection type.

F. Fuse Type and Application Table:

Category of Application	Acceptable Fuse Types (Bussman Designations @ 600V)
Motor feeder	LPS below 600A
Power panel feeders	LPS below 600A
Safety switches	LPS

1.5 CIRCUIT BREAKERS

A. "Bolted-In" type, manually operated, quick-make, quick-break, mechanically trip-free operating mechanisms for simultaneous operation, of all poles, with contacts, arc interrupters and trip elements for each pole. "Plug-in" breakers are not permitted. New circuit breakers to be installed in existing panelboards shall be U.L. certified for installation in those panelboards and be labeled with make and model.

B. Tripping units shall be "thermal-magnetic" type having bimetallic elements for time delay overload protection, and magnetic elements for short circuit protection.

C. Manually operable by mean of toggle type operating handles having tripped positions midway between the "on-off" position. Handle to be clearly labeled as to breaker rating.

D. Minimum frame size for all circuit breakers, 1, 2, or 3 pole shall be 100 amperes.

E. Their interrupting rating shall not be less than 25,000 amperes RMS symmetrical at 208 volt for distribution panels and 10,000 amperes for power panels.

1.6 APPLICATIONS

A. Category of Application for Fuses:

1. Feeders on switchboards.

2. Branch fused switch unit in distribution panel.

3. Fused safety switch.

4. Combination motor starters.

B. Category of Application for Circuit Breakers:

1. Panelboards.

2. Switchboards.

3. Individual enclosures.

4. Combination motor starters.

1.7 SPARE FUSES

A. Upon Engineer's acceptance of the electrical distribution system, provide spare fuses as follows: 10% of each type and rating installed 600 amperes and smaller (minimum of 3). Provide spare fuse cabinet with directory to store all spare fuses. Locate as directed by Engineer and/or Owner.

1.8 APPROVED MANUFACTURERS

A. Fuses: Bussman, Ferraz-Shawmut.

B. Circuit Breakers: Siemens, General Electric, Square D.

1.9 INSTALLATION

A. All material installation shall be in accordance with manufacturer recommendations and the provisions of all applicable codes.

B. All fuses and circuit breakers shall be selectively coordinated.

C. Install disconnect switches where indicated on Drawings.

D. Install fuses in fusible disconnect switches.

E. Disconnects shall have NEMA 3R enclosure.

1.10 RECORD DRAWINGS

A. Shop drawings showing dimensions, location of equipment and method of installation.

B. Product Data: Manufacturer’s printed data, catalog cuts, performance curves.

END OF SECTION 260320

SECTION 260350 - BOXES

PART 1 - GENERAL

Applicable provisions of the conditions of the Contract and Division 1 General Requirements govern the work in this section. Submit shop drawings for checking and approval.

1.1 WORK INCLUDED

A. The work under this section shall include the furnishing of all material, labor, tools and services necessary to install wall and ceiling outlet boxes, floor boxes, pull and junction boxes to complete all work shown on the Drawings or specified herein.

1.2 RELATED WORK

A. Access doors.

B. Wiring devices: Service fittings and fire-rated poke-through fittings for floor boxes.

C. Cabinets and enclosures.

PART 2 - PRODUCTS

2.1 OUTLET BOXES

A. Sheet metal outlet boxes: ANSI/NEMA OS 1; Galvanized steel, with 1/2 inch male fixture studs where required.

B. Cast boxes: Cast feralloy, deep type, gasketed cover, threaded hubs.

C. Typical receptacle box shall be 4" square metal boxes, 30.8 cubic inch capacity with brackets as required. Provide 4" square raised device covers.

2.2 PULL AND JUNCTION BOXES

A. Sheet metal boxes: ANSI/NEMA OS 1; Galvanized steel.

B. Sheet metal boxes larger than 12 inches in any dimension: hinged enclosure in accordance with Section 26 04 50.

C. Cast metal boxes for outdoor and wet location installations: NEMA 250; Type 4 and type 6, flat-flanged, surface-mounted junction box, UL listed as raintight. Galvanized cast iron box and cover with ground flange, neoprene gasket, and stainless steel cover screws.

D. Cast metal boxes for underground installation: NEMA 250; Type 4, inside flanged, recessed cover box for flush mounting, UL listed as raintight. Galvanized cast iron box and plain cover with neoprene gasket and stainless cover screws.

PART 3 - EXECUTION

3.1 COORDINATION OF BOX LOCATIONS

A. Provide electrical boxes as required in excess of that shown on Drawings and as required for splices, taps, wire pulling, equipment connections and code compliance.

B. Electrical box locations shown on Contract Drawings are approximate unless dimensioned. Verify location of floor boxes and outlets in offices and work areas prior to rough-in.

C. Locate and install boxes to allow access. Where installations are accessible, coordinate locations and sizes of required access doors with Division 1.

D. Locate and install to maintain headroom and to present neat appearance.

3.2 OUTLET BOX INSTALLATION

A. Do not install boxes back-to-back in walls. Provide minimum 6 inch separation, except provide minimum 24 inch separation in acoustic-rated walls.

B. Locate boxes in masonry walls to require cutting of masonry unit corner only. Coordinate masonry cutting to achieve neat openings for boxes.

C. Provide knockout closures for unused openings.

D. Support boxes independently of conduit except for cast iron boxes that are connected of rigid metal conduits, both supported within 12 inches of box.

E. Use multiple-gang boxes where more than one device is mounted together; do not use sectional boxes. Provide barriers to separate wiring of different voltage systems.

F. Install boxes in wall without damaging wall insulation.

G. Coordinate mounting heights and locations of outlets mounted above counters, benches and backspaces.

H. Position outlets to locate luminaries as shown on reflected ceiling plans.

I. In inaccessible ceiling areas, position outlets and junction boxes within 6 inches of recessed luminaire, to be accessible through luminaire ceiling opening.

J. Provide recessed outlet boxes in finished areas; secure boxes to interior wall and partition studs, accurately positioning to allow for surface finish thickness. Use stamped steel stud bridges for flush outlets in hollow stud wall, and adjustable steel channel fasteners for flush ceiling outlet boxes.

K. Align wall-mounted outlet boxes for switches, thermostats, and similar devices.

L. Provide cast outlet boxes in exterior locations exposed to the weather and wet locations.

3.3 PULL AND JUNCTION BOX INSTALLATION

A. Locate pull boxes and junction boxes above accessible ceilings or in unfinished areas.

B. Support pull and junction boxes independent of conduit.

3.4 FLOOR BOX INSTALLATION

A. Set boxes level and flush with finish flooring material.

B. Use cast iron floor boxes for installation in slab on grade.

END OF SECTION 260350

SECTION 260400 - WIRING DEVICES

PART 1 - GENERAL

Applicable Provisions of the Conditions of the Contract and Division 1 General Requirements govern work in this section. Submit shop drawings for checking and approval.

1.1 WORK INCLUDED

A. The work under this section shall include the furnishing of all materials, labor, tools and services necessary to install receptacles, service fittings device plates and box covers to complete all work shown on the Drawings or specified herein.

1.2 REFERENCES

A. FS W-C-596 - Electrical power connector, plug, receptacles and cable outlet.

B. FS W-S-896 - Switch, toggle.

C. NEMA WD 1 - General purpose wiring devices.

D. NEMA WD 5 - Specific-purpose wiring devices.

1.3 SUBMITTALS

A. Submit product data under Provisions of Contract and Division 1.

B. Provide product data showing configurations, finishes, dimensions and manufacturer's instructions.

PART 2 - EXECUTION

2.1 INSTALLATION

A. Install receptacles on roof along parapet wall.

B. Install specific use receptacles at heights shown on contract drawings.

C. Drill opening for poke - through fitting installation in accordance with manufacturer's instructions.

D. Install plates on switch, receptacle, and blank outlets in finished areas, using jumbo size plates for outlets installed in masonry walls.

E. Install galvanized steel plates on outlet boxes and junction boxes in unfinished areas, above accessible ceilings and on surface mounted outlets.

F. Install devices and wall plates flush and level.

END OF SECTION 260400

SECTION 260450 - CABINETS AND ENCLOSURES

PART 1 - GENERAL

Applicable Provisions of the conditions of the Contract and Division 1 General Requirements govern the work in this section. Submit shop drawings for checking and approval.

1.1 WORK INCLUDED

A. The work under this section shall include the furnishing of all materials, labor, tools and services necessary to install hinged cover enclosures to complete all work shown on the Drawings or specified herein.

1.2 REFERENCES

A. NEMA 250 - Enclosures for electrical equipment (1000 volts maximum).

B. Submittals - Submit product data under Provisions of Contract and Division 1.

PART 2 - PRODUCTS

2.1 HINGED COVER ENCLOSURES

A. Construction: NEMA 250; Type 1 and 3R steel.

B. Finished: Manufacturer's standard enamel finish.

C. Covers: Continuous hinge, held closed by operable by key.

D. Provide barriers between normal and emergency wiring. Barriers shall be of non-current carrying material of adequate thickness for mechanical strength but in no case less than 1/4". Each barrier shall have an angle iron framing support all around.

2.2 FABRICATION

A. Shop assemble enclosures in accordance with ANSI/NEMA ISC 6.

B. Provide knockouts on enclosures.

PART 3 - EXECUTION

3.1 INSTALLATION

A. Install enclosures plumb; Anchor securely to wall and structural supports at each corner, minimum.

B. Provide necessary feet for free-standing equipment enclosures.

C. Install trim plumb.

END OF SECTION 260450

SECTION 260500 - SUPPORTING DEVICES

PART 1 - GENERAL

Applicable Provisions of the Conditions of the Contract and Division 1 General Requirements govern work in this section. Submit shop drawings for checking and approval.

1.1 WORK INCLUDED

A. The work under this section shall include the furnishing of all material, labor, tools and services necessary to install rigid metal conduit, electrical metallic tubing and flexible metal conduit, including all fittings to complete all work shown on the Drawings or specified herein.

1.2 RELATED WORK

A. Conduit and equipment supports.

B. Fastening hardware.

1.3 REFERENCES

A. Conduit supports.

1.4 QUALITY ASSURANCE

A. Support system shall be adequate for weight of equipment and conduit, including wiring, which they carry.

PART 2 - PRODUCTS

2.1 MATERIALS

A. Support channel: Galvanized or painted steel.

B. Hardware: Corrosion resistant.

PART 3 - EXECUTION

3.1 INSTALLATION

A. Fasten hanger rods, conduit clamps, outlet, junction boxes to building structure using preset inserts, beam clamps and spring steel clips.

B. Use toggle bolts or hollow wall fasteners in hollow masonry, plaster, or gypsum board partitions and walls; Expansion anchors or preset inserts in solid masonry walls; self-drilling anchors or expansion anchors on concrete surfaces; sheet metal screws in sheet metal studs and wood screws in wood construction.

C. Do not fasten supports to piping, ductwork, mechanical equipment, or conduit.

D. Do not use powder-actuated anchors.

E. Fabricate supports from structural steel or steel channel, rigidly welded or bolted to present a neat appearance. Use hexagon head bolts with spring lock washers under all nuts.

F. In wet locations install free-standing electrical equipment on concrete pads.

G. Install surface mounted cabinets and panelboards with minimum of four anchors. Provide steel channel supports to stand cabinet one inch off wall.

H. Bridge studs top and bottom with channels to support flush mounted cabinets and panelboards in stud walls.

END OF SECTION 230500

SECTION 260550 - GENERAL LABELING AND IDENTIFICATION

PART 1 - GENERAL

Applicable Provisions of the Conditions of the Contract and Division 1 General Requirements govern the work in this section. Submit shop drawings for checking and approval.

1.1 WORK INCLUDED

A. The work under this section shall include the furnishing of all material, labor, tools and services necessary to install nameplates, tape labels, wire markers, conduit color coding to complete all work shown on the Drawings or specified herein.

1.2 RELATED WORK

A. Painting.

1.3 SUBMITTALS

A. Submit shop drawings under provisions of Division 1.

B. Include schedule for nameplates and tape labels.

PART 2 - PRODUCTS

2.1 MATERIALS

A. Nameplates: Engraved three-layer laminated plastic, white letters on a black background.

B. Tape labels: Embossed adhesive tape with 3/16 inch black letters on a white background.

C. Wire and cable markers: Cloth markers, split sleeve or tubing type.

PART 3 - EXECUTION

3.1 INSTALLATION

A. De-grease and clean surfaces to receive nameplates and tape labels.

B. Install nameplates and tape labels parallel to equipment lines.

C. Secure nameplates to equipment fronts using screws, rivets, or adhesive. Secure nameplate to inside face of recessed panelboard doors in finished locations.

D. Embossed tape will not be permitted for any application. Use embossed tape only for identification of individual wall switches and receptacles and control device stations.

3.2 WIRE IDENTIFICATION

A. Provide wire markers on each conductor in panelboard gutters, pull boxes, outlet and junction boxes and at load connection. Identify each branch circuit or feeder number for power and lighting circuits and each control wire number as indicated on equipment manufacturer's shop drawings for control wiring.

3.3 NAMEPLATE ENGRAVING SCHEDULE

A. Provide nameplates to identify all electrical distribution, control equipment and loads served including year of installation. Letter height: 1/2 inch for individual switches, loads served, distributions and control equipment identification. For example:

MP-1 INSTALLED 2024

B. Panelboards: 3/4 inch, identify equipment designation. 1/2 inch, identify voltage rating and source of power.

C. Individual circuit breakers, switches and motor starters in panelboards, switchboards and motor control centers: 1/4 inch, identify circuit and load served, including location.

D. Individual circuit breakers, enclosed switches and motor starters: 1/2 inch, identify load served.

3.4 FIRE ALARM

A. All fire alarm raceway components shall be painted red and identified.

END OF SECTION 260550

SECTION 260600 - DISCONNECT SWITCHES

PART 1 - GENERAL

Applicable provisions of the conditions of the Contract and Division 1 General Requirements govern the work in this section. Submit shop drawings for checking and approval.

1.1 WORK INCLUDED

A. The work under this section shall include the furnishing of all materials, labor, tools and services necessary to install disconnect switches, fuses and enclosures to complete all work shown on the Drawings or specified herein.

1.2 SUBMITTALS

A. Submit product data under Provisions of Contract and Division 1.

B. Include outline Drawings with dimensions, equipment ratings for voltage, capacity, horsepower and short circuit.

PART 2 - PRODUCTS

2.1 ACCEPTABLE MANUFACTURERS - DISCONNECT SWITCHES

A. Siemens.

B. Square 'D'.

C. General Electric.

D. Or approved equal.

2.2 DISCONNECT SWITCHES

A. Fusible switch assemblies: Quick-make, quick-break, load interrupter enclosed knife switch with externally operable handle interlocked to prevent opening front cover with switch is in ON position. Handle lockable in OFF position. Fuse clips: Designed to accommodate class R, J fuses.

B. Non-fusible switch assemblies: Quick-make, quick-break, load interrupter enclosed knife switch with externally operable handle interlocked to prevent opening front cover with switch in ON position. Handle lockable in OFF position.

C. Enclosures: NEMA Type 1; 3R; 4 as indicated on Drawings.

2.3 ACCEPTABLE MANUFACTURERS - FUSES

A. Bussman.

B. Ferraz-Shawmut.

C. Or approved equal.

2.4 FUSES

A. Fuses 600 amperes and less: ANSI/UL 198E, class RK1; RK5; Dual element, current limiting, time delay, 250 volt.

B. Interrupting rating: 200,000 rms amperes.

C. An additional fuse of each size required to be supplied.

PART 3 - EXECUTION

3.1 INSTALLATION

A. Install disconnect switches where indicated on Drawings.

B. Install fuses in fusible disconnect switches.

C. Disconnects installed outdoors shall have NEMA 3R enclosures.

D. Disconnects installed indoors in dry locations shall have NEMA 1 enclosure.

END OF SECTION 260600

SECTION 260650 - GROUNDING

PART 1 - GENERAL

Applicable provisions of the conditions of the Contract and Division 1 General Requirements govern the work in this section. Submit shop drawings for checking and approval.

1.1 WORK INCLUDED

A. The work under this section shall include the furnishing of all materials, labor, tools and services necessary to install the power system grounding to complete all work shown on the Drawings or specified herein.

1.2 RELATED WORK

A. Panelboards.

B. Raceways.

C. Connection Equipment.

D. Electric Equipment.

E. Tests and Acceptance.

1.3 SUBMITTALS

A. Manufacturers' data, catalog cuts of ground rods, connectors, bushings, etc., along with recommended installation procedures.

PART 2 - PRODUCTS

2.1 WIRING

A. All wiring used for grounding shall be insulated copper, unless otherwise noted. Size shall be in accordance with code for the application, minimum #12.

B. Where used in conjunction with computer equipment, grounding conductors shall be equal in size to the phase conductors.

C. Avoid splices in ground conductors.

2.2 RACEWAY

A. Grounding continuity shall be maintained for all metallic raceways.

B. Provide bonding jumpers across metal parts separated by non-conducting materials.

C. Where a grounding conductor is installed as a supplement to metallic raceway serving as the equipment grounding conductor, bonding conductor to the raceway at each end.

D. All raceway accessories, such as locknuts, bushings, expansion fittings, etc. shall be installed to provide maximum metal-to-metal bonding.

2.3 CLAMPS

A. Provide approved ground clamps for connecting grounding conductors to pipe, conduits, wireways, building steel, grounding rods, etc.

B. Where bond will be in an inaccessible location or as an alternate to ground clamps, provide exothermic weld, similar to Cadweld.

2.4 ACCESSORIES

A. Provide all necessary accessories of appropriate size and material for connection or termination of grounding conductors including:

1. Straps.
2. Clamps.
3. Lugs.
4. Bars and buses.
5. Isolators (where applicable).
6. Locknuts and bushings.

2.5 ACCEPTABLE MANUFACTURERS

A. Copperweld.

B. Cadweld (for exothermic welds).

C. O.Z. Gedney.

D. Burndy.

PART 3 - EXECUTION

3.1 SERVICE ENTRANCE/SWITCH

A. Coordinate all bonding and grounding requirements of the service entrance with the utility company.

B. Provide ground lug in each switchboard, minimum 25% of phase bus, along entire length of switchboard.

C. Separately connect each ground to existing grounding electrode. Test existing grounding electrode for proper resistance values and provide all necessary modifications required.

3.2 TRANSFORMERS

A. Bond each transformer secondary neutral to nearest building structural column or beam via transformer case grounding stud.

B. Provide jumper between transformer case and all conduit bushings.

C. Where a separate equipment-grounding conductor is provided the primary and/or secondary feeders; bond to transformer grounding stud.

D. Where isolation shield is provided, bond to transformer grounding stud.

E. Where a separate ground riser is provided in addition to or instead of building steel; bond transformer-grounding stud to the ground riser.

3.3 STRUCTURAL STEEL BUILDINGS

A. Select a column common to aligned electric closets as the bonding column for grounding of transformer neutrals, isolated grounds and separate equipment grounding conductors.

B. All grounding conductors in each closet shall be bonded in close proximity to one another.

C. Where a grounding conductor to be bonded is not in proximity to the common column, bond to the nearest column or structural beam.

D. Provide bonding jumper strap across all structural expansion joints where the grounding integrity of the structural system is reduced

3.4 RACEWAYS

A. Grounding continuity is to be maintained for all metallic raceways. Provide necessary clamps, bushings, straps and locknuts to assure continuity.

B. For non-metallic or flexible raceways, provide a separate equipment-grounding conductor bonded to both ends.

C. Where indicated, an additional equipment-grounding conductor shall be provided in metallic raceway.

D. Where indicated, an isolated ground conductor shall be provided in addition to the equipment-grounding conductor. Bond at each end to the isolated ground terminal identified.

3.5 EQUIPMENT

A. All equipment shall be grounded.

B. Where isolated grounding is indicated, it shall be for the isolation of internal equipment components only. All metallic enclosures of such equipment shall be connected to the equipment ground system.

3.6 PANELBOARDS

A. All panelboards and distribution panels shall be provided with a ground bar bonded to the enclosure. Provide an isolated ground bar connected to the incoming feeder ground where indicated.

3.7 TESTING

A. Upon completion of the installation, confirm the grounding continuity of all raceways, conductors and equipment. Maximum allowable resistance is 25 ohms.

3.8 RECORD DRAWINGS

A. Submit record As-Built Drawings indicating the location of all points where grounding conductors are bonded to steel, rods, plates, etc.

B. Indicate the location of all grounding buses not installed within distribution equipment.

END OF SECTION 260650

SECTION 260700 - PANELBOARDS

PART 1 - GENERAL

Applicable provisions of the Conditions of the Contract and Division 1 General Requirements govern work in this section. Submit shop drawings for checking and approval.

1.1 WORK INCLUDED

A. The work under this section shall include the furnishing of all materials, labor, tools and services necessary to install the panelboards and to complete all work shown on the Drawings or specified herein.

1.2 RELATED WORK

A. Grounding

B. Overcurrent Protection

1.3 SUBMITTALS

A. Submit shop drawings for equipment and component devices under provisions of Division 1.

B. Include outline and support point dimensions, voltage, main bus ampacity, integrated short circuit ampere rating, circuit breaker and fusible switch arrangement and sizes.

C. Furnish two (2) sets of keys to Owner.

1.4 REFERENCES

A. FS W-C-375 - Circuit breakers, molded case, branch circuit and service.

B. FS W-P-115 - Power distribution panel.

C. NEMA AB 1 - Molded case circuit breakers.

D. NEMA KS 1 - Enclosed switches.

E. NEMA PB 1 - Panelboards.

F. NEMA PB 1.1 - Instruction for safe installation, operation and maintenance of panelboard rated 600 volts or less.

PART 2 - PRODUCTS

2.1 ACCEPTABLE MANUFACTURERS - PANELBOARD AND LOAD CENTERS

A. Siemens.

B. Square "D".

C. General Electric.

D. Or approved equal.

2.2 BRANCH CIRCUIT PANELBOARDS

A. Lighting and appliance branch circuit panelboards: NEMA PB 1; circuit breaker type.

B. Enclosure: NEMA PB 1; Type 1.

C. Cabinet size: Approximately 6 inches deep; 20 inches wide for 240 volt and less panelboards. Verity field conditions and alter dimensions to suit at no additional cost.

D. Provide surface cabinet front door-in-door with concealed trim clamps, concealed hinge and flush lock all keyed alike. Finish in manufacturer's standard gray enamel.

E. Provide panelboards with copper bus, rating as scheduled on Drawings. Provide copper ground bus in all panelboards and isolated ground bus in those as indicated on Drawings.

F. Minimum integrated short circuit rating: 10,000 amperes rms symmetrical for 240 volt rated for 125 amps or less, 22,000 amperes rms symmetrical for 240 volt rated greater than 125 amps to 225 amps and 30,000 amperes for emergency power panelboards (verify in field). If panelboard is noted as a main distribution panelboard, than panel shall be rated as a distribution panelboard. Contractor shall provide short circuit study to ensure adequacy.

G. Molded case circuit breakers: Bolt-on type thermal magnetic trip handle for all poles. Provide circuit breakers UL listed as type SWD for lighting circuits. Breaker handle to indicate ampere rating.

2.3 DISTRIBUTION PANELBOARDS

A. Description: NEMA PB 1, circuit breaker type. The bus of all panels rated a minimum 400 amps shall be distribution type.

B. Panelboard Bus: Copper, ratings as indicated. Provide copper ground bus in each panelboard.

C. Minimum integrated short circuit rating: 65,000 amperes rms symmetrical for 240 volt panelboards; 65,000 amperes rms symmetrical for 480 volt panelboards, unless otherwise noted on Drawings.

D. Model Case Circuit Breakers: NEMA AB 1, circuit breakers with integral thermal and instantaneous magnetic trip in each pole. Provide circuit breakers UL listed as Type HACR as specified on Drawings.

E. Enclosure: NEMA PB 1, Type 1.

F. Cabinet Front: Surface type, fastened with screws. Double hinged doors with flush lock, metal directory frame, finished in manufacturer's standard gray enamel. One hinged door to access breakers, the other to access wiring compartment.

PART 3 - EXECUTION

3.1 INSTALLATION

A. Install panelboards flush or surface mounted as indicated on Drawings.

B. Mounting height maximum 6 ft. (2 m) to top circuit breaker.

C. Provide filler plates for unused spaces in panelboards.

D. Provide type written circuit directory for each branch circuit panelboard. Indicate loads served and panel name by matching that shown on panel schedules on Drawings. Revise directory to reflect circuiting changes required to balance phase loads. Provide a second copy and turn over to Owner.

E. Provide 3/4" thick plywood backboard for mounting of panels. Paint backboard with fire retardant paint.

F. Provide nameplates as indicated in Section 16550.

3.2 FIELD QUALITY CONTROL

A. Measure steady state load currents at each panelboard feeder. Should the difference at any panelboard between phases exceed 20 percent, rearrange circuits in the panelboard to balance the phase loads within 20 percent. Take care to maintain proper phasing for multi-wire branch circuits.

B. Visual and mechanical inspection: Inspect for physical damage, proper alignment, anchorage and grounding. Check proper installation and tightness of connections for circuit breakers, fusible switches and fuses.

C. Provide thermographic inspections in accordance with Section 26 0100.

3.3 TESTS

A. Submit certification that each panelboard has withstood, without breakdown, a factory dielectric (Hi-Pot) test consisting of a one minute application of a 60 cycle AC test voltage applied between phase legs and from each phase leg to enclosure.

B. The applied test voltage shall have an RMS value of at least twice the line to line system voltage to which the panelboard is to be applied, plus one thousand volts (minimum 1500V).

3.4 RECORD DRAWINGS

A. Submit As-Built Drawings indicating the location of all panelboards.

END OF SECTION 260700

SECTION 260725 - EXISTING DISTRIBUTION SWITCHBOARD RETROFIT

PART 1 - GENERAL

Applicable provisions of the Conditions of the Contract and Division 1 General Requirements govern work in this section. Submit shop drawings for checking and approval.

1.1 RELATED DOCUMENTS

A. The Contractor, Subcontractors, vendors and the like shall meet all Con Edison requirements.

1.2 SUMMARY

A. Work of this section shall be governed by the contract documents. Provide materials, labor, equipment and services necessary to furnish, deliver and install all work of this section as shown on the drawings, as specified herein and/or as required by job conditions.

B. The work shall include, but not be limited to, indoor, low voltage switchboards of the circuit breaker, front accessible only, rear aligned, groove mounted type, as shown on the drawings and specified herein.

1.3 REFERENCES

A. Related Work Specified Elsewhere

1. General Conditions: Section 260100
2. Overcurrent Protective Devices: Section 260320

1.4 INTENT AND CODES

A. This specification describes the equipment required. It does not cover all phases of manufacture or assembly. Supplier shall assume the responsibility for providing well-integrated units of good quality.

B. All codes, rules, regulations and ordinances governing this work, are as fully a part of this specification as if herein repeated or hereto attached. Where the requirements of this specification are more stringent than any applicable codes etc., the specification shall apply.

1.5 MATERIAL AND WORKMANSHIP

A. Unless otherwise specified all materials shall be new. Supplier shall be responsible for defects in equipment and devices furnished but not manufactured by him. Exposed finishes and other features shall match in all respects. Supplier alone shall be responsible for all errors of fabrication and for correct fitting of all components that must be erected and joined in the field.

1.6 SHOP DRAWINGS

A. Complete shop drawings showing size and arrangement of equipment, foundation and anchor bolt requirements, bill of materials, performance data and curves, wiring and elementary diagrams, methods of assembly, connections to other work and other pertinent data as called for in the various parts of this Specification shall be furnished by the Supplier for checking and approval.

1.7 MAINTENANCE AND OPERATING INSTRUCTIONS

A. In addition to submittal for approval, furnish to the Owner's Representative six (6) copies of the items listed below for all equipment and material furnished under this specification.

B. Each approved shop drawing, including all final comments, shall be folded down so that it can be placed in a loose leaf binder of the size using standard 8-1/2" x 11" paper. The drawings shall be folded in a manner that they can be fully opened without removal from the binder.

C. Complete detailed parts lists and/or assembly drawings.

D. All governing agencies' and/or manufacturer's test certificates, permits and inspection reports, insurance inspection and all shop or field performance tests, when required.

E. All operating and maintenance manuals as required by this specification. Such manuals shall be edited to identify equipment furnished.

F. Approved catalog cuts and/or material lists as required by this specification.

G. The Manufacturer's Specification, including tabulation of sizes and identifying numbers for all installed material and equipment. The applicable items in each brochure shall be clearly defined and marked.

H. List of recommended spare parts.

I. All of the above items shall be assembled in books identified for units covered, including all assemblies and components. Each book shall contain Table of Contents page. Forward all the above information except for field test and/or field inspection reports to the Owner's Representative promptly after approval of shop drawings for each item and before delivery of any equipment involved.

1.8 SHIPPING AND PROTECTION INSPECTION

A. All material, equipment and component parts shall be adequately protected to prevent damage, corrosion or entry of foreign matter during shipment, unheated storage or in a dusty atmosphere.

B. Each packing crate and carton containing components shall be visibly stenciled, clearly identifying contents as to the type(s) of unit(s) contained therein and the related equipment assembly or assemblies.

C. Each shipment shall contain packing slip listing all components.

D. For handling during shipment, lifting irons, eye bolts, or other lifting aids shall be bolted to the housing and shall not be removed until the equipment is in final position. The shipping sections may consist of completely assembled structures or sections of one or more units, as required to suit the handling facilities and to facilitate installation. Wiring that extends between sections to be terminated at accessible terminal blocks with wiring harnesses to facilitate field interconnections. Clearly identify all conductors and terminals.

1.9 SERVICE CONDITIONS

A. The material covered by this specification shall be designed for operation under conditions where the altitude does not exceed 3300 feet and the temperature of the cooling air does not exceed 40 Degrees C. maximum, 30 Degrees C. average, unless otherwise specified.

1.10 GUARANTEE-WARRANTY

A. Guarantee that all equipment meets the design and performance requirements specified and alter and/or replace, at no costs to the Owner, any piece of equipment which fails to meet these requirements. This shall include any field work and factory trained supervision necessary.

B. All material included herein shall be free from defects and warranted for a period of 18 months from date of shipment of material from factory or 12 months from date of installation. Any parts found defective due to manufacture shall be replaced and reinstalled at no expense to the owner.

PART 2 - PRODUCTS

2.1 GENERAL REQUIREMENTS

A. Scope

1. This part of the Specification covers the basic equipment and detailed construction requirements, and the required shop drawings to be submitted fore the switchboard. All components, electric interconnections and accessories shall be designed and constructed in accordance with the latest applicable standards as recommended by the American National Standards Institute (ANSI), the National Electrical Manufacturers' Association (NEMA), the Institute of Electrical and Electronics Engineers (IEEE), the Underwriter's Laboratory (UL) as well as the construction details specified herein. In case of conflict between the aforementioned Standards and this Specification, the more stringent requirement shall apply.

2. Applicable requirements of all Local Codes shall also be complied with.

3. Switchboards shall conform to the following standards:

a. Underwriters Laboratories (UL) -
UL 891 - "Dead Front Electrical Switchboards".
Switchboards and its components shall be UL listed and labeled.

b. National Electrical Manufacturers Association

NEMA-PB2 - “Dead Front Distribution Switchboards”.

NEMA-PB2.1-General Instructions for proper handling, installation, operation, and maintenance of dead front distribution switchboards rated 600 volts or less.

4. The general arrangements, limiting dimensions, type and/or ratings are shown on the drawings accompanying this Specification. The basic equipment and detailed construction requirements for the various components entering into individual switchboards, shall be in accordance with the applicable provisions of this part. Coordinate the requirements of the various Parts of this Specification with the drawings when ordering equipment or material in accordance with the applicable provisions of this Part.

2.2 REQUIRED SHOP DRAWINGS

A. Shop drawings shall be submitted as specified in Part 1 - General. As a minimum the following drawings shall be submitted for approval in accordance with the procedure indicated, falling into two categories.

B. Drawings for Preliminary Approval to enable Supplier to proceed with equipment ordering and scheduling of fabrication:

1. Front elevation, one line diagram showing main and branch circuit breaker ratings and types and any information required for complete identification and location of major equipment items, including dimension outline sizes, weights, shipping splits, and arrangement of all equipment.

2. Voltage, phase, frequency, horizontal and vertical bus capacities, short circuit ratings.

3. Floor plan and top view showing materials, sizes, anchoring, location of power and control conduit, and ground cable entries above and below.

4. Preliminary Bill of Material or switchboard summary showing all major components.

5. Preliminary schematic diagrams of nonstandard circuits.

C. Detailed Engineering Drawings supplied to Owner promptly after approval of preliminary drawings.

1. Wiring and schematic diagrams of all power circuits. Wiring diagrams shall be separate from schematic diagrams and shall show equipment arrangement, terminal numbers and point-to-point wiring of each piece of equipment and terminal block. Interconnection wiring diagram shall be furnished, showing general physical arrangement of all units and terminal blocks used in wiring between such units. The separate schematic diagrams shall include complete three line diagrams for buses, low-voltage switch and fuse units and any other devices in this Switchboard.

2. Complete Bill of Material, or switchboard summary showing all components and materials, clearly describing same and providing numbers and data for checking.

3. Detailed sections through all frames showing equipment, buswork, bus phasing connections and ground stud assembly on bus.

4. Detailed drawings showing provision for main and feeder bus extension and bus risers and indication of short circuit bracing.

5. Handling, installation and assembly drawing.

6. Final dimensioned outline drawings and accessories, phasing, location of jacking points, etc.

7. Device connection diagrams.

8. Nameplate data sheets.

9. Cable lug type, quantities and sizes.

10. Operating and maintenance instruction manuals for all types of equipment.

2.3 LIMITING DIMENSIONS

A. The dimensions indicated on the drawings are limiting and the orientation of the equipment shall be maintained. If a particular manufacturer's equipment exceeds any of the dimensions shown, it should be clearly stated in his proposal. The Owner will evaluate the cost of accommodating this equipment in the building design when reviewing his bid.

2.4 EXISTING SWITCHBOARD RETROFITTED

A. General

1. The existing internal components of the 120/208v, 2500amp, 3 phase 4 wire c/t cabinet and distribution section, including the bus, buckets, cover, cabling, nuts, and bolts, will be replaced in its entirety in kind by this contractor, including the painting of the exterior of the existing cabinet with ansi 61 gray paint. Contact robert burns of precision switchboard, 914.345.0794, for all the new fabricated internal components, including new bus, covers, buckets, nuts and bolts. This contractor is responsible for all required and necessary accessories for a complete operational equipment, including all cabling, interconnection, etc. There are two existing buckets, as indicated. They are rated for 1200amps.

2. Provide nameplates for all units.

B. Enclosure

1. The existing steel framework shall be reused, and all new covers shall be provided.

2. Cable compartments shall have adequate space for cables as required. Provide cable supports for each vertical section.

3. The new covers / housing shall be thoroughly cleaned and degreased after fabrication, bonderized and primed with zinc chromate. Finish shall be two coats of gray enamel, ANSI #61.

C. Buswork / Cable Connection

1. Any buswork that will be used shall be 3-phase, 4-wire fabricated of copper, tin or silver plated, ampere rating as shown on the drawings.

2. Cables shall interconnect from C/T Cabinet to Switch Sections. Vertical buswork shall be equal to the sum of the switch sizes in the vertical section. Provide UL required spacing for all cable compartments and connections. The continuous current ratings of the retrofitted component the busses shall be determined by temperature rise as limited by ANSI standards and the National Electrical Code. Neutral bus shall be full sized, rating scale as the phase busses.

3. Provide an A-B-C bus arrangement, left to right, top to bottom, front to back, throughout as viewed from the front of the switchboard.

4. Any buswork within C/T portion of the cabinet and distribution section vertical bus shall be braced and supported to safely withstand short circuit stresses equal to the full available fault currents at the switchboard, minimum 200,000 AIC ampere RMS symmetrical.

5. Provide two-hole long barrel compression cable connectors for cable as indicated per phase, neutral and ground on all incoming conductors.

6. Provide bus tap lugs for connection of transient voltage surge suppressors as close to incoming conductors as possible.

7. Ground bus shall be rated 25 percent of the phase busses with minimum size of 3 inches by 1/4 inch and be continuous for the entire length of the switchboard. Ground bus shall be accessible from the front of the switchboard. Ground bus shall be copper.

D. All necessary devices and connections shall be complete and in accordance with the following Specifications.

1. Fusible Switch Units shall consist of twin or single type units of ampere (and corresponding horsepower) rating indicated. Units shall be quick make, quick break, heavy duty switch and fuse mechanism, individually enclosed by a hinged steel cover and external operating handle indicating "ON" and "OFF" position to switch. Switches shall be of design to minimize arcing and pitting when rupturing current and shall be equipped with arc quenchers. Wiring terminals shall be solderless pressure type lugs. Cover of unit shall be interlocked so that door cannot be opened except when switch is in "OFF" position. Unit shall have provision for padlocking. Covers shall be accurately aligned by rugged hinges and all edges shall be smooth. The individual units shall bear Underwriter's Laboratories, Inc. label of approval. Individual 30-ampere units shall be interchangeable with 60-ampere units and operating handles shall not exceed 6'-9" above floor not less than 18" above floor.

2. Each unit shall have a pinned or riveted phenolic or metal nameplate which shall indicate ampere rating of switch, circuit designation and required fuse size. The fuse switch units shall be by Square 'D' Co., Challenger, General Electric, Siemens or Westinghouse Electric labelled for Service Entrance Use if required.

E. Fuses

1. Fuses shall have minimum interrupting rating of 200,000 R.M.S. amperes the equal of Bussman or Gould Shawmut class L fuses.

F. Spare Fuses

1. Provide and deliver three (3) fuses of each type and size installed, as spares.

G. Spaces

1. Sections that are designated "space" or "provision for future switch" shall be equipped with all accessories required to accept a future switch.

H. Accessories

1. The following accessories shall be furnished with each switchboard.

a. One (1) quart of touchup paint.
b. One set of special wrenches, removable hand cranks, tools as required to maintain and disassemble parts of the switchgear for field maintenance.

I. Approved Manufactures

1. Contact Robert Burns of Precision Switchboard, 914.345.0794, for all the new fabricated internal components, including new bus, covers, buckets, nuts, and bolts.

PART 3 - EXECUTION

3.1 SHIPMENT

A. Prior to shipment, all equipment shall be cleaned. All openings shall be covered to prevent entrance of foreign material. Where necessary, desiccant bags shall be located within cabinets to provide a minimum of 3 months protection.

B. Equipment shall be shipped in sections to facilitate installation, complete with all accessories required for assembly. All wiring that extends between sections shall terminate on terminal blocks at the interface points, with a wiring harness (with framing strips) that will be field installed between adjacent sections. All terminal and wires shall be clearly marked with wire numbers.

3.2 INSTALLATION

A. General: Install and connect switchboard equipment in accordance with approved manufacturer's shop drawings including supplemental devices required to make each unit a complete installation.

B. Mechanical Connections

1. Make all required connections including split line connections.

2. Remove shipping irons after equipment is set in place.

C. Electrical Connections

1. Bus connections: Use manufacturer's recommended torque.

2. Install control wiring connections at shipping splits and coordinate with SCADA requirements for Emergency Switchboards.

3. Provide holes in plates to allow for required conduit connections.

4. Terminate low voltage cables.

5. Ground conduits and cables as specified in Section 26 0200 and 26 0300.

6. Insulating Tape: When main buses are insulated or enclosed by barriers, insulate with tape wrappings all cable connections for voltage level involved so no current carrying parts are exposed.

7. Cable Blocks: support all outgoing secondary cables from cable blocks.

3.3 FIELD QUALITY CONTROL

A. Phase Sequence

1. Coordinate with the system supply for proper phase sequence throughout.

2. Provide phase sequence indicator on jobsite to verify all secondary outgoing feeder rotation.

B. Test all circuit breakers or fuses and switches for proper operation.

C. Bus Bar Connections

1. Check for proper resistance values using "Ducter" low resistance ohmmeter. Make adjustments where valves exceed manufacturer's recommendations.

2. “Megger” phase bus bars to assure that no grounds or shorts are present. Disconnect potential and control transformers, instrument fuses and other equipment which may cause false readings.

D. Start-Up and Acceptance

1. Coordinate with equipment supplier and Owner for preparatory work required prior to energizing and acceptance and in accordance with Owner’s start-up procedures.

E. Contractor shall leave the entire installation in perfect working order.

END OF SECTION 260725

SECTION 260775 - SURGE SUPRESSOR

PART 1 - GENERAL

Applicable Provisions of the Conditions of the Contract and Division 1 General Requirements govern the work in this section. Submit shop drawings for checking and approval.

1.1 WORK INCLUDED

A. This specification describes the mechanical and electrical requirements for a Surge Protection Device herein known and shown on all drawings as SPD. The SPD shall be suitable for application in category C High environments as described in ANSI/IEEE C62.41. The SPD shall be parallel in design and provide protection for the following modes: {Line to Neutral, Line to Ground, Line to Line, Neutral to Ground} for electrical distribution systems. “Series” type SPD units will be deemed unacceptable.

1.2 SUBMITTALS

A. Product Data: For each type of product indicated. Include rated capacities, operating weights, operating characteristics, furnished specialties, and accessories.

B. Product Certificates: For surge protection devices, signed by product manufacturer certifying compliance with the following standards:

1. UL 1283
2. UL 1449 3rd Edition

1.3 QUALITY ASSURANCE

A. Source Limitations: Obtain suppression devices and accessories through one source from a single manufacturer

B. Product Options: Drawings shall indicate size, dimensional requirements, and electrical performance of suppressors and are based on the specific system indicated.

C. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, Article 100, by a testing agency acceptable to authorities having jurisdiction, and marked for intended use.

D. Comply with NEMA LS 1, “Low Voltage Surge Protection Devices”

E. Codes and Standards

1. UL compliance and Labeling: Listed per UL 1449 3rd Edition.
2. UL 1283 “Electromagnetic Interference Filters”.
3. Comply with ANSI/IEEE C62.1, C62.41, and C62.45.
4. NEC compliance: Comply with NEC as applicable to construction and Article 280 for installation.

1.4 MANUFACTURERS QUALIFICATIONS

A. Only pre-approved SPD products shall be accepted.

B. Manufacturer Qualifications: All SPD units shall be manufacturer by a firm that strictly manufactures SPD products only, for at least 10 years. Firms must also regularly engage in the manufacturing of SPD products for Categories B (ANSI/IEEE 62.41) and C High.

C. The SPD shall be warranted for no less than 15 years and shall include free replacement in whole or in part during those 15 years for any reason of failure.

PART 2 - PRODUCTS

2.1 SERVICE ENTRANCE SUPPRESSORS

A. General: The A.C. Voltage Surge Protective Devices shall be a high speed, high current solid-state device designed to protect electronic equipment and electrical systems from transient over voltages. It shall limit the magnitude of a transient overvoltage present on the AC service or distribution power lines. The suppressor shall provide continuous bi-polar, bi directional, non-interrupting protection and be capable of instant automatic reset with no degradation in protection capabilities. The suppressor shall be solid state, utilizing 40mm metal oxide arrestors (MOV's). Gas tubes are not acceptable. It shall start to suppress the transient at a minimum of 115% of the peak voltage of the sinewave. The suppressor assembly shall be installed in parallel of the service main disconnect, distribution or branch panel main lugs. Connect the suppressor to over current protection sized with an AIC rating equal to or greater than the panel rating. The suppressor shall be contained in an enclosure appropriate for environmental application.

B. Electrical Performance

1. ANSI/IEEE Testing Minimum Requirements

	SVR UL 1449 2nd	VPR UL 1449 3rd	CAT B 6kV/3kA	CAT C High 20kV/10kA
208Y/120	400V	700V	416V	528V

C. SPD specifics:

1. The surge protection device shall be permanently wired through an over current device (specific size shall be specified by the manufacturer) installed in the service entrance electrical equipment (rated with the same electrical characteristics of the panel) with leads as short as possible and not to exceed 18 inches.

2. Surge Protection Device Description - Modular Design with field replaceable modules and the following features and accessories:

a. Fabrication using bolted compression lugs for internal wiring.

b. Replaceable bolt down modules per phase. The use of single “Brick” Module and/or “Plug In” type module designs will not be accepted.
c. Arrangement with wire connections to phase buses, neutral bus, and ground bus.
d. A 200,000 AIC Fused Rotary Disconnect.
e. Remote Audio/ Visual Alarm Panel.
f. UL Listed 1283 Extended Power Range Filter.
g. Green/Red LED Indicator lights for power and protection status. Green = Power On / Protection Present Red = Failure
h. Normally Open / Normally Closed Form C Dry Contacts
i. Surge Event Counter.

3. Peak Single-Impulse Surge Current Rating shall be 240kA per phase.
4. Standard unit housings shall be 16 gauge painted steel and match the NEMA rating of the panel board.
5. Standard unit warranty must be for at least 15 years and be stated in the manufacturer’s literature.

D. Approved Manufacturers

1. Cooper Crouse Hinds – ZoneMaster PRO Series or Equal.

2.2 DISTRIBUTION PANEL SUPPRESSORS

A. General: The A.C. Voltage Surge Protective Devices shall be a high speed, high current solid-state device designed to protect electronic equipment and electrical systems from transient over voltages. It shall limit the magnitude of a transient overvoltage present on the AC service or distribution power lines. The suppressor shall provide continuous bi-polar, bi directional, non-interrupting protection and be capable of instant automatic reset with no degradation in protection capabilities. The suppressor shall be solid state, utilizing 40mm metal oxide arrestors (MOV’s). Gas tubes are not acceptable. It shall start to suppress the transient at a minimum of 115% of the peak voltage of the sinewave. The suppressor assembly shall be installed in parallel of the service main disconnect, distribution or branch panel main lugs. Connect the suppressor to over current protection sized with an AIC rating equal to or greater than the panel rating. The suppressor shall be contained in an enclosure appropriate for the environmental application.

B. Electrical Performance

1. ANSI/IEEE Testing Minimum Requirements

	SVR UL 1449 2nd	VPR UL 1449 3rd	CAT B 6kV/3kA	CAT C High 20kV/10kA
208Y/120	330V	600V	456V	550V

C. SPD specifics:

1. The surge protection device shall be permanently wired through an over current device (specific size shall be specified by the manufacturer) installed in the

service entrance electrical equipment (rated with the same electrical characteristics of the panel) with leads as short as possible and not to exceed 18 inches.

2. Surge Protection Device Description - Modular Design with field replaceable modules and the following features and accessories:

   a. Fabrication using bolted compression lugs for internal wiring
   b. Replaceable bolt down modules per phase. The use of single “Brick” Module and/or “Plug In” type module designs will not be accepted.
   c. Arrangement with wire connections to phase buses, neutral bus, and ground bus
   d. UL Listed 1283 Extended Power Range Filter
   e. Green/Red LED Indicator lights for power and protection status. Green = Power On / Protection Present Red = Failure
   f. Normally Open / Normally Closed Form C Dry Contacts

3. Peak Single-Impulse Surge Current Rating shall be 100kA per phase

4. Standard unit housings shall have a transparent front cover for complete visual inspection and monitoring the status of protection for each module, any onboard diagnostics, module configuration, and wiring configuration.

5. Standard unit housings shall be non-metallic and meet NEMA 1, 2, 3, 3S, 4, 4X, 12 and 13 classifications

6. Standard unit warranty must be for at least 15 years and be stated in the manufacturer’s literature.

D. Approved Manufacturers

1. Cooper Crouse Hinds – ZoneSentinel 100 Series or equal.

PART 3 - EXECUTION

3.1 APPLICATION OF SPD

A. General

1. Apply SPD on the load side of the first main disconnect at the electrical service entrance switchboard and on the load side of the main overcurrent device at the electrical distribution panelboard.

2. Coordinate system voltage, wiring configuration, and location as shown on project drawings.

3.2 INSTALLATION OF SPD

A. Service Entrance: Connect the SPD to a 60A Breaker with #6 AWG minimum conductors, #4 AWG maximum (for ease of dressing), to the Service Entrances panel being protected. The conductors are to be as short and straight as practically possible and shall not exceed 18 inches in length. The SPD shall be installed following the manufacturer's recommended practices and in compliance with all applicable codes.

B. Distribution Panels: Connect the SPD to a 60A or 30A (whichever is specified by the manufacturer for that model) with #8 AWG minimum conductors, #4 AWG maximum (for ease of dressing), to the Distribution panels being protected. The conductors are to be as short and straight as practically possible and shall not exceed 18 inches in length. The SPD shall be installed following the manufacturer's recommended practices and in compliance with all applicable codes.

C. Branch Panels: Install the SPD to with #10 AWG provided from the manufacturer to the Branch panels being protected. The conductors are to be kept as short and straight as practically possible and shall not exceed 18 inches in length that is provided. The SPD shall be installed following the manufacturer's recommended practices and in compliance with all applicable codes.

END OF SECTION 260775

SECTION 260900 - GUARANTEE

PART 1 - GENERAL

Applicable Provisions of the Conditions of the Contract and Division 1 General Requirements govern work in this section.

1.1 GUARANTEE

A. The Contractor shall remove, replace and/or repair at his own expense and at the convenience of the Owner, any defects in workmanship, materials, ratings, capacities and/or characteristics occurring in the work within one (1) year or within such longer period as may be provided in the Drawings and/or Section of the Specifications, which guarantee period shall commence with the final acceptance of the entire Contract in accordance with the guarantee provisions stated in the General Conditions, and the Contractor shall pay for all damage to the system resulting from defects in the work and all expenses necessary to remove, replace, and/or repair any other work which may be damaged in removing, replacing and/or repairing the work.

END OF SECTION 260900