2122-43VS
LHS Cooling Tower Replacement

Loris High School
301 Loris Lions Road
Loris, SC 29569

TECHNICAL SPECIFICATIONS

January 18, 2022

HORRY COUNTY SCHOOLS
P.O. Box 260005
Conway, SC 29528-6005

INDEX

SECTION 011000 - SUMMARY

PART 1 GENERAL

1.1 SUMMARY

A. Section Includes:
1. Contract description.
2. Work by Owner or other Work at the Site.
3. Owner-furnished products.
4. Contractor's use of Site and premises.
5. Future work.
6. Work sequence.
7. Owner occupancy.
8. Permits.
9. Specification conventions.

1.2 CONTRACT DESCRIPTION

A. Work of the Project includes construction or alteration per the project drawings.
1. Work is the replacement of existing cooling tower/heat exchanger and building pump package with a new closed circuit cooler and pump package.

B. Contract with Owner according to Conditions of Contract.

1.3 WORK BY OWNER OR OTHERS

A. Work associated with the Building Automation System is to be contracted with HCS Contractor and to be paid directly by HCS. Owner will coordinate the sequence of work under all contracts according to "Work Sequence" and "Contractor's Use of Site and Premises" Articles in this Section.

B. Contractor to coordinate BAS work with Owner, Owner contractor and contractor’s forces.

C. Work under this Contract includes:
1. Work as indicated on Drawings and as specified in the Project Manual.

D. Items noted NIC (Not in Contract) will be furnished and installed by Owner.

1.4 OWNER-FURNISHED PRODUCTS

A. Owner's Responsibilities:
1. Arrange for and deliver Owner-reviewed Shop Drawings, Product Data, and Samples to Contractor.
2. Arrange and pay for delivery to Site.
3. Upon delivery, inspect products jointly with Contractor.

4. Submit claims for transportation damage and replace damaged, defective, or deficient items.
5. Arrange for manufacturers' warranties, inspections, and service.

B. Contractor's Responsibilities:
1. Review Owner-reviewed Shop Drawings, Product Data, and Samples.
2. Receive and unload products at Site; inspect for completeness or damage jointly with Owner.
3. Handle, store, install, and finish products.
4. Repair or replace items damaged after receipt.

1.5 CONTRACTOR'S USE OF SITE AND PREMISES

A. Limit use of Site and premises to allow:
1. Owner occupancy.
2. Work by Owner.

B. Construction Operations: Limited to areas indicated on Drawings.
1. Noisy and Disruptive Operations (such as Use of Jack Hammers and Other Noisy Equipment): Not allowed in close proximity to existing building during regular hours of operation. Coordinate and schedule such operations with Owner to minimize disruptions.

C. Utility Outages and Shutdown:
1. Coordinate and schedule electrical and other utility outages with Owner.
2. Outages: Allowed only at previously agreed upon times. In general, schedule outages at times when facility is not being used.

D. Construction Plan: Before start of construction, submit three copies of construction plan regarding access to Work, use of Site, and utility outages for acceptance by Owner. After acceptance of plan, construction operations shall comply with accepted plan unless deviations are accepted by Owner in writing.

1.6 PERMITS

A. Obtain all permits and licenses required to perform the work required by the Contract Documents (Drawings, Specifications and Contract).

1.7 SPECIFICATION LANGUAGE

A. These Specifications are written in imperative mood and streamlined form. This imperative language is directed to Contractor unless specifically noted otherwise. The words "shall be" are included by inference where a colon (:) is used within sentences or phrases.

PART 2 PRODUCTS - Not Used

PART 3 EXECUTION - Not Used

END OF SECTION

SECTION 012100

ALLOWANCES PROCEDURES

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SECTION INCLUDES

A. Allowances indicated in the Bid Proposal Form to be included in Contract Amount.

1. Selected materials and equipment, and in some cases, their installation, are shown and specified in the Contract Documents by allowances. Allowances have been established in lieu of additional requirements and to defer selection of actual materials and equipment to a later date when additional information is available for evaluation. Additional requirements, if necessary, will be issued by change order.
2. Allowances may be used in lieu of metering for temporary construction site utility services or to reimburse project related work performed by District forces, for example, keying.

1.3 RELATED SECTIONS

A. Refer to product Specifications Sections identified in Allowance description.

1.4 GENERAL REQUIREMENTS FOR ALLOWANCES

A. Contractor shall submit cost data and other descriptive data to establish basis used by Contractor for determining costs in Contract Amount attributable to each Allowance.

B. Any amount not fully consumed shall be adjusted by change order.

1. The Contractor will be credited for his actual cost of labor, materials, and other actual costs WITHOUT mark-up.
2. Any unused allowances shall be returned to the Owner using a credit change order for the full amount of the value unused.
3. Should the Contractor's actual costs exceed the specified allowance, the Contractor's Contract Amount will be adjusted by change order in accordance with Contract.

PART 2 - PRODUCTS

2.1 LUMP SUM ALLOWANCES

A. Owners Contingency:

1. The Contractor shall include a contract allowance of $20,000.00 in their proposal to provide all material, labor, and equipment necessary to design, permit, and installation of unknown conditions.
2. Owner to determine the conditions and use of this allowance.

PART 3 - EXECUTION

3.1 SELECTION OF PRODUCTS

A. Owner's Representative and Architect will:
   1. Consult with Contractor for considerations to be given in selection of products, suppliers and qualified installers.
   2. Make selection in consultation with HCS Facility staff. Obtain written direction by HCS's Representative designating:
      a. Product, color, design and finish.
      b. Accessories and attachments.
      c. Suppliers and qualified installers, as applicable.
      d. Allowance amount to be included in Contract Amount.
      e. Construction Contract warranty and manufacturer's guarantee provisions.

B. Contractor shall:
   1. Assist HCS Facility staff's Representative and Architect in determining qualified suppliers or installers.
   2. Obtain proposals from suppliers and installers.
   3. Make cost and constructability recommendations to Owner's Representative and Architect for consideration in product, supplier and qualified installer selections.
   4. Notify Owner's Representative and Architect promptly of:
      a. Reasonable objections Contractor may have against any supplier or party under consideration for installation.
      b. Effects on Construction Schedule anticipated by selections under consideration.

3.2 CONTRACTOR'S RESPONSIBILITIES

A. Upon notification of selection, Contractor shall execute purchase agreement with designated supplier(s) and enter into contract with designated qualified installer(s), as applicable.

B. Contractor shall make all arrangements for and submit shop drawings, product data and samples as required.

C. Contractor shall make all arrangements for pick-up, delivery, handling and storage of products.

D. Upon delivery, Contractor shall promptly inspect products for damage or defects. Should damage or defects be found, Contractor shall effect return, replacement or repair of products, as appropriate, and process claims for transportation damage.

E. Contractor shall apply, install and finish products in compliance with requirements of applicable Sections of Specifications.

3.3 ADJUSTMENT COSTS

A. Should the net cost of the Allowance be more or less than the amount included in the Contract Amount, the Contract Amount shall be adjusted in accordance with provisions of the Contract General Conditions and a Change Order shall be executed.

END OF SECTION

SECTION 013100 - PROJECT MANAGEMENT AND COORDINATION

PART 1 - GENERAL

1.1 CONTRACT DOCUMENT

A. The **Contract Agreement** with referenced attachments, technical specifications and drawings including all project addenda constitute the Scope of the Work.

B. Specific project requirements are included in the Contract Agreement and contain, but may include more than the following:

1. Pre-Construction Meeting
2. Construction Management
3. Conformance to applicable Codes and Laws
4. Project Schedule
5. SLED Background checks
6. Submittals
7. Record Drawings
8. Quality Control
9. Cut and Patching
10. Jobsite Supervision
11. Work site control and clean-up.
12. Material testing and Inspections
13. Warranties and Guarantees
14. Traffic Control and Safety

C. Important safety and specific Horry County School requirements are contained in the Contract Agreement and specifically Section 83 " Mandatory Safety and Conduct Requirements."

1.2 SUMMARY

A. Section includes requirements for temporary utilities, support facilities, and security and protection facilities.

B. Related Requirements:

1. Those work restrictions and limitations listed on the **Scope of Work (Exhibit A)** and the **Contract Agreement**.

1.3 UTILITY USE AND CHARGES

A. General: Installation and removal of and use charges for temporary facilities shall be included in the Contract Sum unless specifically noted otherwise within the Scope of Work (Exhibit A) to the Contract Agreement. Allow other entities to use temporary

services and facilities without cost, including, but not limited to, Owner's construction forces, Architect, testing agencies, and authorities having jurisdiction.

B. Requirement for temporary utilities to be paid for by the Owner:

1. Water and Sewer Service from Existing System: Water from Owner's existing water system is available for use without metering and without payment of use charges. Provide connections and extensions of services as required for construction operations at no cost to the Owner.

2. Electric Power Service from Existing System: Electric power from Owner's existing system is available for use without metering and without payment of use charges. Provide connections and extensions of services as required for construction operations at no cost to the Owner.
   a. Electric Service: Comply with NECA, NEMA, and UL standards and regulations for temporary electric service. Install service to comply with NFPA 70.
   b. Tests and Inspections: Arrange for authorities having jurisdiction to test and inspect each temporary utility before use. Obtain required certifications and permits.

1.4 QUALITY ASSURANCE

A. Electric Service: Comply with NECA, NEMA, and UL standards and regulations for temporary electric service. Install service to comply with NFPA 70.

B. Tests and Inspections: Arrange for authorities having jurisdiction to test and inspect each temporary utility before use. Obtain required certifications and permits.

1.5 PROJECT CONDITIONS

A. Temporary Use of Permanent Facilities: Engage Installer of each permanent service to assume responsibility for operation, maintenance, and protection of each permanent service during its use as a construction facility before Owner's acceptance, regardless of previously assigned responsibilities.

1.6 DEFINITIONS

A. Included within the **Contract agreement** and within each specific specification section.

PART 2 - PRODUCTS

2.1 TEMPORARY FENCING

A. Chain-Link Fencing: Minimum 2-inch , 0.148-inch- thick, galvanized-steel, chain-link fabric fencing; minimum 6 feet high with galvanized-steel pipe posts; minimum 2-3/8-

inch- OD line posts and 2-7/8-inch- OD corner and pull posts, with 1-5/8-inch- OD top rails.

B. Portable Chain-Link Fencing: Minimum 2-inch , 0.148-inch- thick, galvanized-steel, chain-link fabric fencing; minimum 6 feet high with galvanized-steel pipe posts; minimum 2-3/8-inch- OD line posts and 2-7/8-inch- OD corner and pull posts, with 1-5/8-inch- OD top and bottom rails. Provide galvanized-steel bases for supporting posts.

2.2 TEMPORARY FACILITIES

A. Field Offices, General: Prefabricated or mobile units with serviceable finishes, temperature controls, and foundations adequate for normal loading.

B. Common-Use Field Office: Of sufficient size to accommodate needs of Owner, Architect**,** and construction personnel office activities and to accommodate Project meetings specified in **Contract agreement**. Keep office clean and orderly.

C. Storage and Fabrication Sheds: Provide sheds sized, furnished, and equipped to accommodate materials and equipment for construction operations.

1. Store combustible materials apart from building.

2.3 EQUIPMENT

A. Fire Extinguishers: Portable, UL rated; with class and extinguishing agent as required by locations and classes of fire exposures.

B. HVAC Equipment: Unless Owner authorizes use of permanent HVAC system, provide vented, self-contained, liquid-propane-gas or fuel-oil heaters with individual space thermostatic control.

1. Use of gasoline-burning space heaters, open-flame heaters, or salamander-type heating units is prohibited.
2. Heating Units: Listed and labeled for type of fuel being consumed, by a qualified testing agency acceptable to authorities having jurisdiction, and marked for intended location and application.
3. Permanent HVAC System: If Owner authorizes use of permanent HVAC system for temporary use during construction, provide filter with MERV of 8 at each return-air grille in system and remove at end of construction and clean HVAC system as required in Section 017700 "Closeout Procedures".

PART 3 - EXECUTION

3.1 INSTALLATION, GENERAL

A. Locate facilities where they will serve Project adequately and result in minimum interference with performance of the Work. Relocate and modify facilities as required by progress of the Work.

1. Locate facilities to limit site disturbance.

B. Provide each facility ready for use when needed to avoid delay. Do not remove until facilities are no longer needed or are replaced by authorized use of completed permanent facilities.

3.2 TEMPORARY UTILITY INSTALLATION

A. General: Install temporary service or connect to existing service.

1. Arrange with utility company, Owner, and existing users for time when service can be interrupted, if necessary, to make connections for temporary services.

B. Water Service: Connect to Owner's existing water service facilities. Clean and maintain water service facilities in a condition acceptable to Owner. At Substantial Completion, restore these facilities to condition existing before initial use.

C. Sanitary Facilities: Provide temporary toilets, wash facilities, and drinking water for use of construction personnel. Comply with requirements of authorities having jurisdiction for type, number, location, operation, and maintenance of fixtures and facilities.

D. Heating: Provide temporary heating required by construction activities for curing or drying of completed installations or for protecting installed construction from adverse effects of low temperatures or high humidity. Select equipment that will not have a harmful effect on completed installations or elements being installed.

E. Electric Power Service: Connect to Owner's existing electric power service. Maintain equipment in a condition acceptable to Owner.

F. Electric Power Service: Provide electric power service and distribution system of sufficient size, capacity, and power characteristics required for construction operations.

1. Install electric power service overhead unless otherwise indicated.
2. Connect temporary service to Owner's existing power source, as directed by Owner.

G. Lighting: Provide temporary lighting with local switching that provides adequate illumination for construction operations, observations, inspections, and traffic conditions.

1. Install and operate temporary lighting that fulfills security and protection requirements without operating entire system.

2. Install lighting for Project identification sign.

H. Telephone Service: Provide temporary telephone service in common-use facilities for use by all construction personnel

1. Provide superintendent with cellular telephone or portable two-way radio for use when away from field office.

3.3 SUPPORT FACILITIES INSTALLATION

A. General: Comply with the following:

B. Temporary Roads and Paved Areas: Construct and maintain temporary roads and paved areas adequate for construction operations. Locate temporary roads and paved areas within construction limits indicated on Drawings.

1. Provide dust-control treatment that is nonpolluting and nontracking. Reapply treatment as required to minimize dust.

C. Traffic Controls: Comply with requirements of authorities having jurisdiction.

1. Protect existing site improvements to remain including curbs, pavement, and utilities.
2. Maintain access for fire-fighting equipment and access to fire hydrants.

D. Parking: Provide temporary parking areas for construction personnel.

E. Project Signs: Provide Project signs as indicated. Unauthorized signs are not permitted.

1. Identification Signs: Provide Project identification signs as indicated on Drawings.
2. Temporary Signs: Provide other signs as indicated and as required to inform public and individuals seeking entrance to Project.

a. Provide temporary, directional signs for construction personnel and visitors.

3. Maintain and touchup signs so they are legible at all times.

F. Waste Disposal Facilities: Provide waste-collection containers in sizes adequate to handle waste from construction operations. Comply with requirements of authorities having jurisdiction.

3.4 SECURITY AND PROTECTION FACILITIES INSTALLATION

A. Protection of Existing Facilities: Protect existing vegetation, equipment, structures, utilities, and other improvements at Project site and on adjacent properties, except those indicated to be removed or altered. Repair damage to existing facilities.

B. Environmental Protection: Provide protection, operate temporary facilities, and conduct construction as required to comply with environmental regulations and that minimize possible air, waterway, and subsoil contamination or pollution or other undesirable effects.

C. Stormwater Control: Comply with requirements of authorities having jurisdiction. Provide barriers in and around excavations and subgrade construction to prevent flooding by runoff of stormwater from heavy rains.

D. Tree and Plant Protection: Install temporary fencing located as indicated or outside the drip line of trees to protect vegetation from damage from construction operations. Protect tree root systems from damage, flooding, and erosion.

E. Pest Control: Engage pest-control service to recommend practices to minimize attraction and harboring of rodents, roaches, and other pests and to perform extermination and control procedures at regular intervals so Project will be free of pests and their residues at Substantial Completion. Perform control operations lawfully, using environmentally safe materials.

F. Site Enclosure Fence: Prior to commencing earthwork, furnish and install site enclosure fence in a manner that will prevent people and animals from easily entering site except by entrance gates.

1. Extent of Fence: As required to enclose entire Project site or portion determined sufficient to accommodate construction operations and / or as indicated on Drawings.
2. Maintain security by limiting number of keys and restricting distribution to authorized personnel. Furnish one set of keys to Owner.

G. Security Enclosure and Lockup: Install temporary enclosure around partially completed areas of construction. Provide lockable entrances to prevent unauthorized entrance, vandalism, theft, and similar violations of security. Lock entrances at end of each workday.

H. Barricades, Warning Signs, and Lights: Comply with requirements of authorities having jurisdiction for erecting structurally adequate barricades, including warning signs and lighting.

I. Temporary Egress: Maintain temporary egress from existing occupied facilities as indicated and as required by authorities having jurisdiction.

J. Covered Walkway: Erect protective, covered walkway for passage of individuals through or adjacent to Project site. Coordinate with entrance gates, other facilities, and obstructions. Comply with regulations of authorities having jurisdiction and requirements indicated on Drawings.

1. Construct covered walkways using scaffold or shoring framing.
2. Provide overhead decking, protective enclosure walls, handrails, barricades, warning signs, exit signs, lights, safe and well-drained walkways, and similar provisions for protection and safe passage.
3. Paint and maintain appearance of walkway for duration of the Work.

K. Temporary Enclosures: Provide temporary enclosures for protection of construction, in progress and completed, from exposure, foul weather, other construction operations, and similar activities. Provide temporary weathertight enclosure for building exterior.

1. Where heating or cooling is needed and permanent enclosure is incomplete, insulate temporary enclosures.

L. Temporary Partitions: Provide floor-to-ceiling dustproof partitions to limit dust and dirt migration and to separate areas occupied by Owner from fumes and noise.

1. Construct dustproof partitions with gypsum wallboard with joints taped on occupied side, and fire-retardant-treated plywood on construction operations side.
2. Construct dustproof partitions with two layers of 6-mil polyethylene sheet on each side. Cover floor with two layers of 6-mil polyethylene sheet, extending sheets 18 inches up the sidewalls. Overlap and tape full length of joints. Cover floor with fire-retardant-treated plywood.

   a. Construct vestibule and airlock at each entrance through temporary partition with not less than 48 inches between doors. Maintain water-dampened foot mats in vestibule.

3. Where fire-resistance-rated temporary partitions are indicated or are required by authorities having jurisdiction, construct partitions according to the rated assemblies.
4. Insulate partitions to control noise transmission to occupied areas.
5. Seal joints and perimeter. Equip partitions with gasketed dustproof doors and security locks where openings are required.
6. Protect air-handling equipment.
7. Provide walk-off mats at each entrance through temporary partition.

3.5 OPERATION, TERMINATION, AND REMOVAL

A. Supervision: Enforce strict discipline in use of temporary facilities. To minimize waste and abuse, limit availability of temporary facilities to essential and intended uses.

B. Maintenance: Maintain facilities in good operating condition until removal.

1. Maintain operation of temporary enclosures, heating, cooling, humidity control, ventilation, and similar facilities on a 24-hour basis where required to achieve indicated results and to avoid possibility of damage.

C. Operate Project-identification-sign lighting daily from dusk until 12:00 midnight.

D. Temporary Facility Changeover: Do not change over from using temporary security and protection facilities to permanent facilities until Substantial Completion.

E. Termination and Removal: Remove each temporary facility when need for its service has ended, when it has been replaced by authorized use of a permanent facility, or no later than Substantial Completion. Complete or, if necessary, restore permanent

construction that may have been delayed because of interference with temporary facility. Repair damaged Work, clean exposed surfaces, and replace construction that cannot be satisfactorily repaired.

1. Materials and facilities that constitute temporary facilities are property of Contractor. Owner reserves right to take possession of Project identification signs.
2. Remove temporary roads and paved areas not intended for or acceptable for integration into permanent construction. Where area is intended for landscape development, remove soil and aggregate fill that do not comply with requirements for fill or subsoil. Remove materials contaminated with road oil, asphalt and other petrochemical compounds, and other substances that might impair growth of plant materials or lawns. Repair or replace street paving, curbs, and sidewalks at temporary entrances, as required by authorities having jurisdiction.
3. At Substantial Completion, repair, renovate, and clean permanent facilities used during construction period. Comply with final cleaning requirements specified in Section 017700 "Closeout Procedures."

END OF SECTION 013100

SECTION 017300 - EXECUTION

PART 1 - GENERAL

1.1 SUMMARY

A. Section includes general administrative and procedural requirements governing execution of the Work including, but not limited to, the following:
   1. Installation of the Work.
   2. Cutting and patching.
   3. Coordination of Owner-installed products.
   4. Progress cleaning.
   5. Starting and adjusting.
   6. Protection of installed construction.

1.2 QUALITY ASSURANCE

A. Other Construction Elements: Do not cut and patch other construction elements or components in a manner that could change their load-carrying capacity, that results in reducing their capacity to perform as intended, or that results in increased maintenance or decreased operational life or safety

B. Visual Elements: Do not cut and patch construction in a manner that results in visual evidence of cutting and patching. Do not cut and patch exposed construction in a manner that would, in Architect's opinion, reduce the building's aesthetic qualities. Remove and replace construction that has been cut and patched in a visually unsatisfactory manner.

C. Manufacturer's Installation Instructions: Obtain and maintain on-site manufacturer's written recommendations and instructions for installation of products and equipment.

PART 2 - PRODUCTS

2.1 MATERIALS

A. General: Comply with requirements specified in other Sections.

B. In-Place Materials: Use materials for patching identical to in-place materials. For exposed surfaces, use materials that visually match in-place adjacent surfaces to the fullest extent possible.

   1. If identical materials are unavailable or cannot be used, use materials that, when installed, will provide a match acceptable to Architect for the visual and functional performance of in-place materials.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Existing Conditions: The existence and location of underground and other utilities and construction indicated as existing are not guaranteed. Before beginning sitework, investigate and verify the existence and location of underground utilities, **mechanical and electrical systems,** and other construction affecting the Work.

1. Before construction, verify the location and invert elevation at points of connection of sanitary sewer, storm sewer, and water-service piping; underground electrical services, and other utilities.
2. Furnish location data for work related to Project that must be performed by public utilities serving Project site.

B. Examination and Acceptance of Conditions: Before proceeding with each component of the Work, examine substrates, areas, and conditions, with Installer or Applicator present where indicated, for compliance with requirements for installation tolerances and other conditions affecting performance. Record observations.

1. Examine roughing-in for mechanical and electrical systems to verify actual locations of connections before equipment and fixture installation.
2. Examine walls, floors, and roofs for suitable conditions where products and systems are to be installed.
3. Verify compatibility with and suitability of substrates, including compatibility with existing finishes or primers.

C. Proceed with installation only after unsatisfactory conditions have been corrected. Proceeding with the Work indicates acceptance of surfaces and conditions.

3.2 PREPARATION

A. Existing Utility Information: Furnish information to **local utility and to Owner** that is necessary to adjust, move, or relocate existing utility structures, utility poles, lines, services, or other utility appurtenances located in or affected by construction. Coordinate with authorities having jurisdiction.

B. Field Measurements: Take field measurements as required to fit the Work properly. Recheck measurements before installing each product. Where portions of the Work are indicated to fit to other construction, verify dimensions of other construction by field measurements before fabrication. Coordinate fabrication schedule with construction progress to avoid delaying the Work.

C. Space Requirements: Verify space requirements and dimensions of items shown diagrammatically on Drawings.

D. Review of Contract Documents and Field Conditions: Immediately on discovery of the need for clarification of the Contract Documents caused by differing field conditions outside the control of Contractor, submit a request for information to Owner.

3.3 CONSTRUCTION LAYOUT

A. Verification: Before proceeding to lay out the Work, verify layout information shown on Drawings, in relation to the property survey and existing benchmarks. If discrepancies are discovered, notify Engineer **and Owner** promptly.

3.4 FIELD ENGINEERING

A. Identification: Owner will identify existing benchmarks, control points, and property corners.

B. Reference Points: Locate existing permanent benchmarks, control points, and similar reference points before beginning the Work. Preserve and protect permanent benchmarks and control points during construction operations.

1. Do not change or relocate existing benchmarks or control points without prior written approval of Architect **or Owner**. Report lost or destroyed permanent benchmarks or control points promptly.
2. Replace lost or destroyed permanent benchmarks and control points promptly. Base replacements on the original survey control points.

3.5 PROTECTION OF INSTALLED CONSTRUCTION

A. Provide final protection and maintain conditions that ensure installed Work is without damage or deterioration at time of Substantial Completion.

END OF SECTION 017300

SECTION 017419 - CONSTRUCTION WASTE MANAGEMENT AND DISPOSAL

PART 1 GENERAL

1.1 SUMMARY

A. Section Includes:
1. Construction waste management plan.
2. Construction waste recycling.
3. Construction waste adaptive reuse.

1.2 PLAN REQUIREMENTS

A. Develop and implement construction waste management plan as approved by Architect/Engineer.

B. Intent:
1. Divert construction, demolition, and land-clearing debris from landfill disposal.
2. Redirect recyclable material back to manufacturing process.
3. Generate cost savings or increase minimal additional cost to Project for waste disposal.

1.3 SUBMITTALS

A. Construction Waste Management Plan: Submit construction waste management plan describing methods and procedures for implementation and monitoring compliance including the following:
1. Transportation company hauling construction waste to waste processing facilities.
2. Recycling and adaptive reuse processing facilities and waste type each facility will accept.
3. Construction waste materials anticipated for recycling and adaptive reuse.
4. On-Site sorting and Site storage methods.

1.4 CONSTRUCTION WASTE MANAGEMENT PLAN

A. Construction Waste Landfill Diversion: Minimum 50 percent by weight of construction waste materials for duration of Project through resale, recycling, or adaptive reuse.

B. Implement construction waste management plan at start of construction.

C. Review construction waste management plan at preconstruction meeting and progress meetings.

D. Distribute approved construction waste management plan to Subcontractors and others affected by plan requirements.

E. Oversee plan implementation, instruct construction personnel for plan compliance, and document plan results.

F. Purchase products to prevent waste by:
   1. Ensuring correct quantity of each material is delivered to Site.
   2. Choosing products with minimal or no packaging.
   3. Requiring suppliers to use returnable pallets or containers.
   4. Requiring suppliers to take or buy back rejected or unused items.

1.5 CONSTRUCTION WASTE RECYCLING

A. Use source separation method or comingling method suitable to sorting and processing method of selected recycling center. Dispose nonrecyclable trash separately into landfill.

B. Source Separation Method: Recyclable materials separated from trash and sorted into separate bins or containers, identified by waste type, prior to transportation to recycling center.

C. Comingling Method: Recyclable materials separated from trash and placed in unsorted bins or container for sorting at recycling center.

D. Materials suggested for recycling include:
   1. Packing materials including paper, cardboard, foam plastic, and sheeting.
   2. Recyclable plastics.
   3. Organic plant debris.
   4. Earth materials.
   5. Native stone and granular fill.
   6. Asphalt and concrete paving.
   7. Wood with and without embedded nails and staples.
   8. Glass, clear and colored types.
   9. Metals.
   10. Gypsum products.
   11. Acoustical ceiling tile.
   12. Carpet.
   13. Equipment oil.

1.6 CONSTRUCTION WASTE ADAPTIVE REUSE

A. Arrange with processing facility for salvage of construction material and processing for reuse. Do not reuse construction materials on-Site except as allowed by Architect/Engineer.

B. Materials suggested for adaptive reuse include:
   1. Concrete and crushed concrete.
   2. Masonry units.
   3. Lumber suitable for re-sawing or refinishing.
   4. Casework and millwork.
   5. Doors and door frames.
   6. Windows.
   7. Window glass and insulating glass units.
   8. Hardware.
   9. Acoustical ceiling tile.

10. Equipment and appliances.
11. Fluorescent light fixtures and lamps.
12. Incandescent light fixtures and lamps.

PART 2 PRODUCTS - Not Used

PART 3 EXECUTION

3.1 CONSTRUCTION WASTE COLLECTION

A. Collect construction waste materials in marked bins or containers and arrange for transportation to recycling centers or adaptive salvage and reuse processing facilities.

B. Maintain recycling and adaptive reuse storage and collection area in orderly arrangement with materials separated to eliminate co-mingling of materials required to be delivered separately to waste processing facility.

C. Store construction waste materials to prevent environmental pollution, fire hazards, hazards to persons and property, and contamination of stored materials.

D. Cover construction waste materials subject to disintegration, evaporation, settling, or runoff to prevent polluting air, water, and soil.

3.2 CONSTRUCTION WASTE DISPOSAL

A. Deliver construction waste to waste processing facilities. Obtain receipt for deliveries.

B. Dispose of construction waste not capable of being recycled or adaptively reused by delivery to landfill, incinerator, or other legal disposal facility. Obtain receipt for deliveries.

END OF SECTION

SECTION 017700 - CLOSEOUT PROCEDURES

PART 1 - GENERAL

1.1 SUMMARY

A. Section includes administrative and procedural requirements for contract closeout, including, but not limited to, the following:

1. Substantial Completion procedures.
2. Final completion procedures.
3. Warranties.
4. Final cleaning.
5. Repair of the Work.

1.2 ACTION SUBMITTALS

A. Contractor's List of Incomplete Items: Initial submittal at Substantial Completion.

B. Certified List of Incomplete Items: Final submittal at Final Completion.

1.3 CLOSEOUT SUBMITTALS

A. Certificates of Release: From all authorities having jurisdiction.

B. Certificate of Insurance: For continuing coverage.

1.4 SUBSTANTIAL COMPLETION PROCEDURES

A. Contractor's List of Incomplete Items: Prepare and submit a list of items to be completed and corrected (Contractor's punch list), indicating the value of each item on the list and reasons why the Work is incomplete.

B. Submittals Prior to Substantial Completion: Complete the following a minimum of 5 days prior to requesting inspection for determining date of Substantial Completion. List items below that are incomplete at time of request.

1. Submit closeout submittals specified in other Division 01 Sections, including project record documents, operation and maintenance manuals, final completion construction photographic documentation, damage or settlement surveys, property surveys, and similar final record information.

2. Submit closeout submittals specified in individual Sections, including specific warranties, workmanship bonds, maintenance service agreements, final certifications, and similar documents.
3. Submit changeover information related to Owner's occupancy, use, operation, and maintenance.

C. Procedures Prior to Substantial Completion: Complete the following a minimum of **5** days prior to requesting inspection for determining date of Substantial Completion. List items below that are incomplete at time of request.
1. Terminate and remove temporary facilities from Project site, along with mockups, construction tools, and similar elements.
2. Complete final cleaning requirements, including touchup painting.
3. Touch up and otherwise repair and restore marred exposed finishes to eliminate visual defects.

D. Inspection: Submit a written request for inspection to determine Substantial Completion a minimum of 5 days prior to date the work will be completed and ready for final inspection and tests. On receipt of request, Architect, Engineer and Owner will either proceed with inspection or notify Contractor of unfulfilled requirements. Architect and Engineer will prepare the Certificate of Substantial Completion after inspection or will notify Contractor of items, either on Contractor's list or additional items identified by the Architect and Engineer, that must be completed or corrected before certificate will be issued.

1. Reinspection: Request reinspection when the Work identified in previous inspections as incomplete is completed or corrected. Contractor shall compensate Architect and Engineer at the firm’s standard billing rates for additional reinspections beyond the first.
2. Results of completed inspection will form the basis of requirements for final completion.

1.5 FINAL COMPLETION PROCEDURES

A. Submittals Prior to Final Completion: Before requesting final inspection for determining final completion, complete the following:

1. Submit a final Application for Payment according to Section 012900 "Payment Procedures."
2. Certified List of Incomplete Items:
3. Certificate of Insurance: Submit evidence of final, continuing insurance coverage complying with insurance requirements.

B. Inspection: Submit a written request for final inspection to determine acceptance a minimum of 5 days prior to date the work will be completed and ready for final inspection and tests. Engineer will prepare a final Certificate for Payment after inspection or will notify Contractor of construction that must be completed or corrected before certificate will be issued.
1. Reinspection: Request reinspection when the Work identified in previous inspections as incomplete is completed or corrected. Contractor shall

compensate Architect and Engineer at the firm's standard billing rates for additional reinspections beyond the first.

1.6 SUBMITTAL OF PROJECT WARRANTIES

A. Time of Submittal: Submit written warranties on request of Owner for designated portions of the Work where commencement of warranties other than date of Substantial Completion is indicated, or when delay in submittal of warranties might limit Owner's rights under warranty.

B. Provide additional copies of each warranty to include in operation and maintenance manuals.

PART 2 - PRODUCTS

2.1 NOT USED

PART 3 - EXECUTION

3.1 FINAL CLEANING

A. General: Perform final cleaning. Conduct cleaning and waste-removal operations to comply with local laws and ordinances and Federal and local environmental and antipollution regulations.

B. Cleaning: Clean each surface or unit to condition expected in an average commercial building cleaning and maintenance program. Comply with manufacturer's written instructions.

C. Construction Waste Disposal: Comply with waste disposal requirements specified.

3.2 REPAIR OF THE WORK

A. Complete repair and restoration operations before requesting inspection for determination of Substantial Completion.

B. Repair or remove and replace defective construction. Repairing includes replacing defective parts, refinishing damaged surfaces, touching up with matching materials, and properly adjusting operating equipment. Where damaged or worn items cannot be repaired or restored, provide replacements. Remove and replace operating components that cannot be repaired. Restore damaged construction and permanent facilities used during construction to specified condition.

END OF SECTION 017700

SECTION 017823 - OPERATION AND MAINTENANCE DATA

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and other Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

A. Section includes administrative and procedural requirements for preparing operation and maintenance manuals, including the following:

1. Operation and maintenance documentation directory.
2. Emergency manuals.
3. Operation manuals for systems, subsystems, and equipment.
4. Product maintenance manuals.
5. Systems and equipment maintenance manuals.

1.3 CLOSEOUT SUBMITTALS

A. Manual Content: Operations and maintenance manual content is specified in individual Specification Sections to be reviewed at the time of Section submittals. Submit reviewed manual content formatted and organized as required by this Section.

B. Format: Submit operations and maintenance manuals in the following format:

1. PDF electronic file. Assemble each manual into a composite electronically indexed file. Submit on digital media acceptable to Architect.

   a. Name each indexed document file in composite electronic index with applicable item name. Include a complete electronically linked operation and maintenance directory.
   b. Enable inserted reviewer comments on draft submittals.

C. Initial Manual Submittal: Submit draft copy of each manual at least **30** days before commencing demonstration and training. Engineer will determine whether general scope and content of manual are acceptable.

D. Final Manual Submittal: Submit each manual in final form prior to requesting inspection for Substantial Completion and at least **15** days before commencing demonstration and training.

PART 2 - PRODUCTS

2.1 OPERATION AND MAINTENANCE DOCUMENTATION DIRECTORY

A. Directory: Prepare a single, comprehensive directory of emergency, operation, and maintenance data and materials, listing items and their location to facilitate ready access to desired information. Include a section in the directory for each of the following:

1. List of documents.
2. List of systems.
3. List of equipment.
4. Table of contents.

B. List of Systems and Subsystems: List systems alphabetically. Include references to operation and maintenance manuals that contain information about each system.

C. List of Equipment: List equipment for each system, organized alphabetically by system. For pieces of equipment not part of system, list alphabetically in separate list.

D. Tables of Contents: Include a table of contents for each emergency, operation, and maintenance manual.

E. Identification: In the documentation directory and in each operation and maintenance manual, identify each system, subsystem, and piece of equipment with same designation used in the Contract Documents. If no designation exists, assign a designation according to ASHRAE Guideline 4, "Preparation of Operating and Maintenance Documentation for Building Systems."

2.2 REQUIREMENTS FOR EMERGENCY, OPERATION, AND MAINTENANCE MANUALS

A. Organization: Unless otherwise indicated, organize each manual into a separate section for each system and subsystem, and a separate section for each piece of equipment not part of a system. Each manual shall contain the following materials, in the order listed:

1. Title page.
2. Table of contents.
3. Manual contents.

B. Title Page: Include the following information:

1. Subject matter included in manual.
2. Name and address of Project.
3. Name and address of Owner.
4. Date of submittal.
5. Name and contact information for Contractor.
6. Name and contact information for Construction Manager.

7. Name and contact information for Architect.
8. Name and contact information for Commissioning Authority.
9. Names and contact information for major consultants to the Architect that designed the systems contained in the manuals.
10. Cross-reference to related systems in other operation and maintenance manuals.

C. Table of Contents: List each product included in manual, identified by product name, indexed to the content of the volume, and cross-referenced to Specification Section number in Project Manual.

1. If operation or maintenance documentation requires more than one volume to accommodate data, include comprehensive table of contents for all volumes in each volume of the set.

D. Manual Contents: Organize into sets of manageable size. Arrange contents alphabetically by system, subsystem, and equipment. If possible, assemble instructions for subsystems, equipment, and components of one system into a single binder.

E. Manuals, Electronic Files: Submit manuals in the form of a multiple file composite electronic PDF file for each manual type required.

1. Electronic Files: Use electronic files prepared by manufacturer where available. Where scanning of paper documents is required, configure scanned file for minimum readable file size.

2. File Names and Bookmarks: Enable bookmarking of individual documents based on file names. Name document files to correspond to system, subsystem, and equipment names used in manual directory and table of contents. Group documents for each system and subsystem into individual composite bookmarked files, then create composite manual, so that resulting bookmarks reflect the system, subsystem, and equipment names in a readily navigated file tree. Configure electronic manual to display bookmark panel on opening file.

F. Manuals, Paper Copy: Submit manuals in the form of hard copy, bound and labeled volumes.

1. Binders: Heavy-duty, three-ring, vinyl-covered, **loose-leaf** binders, in thickness necessary to accommodate contents, sized to hold 8-1/2-by-11-inch paper; with clear plastic sleeve on spine to hold label describing contents and with pockets inside covers to hold folded oversize sheets.

a. If two or more binders are necessary to accommodate data of a system, organize data in each binder into groupings by subsystem and related components. Cross-reference other binders if necessary to provide essential information for proper operation or maintenance of equipment or system.
b. Identify each binder on front and spine, with printed title "OPERATION AND MAINTENANCE MANUAL," Project title or name, **and** subject matter

of contents**, and indicate Specification Section number on bottom of spine**. Indicate volume number for multiple-volume sets.

2. Dividers: Heavy-paper dividers with plastic-covered tabs for each section of the manual. Mark each tab to indicate contents. Include typed list of products and major components of equipment included in the section on each divider, cross-referenced to Specification Section number and title of Project Manual.
3. Protective Plastic Sleeves: Transparent plastic sleeves designed to enclose diagnostic software storage media for computerized electronic equipment.
4. Supplementary Text: Prepared on 8-1/2-by-11-inch white bond paper.
5. Drawings: Attach reinforced, punched binder tabs on drawings and bind with text.

    a. If oversize drawings are necessary, fold drawings to same size as text pages and use as foldouts.
    b. If drawings are too large to be used as foldouts, fold and place drawings in labeled envelopes and bind envelopes in rear of manual. At appropriate locations in manual, insert typewritten pages indicating drawing titles, descriptions of contents, and drawing locations.

2.3 OPERATION MANUALS

A. Content: In addition to requirements in this Section, include operation data required in individual Specification Sections and the following information:

1. System, subsystem, and equipment descriptions. Use designations for systems and equipment indicated on Contract Documents.
2. Performance and design criteria if Contractor has delegated design responsibility.
3. Operating standards.
4. Operating procedures.
5. Operating logs.
6. Wiring diagrams.
7. Control diagrams.
8. Piped system diagrams.
9. Precautions against improper use.
10. License requirements including inspection and renewal dates.

B. Descriptions: Include the following:

1. Product name and model number. Use designations for products indicated on Contract Documents.
2. Manufacturer's name.
3. Equipment identification with serial number of each component.
4. Equipment function.
5. Operating characteristics.
6. Limiting conditions.
7. Performance curves.
8. Engineering data and tests.
9. Complete nomenclature and number of replacement parts.

C. Operating Procedures: Include the following, as applicable:

1. Startup procedures.
2. Equipment or system break-in procedures.
3. Routine and normal operating instructions.
4. Regulation and control procedures.
5. Instructions on stopping.
6. Normal shutdown instructions.
7. Seasonal and weekend operating instructions.
8. Required sequences for electric or electronic systems.
9. Special operating instructions and procedures.

D. Systems and Equipment Controls: Describe the sequence of operation, and diagram controls as installed.

E. Piped Systems: Diagram piping as installed and identify color-coding where required for identification.

2.4 PRODUCT MAINTENANCE MANUALS

A. Content: Organize manual into a separate section for each product, material, and finish. Include source information, product information, maintenance procedures, repair materials and sources, and warranties and bonds, as described below.

B. Source Information: List each product included in manual, identified by product name and arranged to match manual's table of contents. For each product, list name, address, and telephone number of Installer or supplier and maintenance service agent, and cross-reference Specification Section number and title in Project Manual and drawing or schedule designation or identifier where applicable.

C. Product Information: Include the following, as applicable:

1. Product name and model number.
2. Manufacturer's name.
3. Color, pattern, and texture.
4. Material and chemical composition.
5. Reordering information for specially manufactured products.

D. Maintenance Procedures: Include manufacturer's written recommendations and the following:

1. Inspection procedures.
2. Types of cleaning agents to be used and methods of cleaning.
3. List of cleaning agents and methods of cleaning detrimental to product.
4. Schedule for routine cleaning and maintenance.
5. Repair instructions.

E. Repair Materials and Sources: Include lists of materials and local sources of materials and related services.

F. Warranties and Bonds: Include copies of warranties and bonds and lists of circumstances and conditions that would affect validity of warranties or bonds.

1. Include procedures to follow and required notifications for warranty claims.

2.5 SYSTEMS AND EQUIPMENT MAINTENANCE MANUALS

A. Content: For each system, subsystem, and piece of equipment not part of a system, include source information, manufacturers' maintenance documentation, maintenance procedures, maintenance and service schedules, spare parts list and source information, maintenance service contracts, and warranty and bond information, as described below.

B. Source Information: List each system, subsystem, and piece of equipment included in manual, identified by product name and arranged to match manual's table of contents. For each product, list name, address, and telephone number of Installer or supplier and maintenance service agent, and cross-reference Specification Section number and title in Project Manual and drawing or schedule designation or identifier where applicable.

C. Manufacturers' Maintenance Documentation: Manufacturers' maintenance documentation including the following information for each component part or piece of equipment:

1. Standard maintenance instructions and bulletins.
2. Drawings, diagrams, and instructions required for maintenance, including disassembly and component removal, replacement, and assembly.
3. Identification and nomenclature of parts and components.
4. List of items recommended to be stocked as spare parts.

D. Maintenance Procedures: Include the following information and items that detail essential maintenance procedures:

1. Test and inspection instructions.
2. Troubleshooting guide.
3. Precautions against improper maintenance.
4. Disassembly; component removal, repair, and replacement; and reassembly instructions.
5. Aligning, adjusting, and checking instructions.
6. Demonstration and training video recording, if available. Provide recording in commonly used digital format.

E. Maintenance and Service Schedules: Include service and lubrication requirements, list of required lubricants for equipment, and separate schedules for preventive and routine maintenance and service with standard time allotment.

1. Scheduled Maintenance and Service: Tabulate actions for daily, weekly, monthly, quarterly, semiannual, and annual frequencies.
2. Maintenance and Service Record: Include manufacturers' forms for recording maintenance.

F. Spare Parts List and Source Information: Include lists of replacement and repair parts, with parts identified and cross-referenced to manufacturers' maintenance documentation and local sources of maintenance materials and related services.

G. Maintenance Service Contracts: Include copies of maintenance agreements with name and telephone number of service agent.

H. Warranties and Bonds: Include copies of warranties and bonds and lists of circumstances and conditions that would affect validity of warranties or bonds.

1. Include procedures to follow and required notifications for warranty claims.

PART 3 - EXECUTION

3.1 MANUAL PREPARATION

A. Operation and Maintenance Documentation Directory: Prepare a separate manual that provides an organized reference to emergency, operation, and maintenance manuals.

B. Emergency Manual: Assemble a complete set of emergency information indicating procedures for use by emergency personnel and by Owner's operating personnel for types of emergencies indicated.

C. Product Maintenance Manual: Assemble a complete set of maintenance data indicating care and maintenance of each product, material, and finish incorporated into the Work.

D. Operation and Maintenance Manuals: Assemble a complete set of operation and maintenance data indicating operation and maintenance of each system, subsystem, and piece of equipment not part of a system.

1. Engage a factory-authorized service representative to assemble and prepare information for each system, subsystem, and piece of equipment not part of a system.
2. Prepare a separate manual for each system and subsystem, in the form of an instructional manual for use by Owner's operating personnel.

E. Manufacturers' Data: Where manuals contain manufacturers' standard printed data, include only sheets pertinent to product or component installed. Mark each sheet to identify each product or component incorporated into the Work. If data include more than one item in a tabular format, identify each item using appropriate references from the Contract Documents. Identify data applicable to the Work and delete references to information not applicable.

1. Prepare supplementary text if manufacturers' standard printed data are not available and where the information is necessary for proper operation and maintenance of equipment or systems.

F. Drawings: Prepare drawings supplementing manufacturers' printed data to illustrate the relationship of component parts of equipment and systems and to illustrate control sequence and flow diagrams. Coordinate these drawings with information contained in record Drawings to ensure correct illustration of completed installation.

1. Do not use original project record documents as part of operation and maintenance manuals.
2. Comply with requirements of newly prepared record Drawings in Section 017839 "Project Record Documents."

G. Comply with Section 017700 "Closeout Procedures" for schedule for submitting operation and maintenance documentation.

END OF SECTION 017823

SECTION 017839 - PROJECT RECORD DOCUMENTS

PART 1 - GENERAL

1.1 SUMMARY

A. Section includes administrative and procedural requirements for project record documents, including the following:

1. Record Drawings.
2. Record Specifications.
3. Record Product Data.
4. Miscellaneous record submittals.

1.2 CLOSEOUT SUBMITTALS

A. Record Drawings:

1. Number of Copies: Submit **one** set(s) of marked-up record prints.

a. Final Submittal:
1) Submit PDF electronic files of scanned record prints and one set of prints.
2) Print each drawing, whether changes and additional information were recorded.

B. Record Specifications: Submit **one paper copy and annotated PDF electronic file** of Project's Specifications, including addenda and contract modifications.

C. Record Product Data: Submit **one paper copy and annotated PDF electronic files and directories** of each submittal.

1. Where record Product Data are required as part of operation and maintenance manuals, submit duplicate marked-up Product Data as a component of manual.

D. Miscellaneous Record Submittals: See other Specification Sections for miscellaneous record-keeping requirements and submittals in connection with various construction activities. Submit **one paper copy and annotated PDF electronic files** of each submittal.

PART 2 - PRODUCTS

2.1 RECORD DRAWINGS

A. Record Prints: Maintain one set of marked-up paper copies of the Contract Drawings and Shop Drawings, incorporating new and revised drawings as modifications are issued.

1. Preparation: Mark record prints to show the actual installation where installation varies from that shown originally. Require individual or entity who obtained record data, whether individual or entity is Installer, subcontractor, or similar entity, to provide information for preparation of corresponding marked-up record prints.

    a. Give particular attention to information on concealed elements that would be difficult to identify or measure and record later.
    b. Accurately record information in an acceptable drawing technique.
    c. Record data as soon as possible after obtaining it.
    d. Record and check the markup before enclosing concealed installations.

2. Mark the Contract Drawings and Shop Drawings completely and accurately. Use personnel proficient at recording graphic information in production of marked-up record prints.
3. Mark record sets with erasable, red-colored pencil. Use other colors to distinguish between changes for different categories of the Work at same location.
4. Mark important additional information that was either shown schematically or omitted from original Drawings.
5. Note Construction Change Directive numbers, alternate numbers, Change Order numbers, and similar identification, where applicable.

2.2 RECORD SPECIFICATIONS

A. Preparation: Mark Specifications to indicate the actual product installation where installation varies from that indicated in Specifications, addenda, and contract modifications.

1. Give particular attention to information on concealed products and installations that cannot be readily identified and recorded later.
2. Mark copy with the proprietary name and model number of products, materials, and equipment furnished, including substitutions and product options selected.
3. Record the name of manufacturer, supplier, Installer, and other information necessary to provide a record of selections made.
4. For each principal product, indicate whether record Product Data has been submitted in operation and maintenance manuals instead of submitted as record Product Data.
5. Note related Change Orders**, record Product Data,** and record Drawings where applicable.

B. Format: Submit record Specifications as **scanned PDF electronic file(s) of marked-up paper copy of Specifications**.

PART 3 - EXECUTION

3.1 RECORDING AND MAINTENANCE

A. Recording: Maintain one copy of each submittal during the construction period for project record document purposes. Post changes and revisions to project record documents as they occur; do not wait until end of Project.

B. Maintenance of Record Documents and Samples: Store record documents and Samples in the field office apart from the Contract Documents used for construction. Do not use project record documents for construction purposes. Maintain record documents in good order and in a clean, dry, legible condition, protected from deterioration and loss. Provide access to project record documents for Engineer's **and Owner's** reference at all times work is being performed.

END OF SECTION 017839

SECTION 017900 - DEMONSTRATION AND TRAINING

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and other Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

A. Section includes administrative and procedural requirements for instructing Owner's personnel, including the following:

1. Demonstration of operation of systems, subsystems, and equipment.
2. Training in operation and maintenance of systems, subsystems, and equipment.
3. Demonstration and training video recordings.

1.3 INFORMATIONAL SUBMITTALS

A. Instruction Program: Submit outline of instructional program for demonstration and training, including a list of training modules and a schedule of proposed dates, times, length of instruction time, and instructors' names for each training module. Include learning objective and outline for each training module.

1. Indicate proposed training modules using manufacturer-produced demonstration and training video recordings for systems, equipment, and products in lieu of video recording of live instructional module.

B. Attendance Record: For each training module, submit list of participants and length of instruction time.

C. Evaluations: For each participant and for each training module, submit results and documentation of performance-based test.

1.4 COORDINATION

A. Coordinate instruction schedule with Owner's operations. Adjust schedule as required to minimize disrupting Owner's operations and to ensure availability of Owner's personnel.

B. Coordinate instructors, including providing notification of dates, times, length of instruction time, and course content.

C. Coordinate content of training modules with content of approved emergency, operation, and maintenance manuals. Do not submit instruction program until operation and maintenance data has been reviewed and approved by Architect.

PART 2 - PRODUCTS

2.1 INSTRUCTION PROGRAM

A. Program Structure: Develop an instruction program that includes individual training modules for each system and for equipment not part of a system, as required by individual Specification Sections.

B. Training Modules: Develop a learning objective and teaching outline for each module. Include a description of specific skills and knowledge that participant is expected to master. For each module, include instruction for the following as applicable to the system, equipment, or component:

1. Basis of System Design, Operational Requirements, and Criteria: Include the following:

    a. System, subsystem, and equipment descriptions.
    b. Performance and design criteria if Contractor is delegated design responsibility.
    c. Operating standards.
    d. Regulatory requirements.
    e. Equipment function.
    f. Operating characteristics.
    g. Limiting conditions.
    h. Performance curves.

2. Documentation: Review the following items in detail:
    a. Operations manuals.
    b. Maintenance manuals.
    c. Project record documents.
    d. Identification systems.
    e. Warranties and bonds.
    f. Maintenance service agreements and similar continuing commitments.

3. Emergencies: Include the following, as applicable:

    a. Instructions on meaning of warnings, trouble indications, and error messages.
    b. Instructions on stopping.
    c. Shutdown instructions for each type of emergency.
    d. Operating instructions for conditions outside of normal operating limits.
    e. Sequences for electric or electronic systems.
    f. Special operating instructions and procedures.

4. Operations: Include the following, as applicable:

a. Startup procedures.
b. Equipment or system break-in procedures.
c. Routine and normal operating instructions.
d. Regulation and control procedures.
e. Control sequences.
f. Safety procedures.
g. Instructions on stopping.
h. Normal shutdown instructions.
i. Operating procedures for emergencies.
j. Operating procedures for system, subsystem, or equipment failure.
k. Seasonal and weekend operating instructions.
l. Required sequences for electric or electronic systems.
m. Special operating instructions and procedures.

5. Adjustments: Include the following:

a. Alignments.
b. Checking adjustments.
c. Noise and vibration adjustments.
d. Economy and efficiency adjustments.

6. Troubleshooting: Include the following:

a. Diagnostic instructions.
b. Test and inspection procedures.

7. Maintenance: Include the following:

a. Inspection procedures.
b. Types of cleaning agents to be used and methods of cleaning.
c. List of cleaning agents and methods of cleaning detrimental to product.
d. Procedures for routine cleaning
e. Procedures for preventive maintenance.
f. Procedures for routine maintenance.
g. Instruction on use of special tools.

8. Repairs: Include the following:

a. Diagnosis instructions.
b. Repair instructions.
c. Disassembly; component removal, repair, and replacement; and reassembly instructions.
d. Instructions for identifying parts and components.
e. Review of spare parts needed for operation and maintenance.

PART 3 - EXECUTION

3.1 PREPARATION

A. Assemble educational materials necessary for instruction, including documentation and training module. Assemble training modules into a training manual organized in coordination with requirements in Section 017823 "Operation and Maintenance Data."

B. Set up instructional equipment at instruction location.

3.2 INSTRUCTION

A. Facilitator: Engage a qualified facilitator to prepare instruction program and training modules, to coordinate instructors, and to coordinate between Contractor and Owner for number of participants, instruction times, and location.

B. Engage qualified instructors to instruct Owner's personnel to adjust, operate, and maintain systems, subsystems, and equipment not part of a system.

1. Architect will furnish an instructor to describe basis of system design, operational requirements, criteria, and regulatory requirements.
2. Owner will furnish an instructor to describe Owner's operational philosophy.
3. Owner will furnish Contractor with names and positions of participants.

C. Training Location and Reference Material: Conduct training on-site in the completed and fully operational facility using the actual equipment in-place. Conduct training using final operation and maintenance data submittals.

3.3 DEMONSTRATION AND TRAINING VIDEO RECORDINGS

A. General: Engage a qualified commercial videographer to record demonstration and training video recordings. Record each training module separately. Include classroom instructions and demonstrations, board diagrams, and other visual aids, but not student practice.

1. At beginning of each training module, record each chart containing learning objective and lesson outline.

B. Video: Provide minimum 640 x 480 video resolution converted to **format file type acceptable to Owner**, on electronic media.

1. Electronic Media: Read-only format compact disc acceptable to Owner, with commercial-grade graphic label.
2. File Names: Utilize file names based upon name of equipment generally described in video segment, as identified in Project specifications.
3. Contractor and Installer Contact File: Using appropriate software, create a file for inclusion on the Equipment Demonstration and Training DVD that describes the following for each Contractor involved on the Project, arranged according to Project table of contents:

a. Name of Contractor/Installer.
b. Business address.
c. Business phone number.
d. Point of contact.
e. E-mail address.

C. Recording: Mount camera on tripod before starting recording, unless otherwise necessary to adequately cover area of demonstration and training. Display continuous running time.

1. Film training session(s) in segments not to exceed 15 minutes.

a. Produce segments to present a single significant piece of equipment per segment.
b. Organize segments with multiple pieces of equipment to follow order of Project Manual table of contents.
c. Where a training session on a particular piece of equipment exceeds 15 minutes, stop filming and pause training session. Begin training session again upon commencement of new filming segment.

D. Light Levels: Verify light levels are adequate to properly light equipment. Verify equipment markings are clearly visible prior to recording.

1. Furnish additional portable lighting as required.

E. Preproduced Video Recordings: Provide video recordings used as a component of training modules in same format as recordings of live training.

END OF SECTION 017900

SECTION 024119 - SELECTIVE DEMOLITION

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:

1. Demolition and removal of selected portions of building or structure.
2. Demolition and removal of selected site elements.
3. Salvage of existing items to be reused or recycled.

1.2 DEFINITIONS

A. Remove: Detach items from existing construction and legally dispose of all items off-site unless indicated to be removed and salvaged or removed and reinstalled.

B. Remove and Salvage: Carefully detach from existing construction, in a manner to prevent damage, and deliver to Owner ready for reuse.

C. Remove and Reinstall: Detach items from existing construction, prepare for reuse, and reinstall where indicated.

D. Existing to Remain: Existing items of construction that are not to be permanently removed and that are not otherwise indicated to be removed, removed and salvaged, or removed and reinstalled.

1.3 MATERIALS OWNERSHIP

A. Unless otherwise indicated, demolition waste becomes property of Contractor.

1.4 PREINSTALLATION MEETINGS

A. Predemolition Conference: Conduct conference at Project site.

1. Inspect and discuss condition of construction to be selectively demolished.
2. Review and finalize selective demolition schedule and verify availability of materials, demolition personnel, equipment, and facilities needed to make progress and avoid delays.
3. Review requirements of work performed by other trades that rely on substrates exposed by selective demolition operations.
4. Review areas where existing construction is to remain and requires protection.

1.5 INFORMATIONAL SUBMITTALS

A. Qualification Data: For refrigerant recovery technician.

B. Proposed Protection Measures: Submit report, including drawings, that indicates the measures proposed for protecting individuals and property for dust control and, for noise control. Indicate proposed locations and construction of barriers.

C. Schedule of Selective Demolition Activities: Indicate the following:

1. Detailed sequence of selective demolition and removal work, with starting and ending dates for each activity. Ensure Owner's building manager's on-site operations are uninterrupted.
2. Interruption of utility services. Indicate how long utility services will be interrupted.
3. Coordination for shutoff, capping, and continuation of utility services.
4. Coordination of Owner's continuing occupancy of portions of existing building and of Owner's partial occupancy of completed Work.

D. Inventory: Submit a list of items to be removed and salvaged and deliver to Owner prior to start of demolition.

E. Predemolition Photographs or Video: Show existing conditions of adjoining construction and site improvements, including finish surfaces, that might be misconstrued as damage caused by demolition operations. Submit before Work begins.

F. Statement of Refrigerant Recovery: Signed by refrigerant recovery technician responsible for recovering refrigerant, stating that all refrigerant that was present was recovered and that recovery was performed according to EPA regulations. Include name and address of technician and date refrigerant was recovered.

G. Warranties: Documentation indicated that existing warranties are still in effect after completion of selective demolition.

1.6 CLOSEOUT SUBMITTALS

A. Inventory: Submit a list of items that have been removed and salvaged.

1.7 FIELD CONDITIONS

A. Owner will occupy portions of building immediately adjacent to selective demolition area. Conduct selective demolition so Owner's operations will not be disrupted.

B. Conditions existing at time of inspection for bidding purpose will be maintained by Owner as far as practical.

C. Notify Owner of discrepancies between existing conditions and Drawings before proceeding with selective demolition.

D. Hazardous Materials: It is not expected that hazardous materials will be encountered in the Work.
   1. If suspected hazardous materials are encountered, do not disturb; immediately notify Architect and Owner. Hazardous materials will be removed by Owner under a separate contract.

E. Storage or sale of removed items or materials on-site is not permitted.

F. Utility Service: Maintain all existing utilities indicated to remain in service and protect them against damage during selective demolition operations.

   1. Maintain fire-protection facilities in service during selective demolition operations.

PART 2 - PRODUCTS

2.1 PEFORMANCE REQUIREMENTS

A. Regulatory Requirements: Comply with governing EPA notification regulations before beginning selective demolition. Comply with hauling and disposal regulations of authorities having jurisdiction.

B. Standards: Comply with ANSI/ASSE A10.6 and NFPA 241.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Verify that utilities have been disconnected and capped before starting selective demolition operations.

B. Review record documents of existing construction provided by Owner. Owner does not guarantee that existing conditions are same as those indicated in record documents.

C. Survey existing conditions and correlate with requirements indicated to determine extent of selective demolition required.

D. When unanticipated mechanical, electrical, or structural elements that conflict with intended function or design are encountered, investigate and measure the nature and extent of conflict. Promptly submit a written report to Architect.

E. Survey of Existing Conditions: Record existing conditions by use of preconstruction photographs.
   1. Inventory and record the condition of items to be removed and salvaged. Provide photographs of conditions that might be misconstrued as damage caused by salvage operations.
   2. Before selective demolition or removal of existing building elements that will be reproduced or duplicated in final Work, make permanent record of

measurements, materials, and construction details required to make exact reproduction.

3.2 UTILITY SERVICES AND MECHANICAL/ELECTRICAL SYSTEMS

A. Existing Services/Systems to Remain: Maintain services/systems indicated to remain and protect them against damage.

B. Existing Services/Systems to Be Removed, Relocated, or Abandoned: Locate, identify, disconnect, and seal or cap off indicated utility services and mechanical/electrical systems serving areas to be selectively demolished.

1. Owner will arrange to shut off indicated services/systems when requested by Contractor.
2. Arrange to shut off indicated utilities with utility companies.
3. If services/systems are required to be removed, relocated, or abandoned, provide temporary services/systems that bypass area of selective demolition and that maintain continuity of services/systems to other parts of building.
4. Disconnect, demolish, and remove fire-suppression systems, plumbing, and HVAC systems, equipment, and components indicated to be removed.

    a. Piping to Be Removed: Remove portion of piping indicated to be removed and cap or plug remaining piping with same or compatible piping material.
    b. Piping to Be Abandoned in Place: Drain piping and cap or plug piping with same or compatible piping material.
    c. Equipment to Be Removed: Disconnect and cap services and remove equipment.
    d. Equipment to Be Removed and Reinstalled: Disconnect and cap services and remove, clean, and store equipment; when appropriate, reinstall, reconnect, and make equipment operational.
    e. Equipment to Be Removed and Salvaged: Disconnect and cap services and remove equipment and deliver to Owner.
    f. Ducts to Be Removed: Remove portion of ducts indicated to be removed and plug remaining ducts with same or compatible ductwork material.
    g. Ducts to Be Abandoned in Place: Cap or plug ducts with same or compatible ductwork material.

C. Refrigerant: Remove refrigerant from mechanical equipment to be selectively demolished according to 40 CFR 82 and regulations of authorities having jurisdiction.

3.3 PREPARATION

A. Site Access and Temporary Controls: Conduct selective demolition and debris-removal operations to ensure minimum interference with roads, streets, walks, walkways, and other adjacent occupied and used facilities.

1. Comply with requirements for access and protection specified in Section 013100 "Project management and Coordination."

B. Temporary Facilities: Provide temporary barricades and other protection required to prevent injury to people and damage to adjacent buildings and facilities to remain.

1. Provide protection to ensure safe passage of people around selective demolition area and to and from occupied portions of building.
2. Protect walls, ceilings, floors, and other existing finish work that are to remain or that are exposed during selective demolition operations.

C. Temporary Shoring: Provide and maintain shoring, bracing, and structural supports as required to preserve stability and prevent movement, settlement, or collapse of construction and finishes to remain, and to prevent unexpected or uncontrolled movement or collapse of construction being demolished.

1. Strengthen or add new supports when required during progress of selective demolition.

3.4 SELECTIVE DEMOLITION, GENERAL

A. General: Demolish and remove existing construction only to the extent required by new construction and as indicated. Use methods required to complete the Work within limitations of governing regulations and as follows:

1. Proceed with selective demolition systematically, from higher to lower level.
2. Neatly cut openings and holes plumb, square, and true to dimensions required. Use cutting methods least likely to damage construction to remain or adjoining construction. Use hand tools or small power tools designed for sawing or grinding, not hammering and chopping, to minimize disturbance of adjacent surfaces. Temporarily cover openings to remain.
3. Cut or drill from the exposed or finished side into concealed surfaces to avoid marring existing finished surfaces.
4. Do not use cutting torches until work area is cleared of flammable materials. At concealed spaces, such as duct and pipe interiors, verify condition and contents of hidden space before starting flame-cutting operations. Maintain fire watch and portable fire-suppression devices during flame-cutting operations.
5. Maintain adequate ventilation when using cutting torches.
6. Remove decayed, vermin-infested, or otherwise dangerous or unsuitable materials and promptly dispose of off-site.
7. Dispose of demolished items and materials promptly.

B. Removed and Salvaged Items:

1. Clean salvaged items.
2. Pack or crate items after cleaning. Identify contents of containers.
3. Store items in a secure area until delivery to Owner.
4. Transport items to Owner's storage area off-site designated by Owner.
5. Protect items from damage during transport and storage.

C. Removed and Reinstalled Items:

1. Clean and repair items to functional condition adequate for intended reuse.

2. Pack or crate items after cleaning and repairing. Identify contents of containers.
3. Protect items from damage during transport and storage.
4. Reinstall items in locations indicated. Comply with installation requirements for new materials and equipment. Provide connections, supports, and miscellaneous materials necessary to make item functional for use indicated.

D. Existing Items to Remain: Protect construction indicated to remain against damage and soiling during selective demolition. When permitted by Architect, items may be removed to a suitable, protected storage location during selective demolition and cleaned and reinstalled in their original locations after selective demolition operations are complete.

3.5 DISPOSAL OF DEMOLISHED MATERIALS

A. General: Except for items or materials indicated to be recycled, reused, salvaged, reinstalled, or otherwise indicated to remain Owner's property, remove demolished materials from Project site and legally dispose of them in an-approved landfill.

1. Do not allow demolished materials to accumulate on-site.
2. Remove and transport debris in a manner that will prevent spillage on adjacent surfaces and areas.

B. Burning: Do not burn demolished materials.

C. Disposal: Transport demolished materials off Owner's property and legally dispose of them.

3.6 CLEANING

A. Clean adjacent structures and improvements of dust, dirt, and debris caused by selective demolition operations. Return adjacent areas to condition existing before selective demolition operations began.

END OF SECTION 024119

SECTION 230007 – SUMMARY OF WORK

PART 1 – GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract apply to this Section.

1.2 PROJECT/WORK IDENTIFICATION

A. General: The project name is Carolina Forest Elementary School HVAC Renewal as shown on Contract Documents prepared by McKnight Smith Ward Griffin Engineers, Inc.

B. Summary, Prime Contract Work: Briefly, the work, as defined in greater detail by other provisions of the Contract Documents, can be summarized as follows:

1. Remove and replace existing cooling tower and heat exchanger on exterior equipment pad with new closed circuit cooler.
2. Remove and replace existing pumping package in main mechanical room.
3. Modify underground condenser water piping to bypass existing water storage tank.
4. Update existing CMI controls for noted mechanical system renovations.

1.03 PROJECT COORDINATION

A. General: The Contract includes coordination of the entire work of the project, including preparation of general coordination drawings, diagrams and schedules and control of site utilization from the beginning of construction activity through project close-out and warranty periods. The HVAC Contractor shall act as the Prime Contractor for coordination of the project schedule. The intent of the paragraph is to Require that the contract be administered as a single prime contract, preferably (logically) with the HVAC Contractor as the Prime. It is not the intent of this paragraph to eliminate the opportunity for other contractors to serve as Prime. Note that the submission of a Bid as Prime Contractor will attest that that subcontractors with proper licensing necessary to secure all required permits are included as a part of the proposal.

PART 2 - PRODUCTS (not used)

PART 3 - EXECUTION (not used)

END OF SECTION 230007

SECTION 230500 – MECHANICAL GENERAL PROVISIONS

PART 1 – GENERAL

1.1 SCOPE

A. Applicable requirements of the General Conditions, Supplementary General Conditions, and Special Conditions bound at the front of these specifications shall govern work under this heading.

B. The Contractor shall coordinate the work and equipment of this Division with the work and equipment specified elsewhere in order to assure a complete and satisfactory installation. Work such as excavation, backfill, concrete, flashing, wiring, etc., which is required by the work of this section shall be performed in accordance with the requirements of the applicable section of the specifications.

C. It is the intention of these specifications and drawings to call for finished work, tested and ready for operation. Whenever the word "provide" is used, it shall mean "furnish and install complete and ready for use".

D. Minor details not usually shown or specified, but necessary for the proper installation and operation, shall be included in the work, the same as if herein specified or shown.

E. This Contractor is referred to the General and Special Conditions of the Contract which shall form a part and be included in this section of the specification and shall be binding on this Contractor.

F. Some items of equipment are specified in the singular; however, the Contractor shall provide and install the number of items or equipment as indicated on the drawings, and as required for complete systems.

1.2 DEFINITION

A. The word "Contractor" as used in this section of the specification refers to the HVAC Contractor unless specifically noted otherwise. The word "provide" means furnish, fabricated, complete, install, erect, including labor and incidental materials necessary to complete in place and ready for operation or use the item referred to or described herein and/or shown or referred to on the Contract Drawings.

1.3 CONTRACTOR'S QUALIFICATIONS

A. It is assumed that the Contractor has had sufficient general knowledge and experience to anticipate the needs of a construction of this nature. The Contractor shall furnish all items required to complete the construction in accordance with reasonable interpretation of the intent of the Drawings and Specifications. Any minor items required by code, law or regulations shall be provided whether or not specified or specifically shown where it is a part of a major item of equipment, or of the control system specified or shown on the plans.

PART 2 - PRODUCTS

2.1 MATERIALS AND WORKMANSHIP

A. All materials and apparatus required for the work, except as specifically specified 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 approved by the Architect shall be furnished.

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

C. Unless otherwise specifically indicated on the plans or specifications, all equipment and material shall be installed with the approval of the Architect in accordance with the recommendations of the manufacturer. This shall include the performance of such tests as the manufacturer recommends.

D. All work must be done by first-class and experienced mechanics properly supervised and it is understood that the Architect has the right to stop any work that is not being properly done and has the right to demand that any workman deemed incompetent by the Architect be removed from the job and a competent workman substituted therefore.

2.2 EQUIPMENT APPLICATION AND PERFORMANCE

A. The Contractor and/or Equipment Supplier shall be responsible to see that equipment supplied is correct for the intended application and will perform within the limits of capacity, noise, life expectancy, pressure drop and space limitations intended for that equipment as shown on the plans or described in the specifications. The shop drawings shall show the capacity and operating characteristics of the equipment.

B. All equipment shall automatically restart after power outages. Motors shall restart after one minute delay unless specified otherwise.

2.3 EQUIPMENT DEVIATIONS

A. Where the Contractor proposes to use an item of equipment other than that specified or detailed on the drawings, which requires any redesign of the structure, partitions, foundations, piping, wiring or any other part of the mechanical, electrical, or architectural layout, all such redesign, and all new drawings and detailing required therefore, shall be prepared by the Subcontractor at his own expense and submitted for approval by the Architect.

B. Where such approved deviation requires a different quantity and arrangement of ductwork, piping, wiring, conduit, and equipment from that specified or indicated on the drawings, the Contractor shall furnish and install any such ductwork, piping, structural supports, insulation, controllers, motors, starters, electrical wiring and conduit, and any other additional equipment required by the system, at no additional cost to the Owner.

2.4 MOTORS

A. Motors shall be built in accordance with the latest standards of NEMA and as specified. Motors shall be tested in accordance with standards of A.S.A. C40 and conform thereto for installation resistance and dielectric strength. Each motor shall be provided with conduit terminal box, adequate starting and protective equipment as specified or required. The capacity shall be sufficient to operate associate driven devices under all conditions of operation and load and without overload, and at least shall be the horsepower indicated or specified. Each motor shall be selected for quiet operation. Motors shall be premium efficient with a minimum efficiency as specified by NEMA MG1-2006, Table 12-12. Motors shall be TEFC or TEAO construction as appropriate. ODP motors are not allowed. Motors shall be 1800 RPM whenever possible.

B. Motors 15 HP or less shall incorporate maintenance free sealed bearings.

2.5 DRIVES

A. Machinery drives shall be provided for all power driven equipment specified in this section.

B. Drives shall be cog V-belt type and shall be selected to overcome the starting inertia of the equipment without slippage, but in no case shall be less than 150% of the full motor load. Drives 1/2 HP and smaller may be provided with single belts. Drives 3/4 HP and larger shall be provided with the number of belts necessary to transmit the required power with 95% minimum efficiency.

C. Where adjustable type sheaves are indicated they shall be selected such that the schedule speed of the driven equipment is at the midpoint in the adjustment range of the sheave. Adjustable sheaves shall be replaced with fixed after final balancing and adjustment.

D. Where fixed type sheaves are indicated the Contractor shall include in his price changing sheave sizes once during the balancing period to achieve proper air quantities.

E. Sheaves shall be machined cast iron of the same manufacturer as the belt provided. Shop drawings shall be submitted of each drive which shall include actual transmission capacity of each drive.

2.6 FOUNDATIONS, SUPPORTS, PIERS, ATTACHMENTS

A. This Contractor shall furnish and install all necessary foundations, supports, pads, bases and piers required for all air conditioning equipment, piping, pumps, tanks, compressors, and for all other equipment furnished under this contract, and shall submit drawings to the Architect for approval before purchase, fabrication or construction of same.

B. For pumps, compressors, and other rotating machinery and for all equipment where foundations are indicated, furnish and install concrete pads minimum 4 inches thick or as shown. All pads shall be extended six (6) inches beyond machine base in all directions with top edge hampered. Insert six (6) inch long, l/2" round steel dowel rods at 12" on center into floors to anchor pads. Shop drawings for all foundations and pads shall be submitted to the Architect for approval before same are constructed.

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

D. All equipment, unless otherwise shown, shall be securely attached to the building structure in an approved manner. Attachments shall be of a strong and durable nature and any attachments that are, in the opinion of the Architect, not strong enough shall be replaced as directed.

2.7 DIELECTRIC CONNECTIONS

A. At any points within the piping systems where dissimilar metals are connected, use full port ball valves. Careful attention shall be given to support brackets and hangers to select proper materials to avoid dissimilar metal contact at these points.

2.8 DRAINS AND VENTS

A. In addition to the drains and vents indicated on the plans and piping details, the Contractor shall install additional drains and vents as required to remove all water and air from the piping systems.

2.9 MOTOR STARTERS AND DISCONNECTS

A. Individual motor controllers complete with auxiliary contacts, control transformers, push buttons, selector switches and remote push button stations not specifically specified to be furnished with the equipment shall be provided under this section. Motor controllers shall comply with NEMA Standards and be complete with proper size heaters and auxiliary contacts and shall be in NEMA enclosures as required. Unless otherwise noted, push button stations shall be oil-tight heavy duty type. Controllers shall be manual, magnetic, or combination type with disconnect switch or circuit breaker as indicated on the drawings or where required by the NEC. Controllers shall include motor over current protection in each phase conductor. Each motor controller shall be provided with phenolic nameplate, black with 1/4" high letters and white border, indicating equipment served, attached using counter sunk screws.

B. Where disconnecting switches are indicated to be furnished under this Section, they shall be General Electric, heavy duty NEMA 1 or NEMA 3R enclosures as applicable, with voltage and amperage rating appropriate to the application. Unless otherwise noted, fuses shall be Buss "Fusetrons", or approved equal. Unfused motor disconnecting switches shall be heavy duty in NEMA 1 or 3R applicable enclosures. Similar and equivalent equipment as manufactured by I.T.E., Square D, or Westinghouse is equally acceptable. Switches used as service switches shall bear such U.L. Label and nameplate on switch shall so indicate.

2.10 PAINTING

A. Paint material shall be selected from the products listed below and, insofar as practical, products of only one manufacturer shall be used. Contractor shall submit to the Architect the listed manufacturer he proposes to use in the work. Should the Contractor desire to use products of a manufacturer not listed below, or products made by a listed manufacturer but not scheduled herein, Contractor shall submit complete technical information on the proposed products to the Architect for approval. Only products approved by the Architect shall be used.

1. Rust Inhibitive Primer:

   a. Devoe: Bar-Ox Quick Dry Metal Primer, Red.
   b. Duron: Deluxe Red Primer.
   c. Glidden: Rustmaster Tank and Structure Primer.
   d. Pittsburgh: Inhibitive Red Primer.

2. Galvanized Metal Primer:

   a. Devoe: Mirrolac Galvanized Metal Primer.
   b. Duron: Duron Deluxe Galvanized Metal Primer
   c. Glidden: Rustmaster Galvanized Iron Metal Primer.
   d. Pittsburgh: Speedhigh Galvanized Steel Primer.

PART 3 - EXECUTION

3.1 DUTIES OF CONTRACTOR

A. Contractor shall furnish and install all materials called for in these Specifications and accompanying drawings, and must furnish the apparatus complete in every respect. Anything called for in the specifications and not shown on the drawings or shown on the drawings and not called for in the specifications must be furnished by the Contractor.

B. Contractor is responsible for familiarizing himself with the details of the construction of the building. Work under these specifications installed improperly or which requires changing due to im-

proper reading or interpretation of building plans shall be corrected and changed as directed by the Architect without additional cost to the Owner.

C. The Contractor shall follow drawings in laying out work and check drawings of other trades to verify spaces in which work will be installed. Maintain maximum headroom and space conditions at all points. Where headroom or space conditions appear inadequate, Architect shall be notified before proceeding with installation.

D. The plans are diagrammatic and are not intended to show each and every fitting, valve, pipe, pipe hanger, or a complete detail of all the work to be done; but are for the purpose of illustrating the type of system, showing pipe sizes, etc., and special conditions considered necessary for the experienced mechanic to take off his materials and lay out his work. This Contractor shall be responsible for taking such measurements as may be necessary at the job and adapting his work to local conditions.

E. Conditions sometimes occur which require certain changes in drawings and specifications. In the event that such changes in drawings and specifications are necessary, the same are to be made by the Contractor without expense to the Owner, providing such changes do not require furnishing more materials, or performing more labor than the true intent of the drawings and specifications demands. It is understood that while the drawings are to be followed as closely as circumstances will permit, the Contractor is held responsible for the installation of the system according to the true intent and meaning of the drawings. Anything not entirely clear in the drawings and specification will be fully explained if application is made to the Architect. Should, however, conditions arise where in the judgment of the Contractor certain changes will be advisable, the Contractor will communicate with the Architect and secure his approval of these changes before going ahead with the work.

F. The right to make any responsible change in location of apparatus, equipment, routing of piping up to the time of roughing in, is reserved by the Architect without involving any additional expense to the Owner.

G. It shall be the duty of prospective Contractors to visit the job site and familiarize themselves with job conditions. No extras will be allowed because of additional work necessitated by, or changes in plans required because of evident job conditions, that are not indicated on the drawings.

H. Contractor shall determine the schedule of work as lay down by the General Contractor and must schedule his work to maintain the building construction schedule so as not to interfere with or hold up any other Contractors.

I. Contractor shall leave the premises in a clean and orderly manner upon completion of the work, and shall remove from the premises all debris that has accumulated during the progress of the work.

3.2 CODES, RULES, PERMITS AND FEES

A. The Contractor shall give all necessary notices, obtain all permits and pay all sales taxes, fees and other costs, including utility connections or extensions, in connection with his work; file all necessary plans prepare all documents and obtain all necessary approvals of all authorities having jurisdiction. Obtain all required certificates of inspection for his work and deliver same to the Architect before request for acceptance and final payment of the work.

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

C. All materials furnished and all work installed shall comply with the National Fire Codes of the National Fire Protection Association, and with the requirements of all governmental departments having jurisdiction.

D. All materials and equipment for the electrical portion of the mechanical system shall bear the approval label, and shall be listed by the Underwriters' Laboratories, Inc.

E. All work shall be done in accordance with the International Building Code, and requirements of governmental agencies having jurisdiction.

3.3 COOPERATION WITH OTHER TRADES

A. This Contractor shall give full cooperation to other trades and shall furnish any information necessary to permit the work of all trades to be installed satisfactorily and with the least possible interference or delay.

B. Where the work of the Contractor will be installed in close proximity to, or may interfere with the work of other trades, he shall assist in working out space conditions to make a satisfactory adjustment. If so directed by the Architect, the Contractor shall prepare composite working drawings and sections at a suitable scale not less than 3/8" = 1'-0", clearly showing how his work is to be installed in relation to the work of other trades. If the Contractor installs his work before coordination with other trades, or so as to cause any interference with work of other trades, he shall make the necessary changes in his work to correct the condition without extra charge.

C. The Contractor shall furnish to other trades, as required, all necessary templates, patterns, setting plans, and shop details for the proper installation of work and for the purpose of coordinating adjacent work.

3.4 RECORD DRAWINGS

A. The Contractor shall furnish drawings showing dimensioned location and depths of all exterior piping and structures, and shall indicate any and all changes in location of piping, ductwork, equipment or valves from that shown on the Contract Drawings. Additional equipment added, such as vents and drains, shall also be indicated on the record drawings. The drawings shall consist of clean, legible sepia prints of the Contract Drawings, available from the Architect on which the Contractor shall mark all notes, dimensions, sizes and information required. The sepias shall be kept for this purpose only. Before final inspection the Contractor shall submit to the Architect eight (8) sets of black line prints of the sepias.

3.5 SURVEYS AND MEASUREMENTS

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

B. Should the Contractor discover any discrepancy between actual measurements and those indicated, which prevents following good practice or the intent of the drawings and specifications, he shall notify the Architect through the General Contractor, and shall not proceed with his work until he has received instructions from the Architect.

3.6 SAFETY REQUIREMENTS

A. All systems shall be installed so as to be safe operating and all moving parts shall be covered where subject to human contact. All rough edges of equipment and materials shall be made smooth.

B. All safety controls shall be checked under the supervision of the Architect's representative and eight (8) copies of test date showing setting and performance of safety controls shall be submitted to the Architect. All pressure vessels shall be ASME stamped and shall have stamped relief valves. Boilers shall be provided with ASME stamped T & P relief valve.

3.7 SHOP DRAWINGS

A. Contractor shall submit within ten (10) days after award of contract eight (8) copies of a complete list of all manufacturers to be used on the job. No substitutions will be allowed after this date except in extenuating circumstances as determined by the Architect.

B. Submission of a manufacturer's name or equipment number on this list shall not be considered as equipment approved by the Architect.

C. The Contractor shall submit for approval eight (8) sets of detailed shop drawings of all equipment and all material required to complete the project, and no materials or equipment may be delivered to the job site or installed until the Contractor has in his possession the approved shop drawings for the particular material or equipment. The shop drawings shall be complete as described herein. The Contractor shall furnish the number of copies required by the General and Special Conditions of the Contract, but in no case less than eight (8) copies.

D. Prior to delivery of any material to the job site, and sufficiently in advance of requirements to allow the Architect ample time for checking, submit for approval detailed, dimensioned drawings or cuts, showing construction, size, arrangement, operating clearances, performance, characteristics and capacity. Each item of equipment proposed shall be standard catalog product of an established manufacturer and of equal quality, finish, performance, and durability to that specified.

E. Samples, drawings, specifications, catalogs, submitted for approval, shall be properly labeled indicating specific service for which material or equipment is to be used, Section and Article number of specification governing, Contractor's Name and Name of Job.

F. Catalogs, pamphlets, or other documents submitted to describe items on which approval is being requested, shall be specific and identification in catalog, pamphlet, etc. of item submitted shall be clearly marked. Data of a general nature will not be accepted. Data shall include eight (8) copies of computation sheets indicating how unit capacity was determined where ratings are at other than standard conditions. No payment for any equipment or labor will be allowed until all major pieces of equipment specified have been submitted to the Architect for approval.

G. The Contractor, as part of the shop drawing submitted, shall submit shop drawing of all ductwork in the mechanical rooms, the risers including takeoffs to the floors with their associated dampers, and ells with unequal legs showing turning vanes.

H. The submittal of shop drawings shall be with the Contractor stamp affixed; this shall assure the Engineer that they are being submitted in accordance with Sub-Paragraph 4.13.4 in AIA Document A201 and/or Paragraph 6.26, in NSPE Document 1910-8. This stamp indicates that the Contractor, by approving and submitting shop drawings, represents that he has determined and verified all field measurements and quantities, field construction criteria, material, catalog material, and similar data that he has reviewed and coordinated information in the shop drawings with the requirements of the work and the Contract Documents. It, also, indicates that any deviation from the Contract Documents has been shown on the submittal and clearly defines the deviations from the specifications.

I. Approval rendered on shop drawings shall not be considered as a guarantee of quantities, measurements, or building conditions. Where drawings are approved, said approval does not mean

that drawings have been checked in detail: said approval does not in any way relieve the Contractor from his responsibilities or necessity of furnishing material or performing work as required by the contract drawings and specifications.

J. Failure of the Contractor to submit shop drawings in ample time for checking shall not entitle him to an extension of Contract time, and no claim for extension by reason of default will be allowed.

K. All shop drawings and submittals are to be in the office of the Architect within 30 days after the Contracts have been awarded. Contractor shall be financially responsible for any price increase of shop drawing items from the time these drawings are issued until they are returned to the Contractor for purchase of items.

L. Contractor shall keep on the job at all times copies of all approved shop drawings.

M. All mechanical submittals shall be contained in one binder. Incomplete submittals will cause the binder to be rejected. (Controls may be submitted individually.)

3.8 OBSERVATION

A. The project will be observed periodically as construction progresses. The Contractor will be responsible for notifying the Architect at least 72 hours in advance when any work to be covered up is ready for inspection. No work will be covered up until after observation has been completed on such items as piping and insulation, etc.

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3.9 ACCESSIBILITY

A. The Contractor shall locate all equipment which must be serviced, operated, or maintained in fully accessible positions. Equipment shall include but not be limited to valves, traps, cleanouts, motors, controllers, switch-gear, and drain points. If required for better accessibility, furnish access doors for this purpose. Minor deviations from drawings may be made to allow for better accessibility and any change shall be submitted for approval.

3.10 SLEEVES AND PLATES

A. This Contractor shall provide and locate all sleeves and inserts required before the floors and walls are built, or shall be responsible for the cost of cutting and patching required where sleeves and inserts were not installed, or where incorrectly located. This Contractor shall do all drilling required for the installation of his hangers.

B. Sleeves shall be provided for all mechanical piping passing through concrete floor slabs and concrete, masonry, tile and gypsum wall construction. Sleeves shall not be provided for piping running imbedded in concrete or in insulating concrete slabs on grade.

C. Where sleeves are placed in exterior walls below grade, the space between the pipe or conduit and the sleeves shall be sealed with expanding elastomeric device and made completely watertight.

D. Where pipe motion due to expansion and contraction will occur, make sleeves of sufficient diameter to permit free movement of pipe. Where sleeves pass insulated pipes, the sleeves shall be large enough to pass the pipe and insulation. Check floor and wall construction finishes to determine proper length of sleeves for various locations; make actual lengths to suit the following:

1. Terminate sleeves flush with walls, partitions and ceiling.
2. In areas where pipes are concealed, as in chases, terminate sleeves flush with floor or as shown on the plans.

3. In all areas where pipes are exposed, extend sleeves 1/4 inch above finished floor, except in rooms having floor drains, where sleeves shall be extended 3/4 inches above floor.

E. Sleeves shall be constructed of schedule 40 black steel pipe unless otherwise indicated on the drawings. Sleeves through concrete beams shall be constructed as indicated on the drawings.

F. Fasten sleeves securely in floor, walls, so that they will not become displaced when concrete is poured or when other construction is built around them. Take precautions to prevent concrete, plaster, or other materials being forced into the space between pipe and sleeve during construction.

G. Where piping penetrates fire rated floors or walls, penetrations shall be sealed with a U.L. approved fire stopping system. System shall be as manufactured and detailed by 3M Company or approved equal.

H. Escutcheon plates shall be provided for all exposed pipes and all exposed conduit passing through walls, floors and ceilings. Plates shall be nickel plated, of the split ring type, of size to match the pipe or conduit. Where plates are provided for pipes passing through sleeves which extend above the floor surface, provide deep recessed plates to conceal the pipe sleeves.

3.11 UTILITIES

A. This Contractor shall bear the cost of utilities required to perform the work under this Contract. Where services such as electricity, hoist, etc. are provided by the General Contractor, he shall be responsible directly to the General Contractor for his portion of the utilities as may be agreed upon.

3.12 SCAFFOLDING, RIGGING, HOISTING

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

3.13 EXCAVATING AND BACKFILLING

A. Each trade shall perform all excavation and backfill required for the installation of its work.

B. Particular care shall be taken not to disturb or damage work of other Contractors.

C. Mass excavation to approximate levels will be carried out under a section of the architectural specifications. The Contractor shall, however, do all trench and pit excavation and backfilling required for work under this section of the specifications, inside and outside the building, including repairing of finished surfaces and all required shoring, bracing, pumping and all protection for safety of persons and property. State and OSHA Safety Codes shall be strictly observed. In addition, it shall be the responsibility of the Contractor to check the indicated elevations of the utilities entering and leaving the building. If such elevations require excavations lower than the footing levels, the Architect shall be notified of such conditions and a redesign shall be made before excavations are commenced. It is also the responsibility of the Contractor to make the excavations at the minimum required depths in order to avoid undercutting the footings.

D. No backfilling shall be done until work involved has been tested and approved by the Architect.

E. Contractor shall schedule excavation work so as not to unduly interfere with work of other trades on the job. Contractor shall be responsible for establishing all lines and grades required for proper location of his work.

F. When rock is encountered in excavation, it shall be paid for as outlined under the architectural section of these specifications.

G. In backfilling pipe trenches, approved fill shall first be compacted firmly and evenly on both sides of pipe in 6" layers to a depth of 12" over the top of the pipe. Remainder of trench shall be backfilled to established grade in 6" layers. Compact between each layer with a high-frequency vibrator tamper such as Dart Soil Compactor (as manufactured by Dart Manufacturing Company, Denver, Colorado). Fill shall be compacted to density specified under Earth Work Section of specifications for specified area through which trench passes. Compact fill to 95% maximum density at optimum moisture content all other areas. Earth bearing pressure as indicated shall be verified by a testing laboratory, which following the criteria specified for foundation wall trench, etc. in the Earth Work Section of the specifications. The reports shall be forwarded to the Architect for approval unless otherwise specified, the cost will be borne by this contractor, before any work is performed. If the earth bearing pressure is less than that required, the Contractor shall not begin additional work until notified by the Architect to do so. A copy of the report shall be forwarded to the Architect in triplicate.

H. Excess earth shall be distributed on premises as directed by the Architect.

I. Where ditches occur outside the building, the surface shall be finished to match existing surfaces. Any existing work or work of other trades which is damaged or disturbed shall be repaired or replaced, and left in good order.

3.14 ELECTRICAL CONNECTIONS

A. The Electrical Contractor shall furnish and install all wiring except: (1) temperature control wiring; (2) equipment control wiring and (3) interlock wiring. The Electrical Contractor shall receive from the Mechanical Contractor and mount all individually mounted motor starters and provide all power wiring to the motor terminals unless otherwise indicated. The Electrical Contractor will provide branch circuit protection and disconnects unless otherwise indicated or specified. The Mechanical Contractor shall provide all other control and protective devices, and perform all control and interlock wiring required for the operation of the equipment. Power wiring, from nearest panel, for control components (dampers, panels, etc.) shall be provided by the Mechanical Contractor unless specifically called for by Division 26.

B. After all circuits are energized and complete, the Electrical Contractor shall be responsible for all power wiring, and all control wiring shall be the responsibility of this Contractor. Motors and equipment shall be provided for current characteristics as shown on the drawings.

C. It shall be the responsibility of this Contractor to check with the Electrical Contractor on service outlets provided for this Contractor, to determine that the switches and wiring provided are of adequate size to meet Code requirements for this Contractor's equipment. Any discrepancy shall be brought to the attention of the Architect before work is installed. Otherwise, any cost for changes shall be at the expense of this Contractor, and in any case electrical cost increase due to equipment substitution of different electrical characteristics shall be this Contractor's expense.

3.15 PIPE WORK

A. All pipe work shown on the drawings and/or specifications or implied herein and required for a complete and operating system shall be done by experienced mechanics in a neat and workmanlike manner and subject to the approval of the Architect.

B. Because of the small scale of the drawings, it is not possible to indicate all offsets, fittings and accessories which may be required and it shall be the responsibility of the Contractor to furnish and install all materials and equipment required for the operating systems.

C. The piping shall be installed as shown on the plans with strict conformity to the sizes listed and due provisions for expansion and contraction.

D. Unless otherwise noted on the plans, all piping shall be installed inside the insulated envelope of the building.

3.16 LUBRICATION

A. All bearing, except those specifically requiring oil lubrication, shall be pressure lubricated. All lubrication points shall be readily accessible, away from locations dangerous to workmen. In areas where lubrication points are not readily accessible Contractor shall provide extended lubrication tubes to positions where lubrication can be easily accomplished. Pressure grease lubrication fittings shall be "Zerk-Hydraulic" type as made by the Stewart-Warner Corporation, or approved equal, for each type of grease required.

B. The Contractor shall furnish lubrication charts or schedules for each piece of equipment or machinery. The charts or schedules shall designate each point of lubrication. Eight (8) copies of charts and schedules shall be submitted to the Architect prior to final inspection and approved copies of each schedule and chart shall be framed by the Contractor in metal frames with glass front and installed in the Equipment Room.

3.17 PROTECTION

A. The Contractor shall protect all work and material from damage, and shall be liable for all damage during construction.

B. The Contractor shall be responsible for work and equipment until all construction is finally inspected, tested and accepted. He shall protect work against theft, injury or damage; and shall carefully store material and equipment received on site which is not immediately installed. He shall close open ends of work including pipe, duct, or equipment with temporary covers or plugs during storage and construction to prevent entry of obstructing materials or dust and debris.

C. Provide a protective covering of not less than 0.004" thick vinyl sheeting (or a similar approved material) to be used in covering all items of equipment, immediately after the equipment has been set in place, (or if in a place of storage within the building under construction) to prevent the accumulation of dirt, sand, cement, plaster, paint or other foreign materials from collecting on the equipment and/or fouling working parts.

3.18 CLEANING

A. Clean from all exposed insulation and metal surfaces grease, debris or other foreign material.

B. Chrome plated fittings, fixtures, piping and trim shall be polished upon completion.

3.19 LABELS, TAGS, COLOR CODING AND INSTRUCTIONS

A. Post in the Equipment Room framed under glass the following:

1. Lubrication instructions listing all equipment which requires lubrication, the type of lubricant to be used and the frequency of lubrication.
2. Photostatic copy of wiring diagram of temperature controls.

3. Step-by-step operating instruction for each piece of equipment with control sequence description.

B. A tabulation shall be made of each panel number and circuit number serving each air conditioning unit, fan or other device with electrical service. This list shall be prepared and be ready to turn over to inspectors prior to calling for final inspection.

C. Comply with ANSI A13.1 for lettering size, length of color field, colors, and viewing angles of identification devices.

D. Stencils: Standard fiberboard stencils, prepared for required applications with letter sizes generally complying with recommendations of ANSI A13.1 for piping and similar applications shall be used. Stencils shall not be less than 1-1/4" high letters for ductwork and not less than 3/4" high letters for access door signs and similar operational instructions. Stencil paint shall be standard exterior type stenciling enamel; black, except as otherwise indicated; either brushing grade or pressurized spray-can form and grade.

E. Engraved Plastic-Laminate Signs

1. Provide engraving stock melamine plastic laminate, in the sizes and thickness indicated, engraved with engraver's standard letter style of the sizes and wording indicated, punched for mechanical fastening except where adhesive mounting is necessary because of substrate.
2. Thickness: 1/16" for units up to 20 square inches or 8" length; 1/8" for larger units.
3. Fasteners: Self-tapping stainless steel screws.

F. ValveTags

1. Brass Tags: Provide 19-gauge polished brass tags with stamp-engraved piping or duct system abbreviation in 1/4" high letters and sequenced numbers 1/2" high and with 5/32" hole for fastener. Provide 1-1/2" diameter tags except as otherwise indicated.
2. Plastic Laminate Tags: Provide manufacturer's standard 3/32" thick engraved plastic laminate tags, with piping or duct system abbreviation in 1/4" high letters and sequenced numbers 1/2" high, and with 5/32" hole for fastener. Provide 1-1/2" square black tags with white lettering, except as otherwise indicated.
3. Ceiling ID Tags: Provide manufacturer's standard 3/4" diameter ceiling tack, with color coding per owners standards.

G. Wrap-Around Plastic Identification

1. All plumbing/mechanical piping identification shall adhere to ANSI A13.1 – 1981. Piping shall utilize pipe markers. All pipe markers shall be snap around whenever possible. Markers shall be located at each wall, floor or ceiling penetration, whether exterior or interior, and every 10 ft. thereafter. Markers shall be fully legible from floor level showing medium contained in pipe, and directional arrows.
2. Piping shall be identified as follows: CONDENSER WATER SUPPLY, CONDENSER WATER RETURN, & others by approval by submittals.

H. Piping in exposed areas, with canvas cloth jackets, to be painted with two coats of latex based paint suitable as per jacketing manufacturer’s instructions, prior to piping identifications.

I. Installation Requirements

1. Coordinate new labeling with existing labeling through Project Manager. Where identification is to be applied to surfaces that require insulation, painting or other covering or fin-

ish, including valve tags in finished mechanical spaces, identification shall be installed after completion of covering and painting. Identification is to be installed prior to installation of acoustical ceilings and similar removable concealment.

J. Piping System Identification

1. General: Provide for wrap around pipe marker plastic identification with application system as indicated in paragraph f. Include arrows to show normal direction of flow. For hot non-insulated pipes, install a segment of pipe insulation with appropriate piping identification.
2. Locate identification as follows wherever piping is exposed to view in occupied spaces, machine rooms, accessible maintenance spaces and exterior non-concealed locations.

    a. Near each valve and control device.
    b. Near each branch, excluding short take-offs for fixtures and terminal units; mark each pipe at branch, where there could be question of flow pattern.
    c. At locations where pipes pass through walls, floors, ceilings, or enter non-accessible enclosures.
    d. At access doors, manholes and similar access points which permit view of concealed piping.
    e. At major equipment items and other points of origination and termination.
    f. Spaced intermediately at maximum spacing of 50' along each piping run, except reduce spacing to 25' in congested areas of piping and equipment.
    g. On piping above removable acoustical ceilings, except omit intermediately spaced markers.
    h. Identify non potable piping and outlets.

3. The following piping shall be color-coded (not banded or striped) in exposed locations by completely painting the piping with the indicated color. Use standard identification methods in concealed areas.

    a. Condenser Water Supply: Light blue / white arrows & letters (Blue Flame 90 BG 57 / 180)
    b. Condenser Water Return: Light blue / black arrows & letters (Blue Flame 90 BG 57 / 180)

K. Valve Identification: Provide for valve tags on every valve cock and control device in each piping system. Exclude check valves, valves within factory-fabricated equipment units, plumbing fixture faucets, convenience and lawn-watering hose bibs, and shut-off valves at plumbing fixtures, HVAC terminal devices and similar rough-in connections of end-use fixtures and units. List each tagged valve in a valve schedule for each piping system.

L. Mechanical Equipment Identification: Provide for engraved plastic laminate sign on or near each major item of mechanical equipment and each operational device. Provide signs for the following general categories of equipment and operational devices:

1. Main control and operating valves, including safety devices.
2. Meters, gauges, thermometers and similar units.
3. Pumps, compressors, and similar motor-driven units.
4. Heat exchangers, coils, heat recovery units and similar equipment.
5. Label ceiling grids for all valve and damper locations above ceilings.
6. Other items as specified by Project Manager.

3.20 IDENTIFICATION OF UNDERGROUND UTILITIES AND PIPING

A. All underground piping and utilities (both metallic and non-metallic) shall have two stages of identification and/or warning by a combination of non-detectable and detectable warning tapes.

B. The 1st stage of identification shall be a buried non-detectable warning tape. This tape shall provide an early warning at shallow depth excavation. The tape shall be 6" wide, and buried approximately 18" to 30" above the service pipe, but a minimum of 10" below finished grade. It shall consist of multiple layers of polyethylene with an overall thickness of 3 to 5 mils. It shall be installed continuous from valve box to valve box or manhole to manhole and shall terminate just outside of valve box or manhole wall. The black colored lettering on the warning tape shall be abrasion resistant and be imprinted on a color coded background that conforms to APWA color code standards.

C. The 2nd stage of identification shall be a detectable warning tape. This tape shall provide pipeline identification, be fully detectable from above grade utility locators and be able to provide a depth reference point to top of pipe. It shall be 6" wide, installed directly on top of the pipeline and permanently secured to the pipeline at 10 ft intervals. The tape shall consist of aluminum foil core or stainless steel tracer wires laminated between multiple layers of polyethylene tape with an overall thickness of 4 to 6 mils. Detectable core or tracer wire "circuit" shall be continuous from valve box to valve box or manhole to manhole for complete pipeline detection and location. Tape manufacturers' approved splice kits shall be used for long runs. Warning tape shall terminate just inside of valve box cover or manhole ring cover and be easily accessible for "clip-on" type utility location meters. The black colored lettering on the warning tape shall be abrasion resistant and be imprinted on a color-coded background that conforms to APWA color code standards.

D. TRACER WIRE: All pipe installed underground shall have a tracer wire installed along the length of the pipe. The wire shall be taped to the bottom of the pipe at a maximum of 10 foot intervals and not allowed to "float freely" within the backfill. Tracer wire shall be 12 gauge minimum, copper single-conductor wire with type UF (Underground Feeder) insulation and shall be continuous along the pipeline passing through the inside of each valve box.

E. The Contractor must notify the Owner through the Project Manager when the installation of tracers is to be done so that the Owner may inspect. If this is not done, the Contractor will demonstrate the operation of the tracer by locating all of the piping installed.

3.21 EQUIPMENT SERVICEABILITY

A. All equipment shall be serviceable. All equipment shall be installed so that it can be removed. All equipment in or connected to piping systems shall have valves to isolate this equipment from the piping system. This includes, but not necessarily limited to control valves, water heaters, sensors, switches, pumps, traps and strainers. Unions (screwed or flanged) shall be provided so that all equipment is removable.

B. Equipment installed in walls, ceilings or floors shall be accessible for service or removal without cutting walls, etc.

C. Equipment requiring periodic service shall be installed to allow clearance for service and have removable panels, access doors, etc. through which the service is to be performed.

3.22 ACCEPTANCE OF EQUIPMENT

A. In the event that the Architect considers it impractical, because of unsuitable test conditions, or some other factors, to execute simultaneous final acceptance of all equipment portions of the installation may be certified by the Architect for final acceptance when that portion of the system is complete and ready for operation.

B. Contractor shall make all necessary tests, trial operation balancing and balance tests, etc., as may be required as directed by the engineer to prove that all work under these plans and specification is in complete serviceable condition and will function as intended.

C. Upon completion of all work the system shall be tested to determine if any excess noise or vibration is apparent during operation of the system. If any such objections are detected in the system or noisy equipment found, the Contractor shall be responsible for correcting same. Ducts, plenums and casings shall be cleaned of all debris and blown free of all particles of rubbish and dust before installing outlet faces. Equipment shall be wiped clean with all traces of oil, dust, dirt and paint spots removed. Bearings shall be lubricated as recommended by the equipment manufacturer. All control valves and equipment shall be adjusted to setting indicated.

3.23 GUARANTEE

A. The Contractor shall guarantee the complete mechanical system against defect due to faulty materials, faulty workmanship or failure due to negligence of the Contractor. This guarantee will exclude normal wear and tear, maintenance lubrication, replacement of expendable components, or abuse. The guarantee period shall begin on the date of the final acceptance and shall continue for a period of 12 months during which time the Contractor shall make good such defective workmanship and materials and any damage resulting there from, within a reasonable time of notice given by the Owner.

3.24 OPERATING AND MAINTENANCE INSTRUCTIONS

A. Submit 3 sets of complete operating and maintenance instructions.

B. Bind each set in plain black vinyl-covered, hard back, 3-ring binder. Individual paper shall be Boorum and Pease Reinforced Ring Book Sheet, No. S-212-101 or equivalent.

C. Organize material in the following format:

1. Section I:

   a. Name of Project
   b. Address
   c. Owner's Name
   d. Mechanical Contractor's Name and Address
   e. Control Subcontractor's Name and Address
   f. Warranty Dates

2. Section II:

   a. Major Equipment List (name, manufacturer, serial no., H.P. and voltage) (include all equipment with motors)
   b. Control Sequence Description
   c. Routine Maintenance Instructions in Step-by-Step form
   d. Lubrication Charts and Schedules
   e. Valve Schedules
   f. Test and Balance Reports
   g. Sound Power Level Readings (Where Required)

3. Section III:

   a. Operating and Maintenance Instructions by Manufacturer

b. Shop Drawings (Major Requirement)
c. Wiring Diagrams
d. Control Drawings

3.25 PAINTING

A. Painting shall be performed as detailed in Division 9.

B. All surfaces to receive paint shall be dry and clean.

C. Before priming, all surfaces shall be thoroughly cleaned of all dirt, oil, grease, rust, scale and other foreign matter. Cleaning shall be done with sandpaper, steel scraper, or wire brush where appropriate and necessary. Metallic surfaces which have been soldered shall be cleaned with benzol and all other metal surfaces washed with benzine.

D. Mixing shall be in galvanized iron pans. Paint shall be mixed in full compliance with manufacturer's directions. Thinning shall be done only in full compliance with manufacturer's directions.

E. Workmanship shall be highest quality, free from brush marks, laps, streaks, sags, unfinished patches, or other blemishes. Edges where paint joins other material or colors shall be sharp and clean without overlapping. Paint shall be brushed or sprayed on in strict compliance with manufacturer's directions and shall work evenly and be allowed to dry at least 48 hours before subsequent coating. Paint shall not be applied in damp or rainy weather or until surface has thoroughly dried. Contractor shall furnish and lay drop-cloths in all areas where painting is done as necessary to protect work of other trades. Varnish and enamel shall not be applied when temperature in the area is less than 60 degrees Fahrenheit nor paint when under 50 degrees Fahrenheit. Prior to final acceptance, Contractor shall touch up or restore any damaged finish. All insulation materials shall be provided with a paint suitable jacket.

F. The following materials and equipment require painting as noted:

1. All concealed piping, sheet metal, hangers and accessories except galvanized sheet metal or piping and tar coated cast iron piping:

   a. One coat rust-inhibitive primer except where exterior insulation is provided.

2. All exposed, exterior and interior, piping, sheet metal, hangers and accessories, air handling units, chillers, pumps, etc. except galvanized sheet metal or piping and tar coated cast iron piping:

   a. One coat rust-inhibitive primer except where exterior insulation is provided.

3. All concealed galvanized sheet metal, piping and accessories.

   a. One coat galvanized metal primer on threaded portions of piping and any damaged galvanized surfaces.

4. All exposed, exterior and interior galvanized sheet metal, piping and accessories.

   a. One coat galvanized metal primer except where exterior insulation is provided.

5. All exposed, exterior and interior, insulation equipment.

   a. Two coats exterior glass enamel over paint suitable insulation jacket.

G. All piping in Equipment Rooms shall be painted (color shown below) and identified by stenciling with letters minimum 1/2" high in a contrasting color. Piping outside Equipment Rooms shall be stenciled. Stenciling shall occur at each change of direction and every 20 feet. Arrows should be placed adjacent to letters signifying direction of flow.

END OF SECTION 230500

SECTION 230510 – VARIABLE FREQUENCY DRIVE

PART 1 – GENERAL

1.1 SCOPE

A. The provisions of Section 230500 apply to all the work in this section.

B. Furnish and install adjustable frequency controller as required to provide fan speed control.

1.2 SUBMITTALS Submit the following in accordance with Section 230500

A. Manufacturer's Cuts.

B. Certified Capacity Ratings.

C. Installation Instructions.

D. Operating and Maintenance Instructions.

PART 2 - PRODUCT

2.1 ADJUSTABLE FREQUENCY CONTROLLER (AFC)

A. Furnish complete variable frequency drives as specified herein for the fans and pumps designated on the drawing schedules to be variable speed. All standard and optional features shall be included within the VFD enclosure, unless otherwise specified. VFD enclosure shall be NEMA 1 with inlet air filters. Drives shall be as manufactured by ABB, Toshiba or AC Tech. All adjustable frequency controllers on the project shall be submitted by the same manufacturer.

B. The VFD shall convert three-phase, 60 Hz utility power to adjustable voltage and frequency, three phase power for stepless motor speed control from 10% to 100% of the motor's 60 Hz speed. Input voltage shall be as specified on the drawing schedules.

C. The VFD shall include a converter and an inverter section. The converter section shall convert fixed frequency and voltage AC utility power to DC voltage. All VFD's shall include input line reactors.

D. The inverter section of the VFD shall invert the DC voltage into a quality output waveform, with adjustable voltage and frequency for stepless motor speed control. The VFD shall maintain a constant V/Hz ratio.

E. The VFD and options shall be tested to ANSI/UL Standard 508. The complete drive, including all specified options, shall be listed by a nationally recognized testing agency such as UL or ETL.

F. Power line noise shall be limited to a voltage distortion factor and line notch depth as defined in IEEE Standard 519-1981, Guide for Harmonic Control and Reactive Compensation of Static Power Converters. The total voltage distortion shall not exceed 5%.

G. The VFD shall not emit radiated RFI in excess of the limitations set forth in the FCC Rules and Regulations, Part 15 for Class A computing devices. The VFD shall carry a FCC compliance label. PWM type drives shall include RFI filters.

H. Motor noise as a result of the VFD shall be limited to three dB over across the line operation, measured at three feet from the motor's center line.

I. The VFD's full load amp rating shall meet or exceed NEC Table 430-150.

J. Protective Features.

1. Individual motor overload protection for each motor controlled.
2. Protection against input power undervoltage, overvoltage, and phase loss.
3. Protection against output current overload and instantaneous over current.
4. Protection against overtemperature within the VFD enclosure.
5. Protection against overvoltage on the DC bus.
6. Protect VFD from sustained power or phase loss. Undervoltage trip activates automatically when line voltage drops more than 10% below rated input voltage.
7. Automatically reset faults due to undervoltage, overvoltage, phase loss, or overtemperature.
8. Protection against output short circuit and motor winding shorting to case faults, as defined by UL508.
9. Status lights or digital display for indication of individual fault conditions.
10. Controller capable of operating without a motor or any other equipment connected to the drive output to facilitate start-up and troubleshooting.
11. Input line reactors shall be provided to minimize harmonics introduced to the AC line, and to provide additional protection to AC line transients.

K. Interface Features.

1. Door mounted Hand/Off/Auto selector switch to start and stop the VFD. In the auto position, the VFD will start/stop from a remote contact closure. In the HAND Position, the VFD will run regardless of the remote contact position.
2. Manual speed control capability.
3. Local/Remote selector switch. In the remote position, motor speed is determined by the follower signal. In the local position, motor speed is determined by the manual speed control.
4. Power/on light to indicate that the VFD is receiving utility power.
5. Fault light to indicate that the VFD has tripped on a fault condition.
6. Digital meter with selector switch to indicate percent speed and percent load.
7. A set of form-C, dry contacts to indicate when the VFD is in the run mode.
8. A set of form-C, dry contacts to indicate when the VFD is in the fault mode.
9. A 0 to 10Vdc output signal to vary in direct proportion to the controller's speed.
10. VFD to have terminal strip to accept N. C. safety contacts such as freezestats, smoke alarms, etc. VFD to safely shut down in drive or bypass mode when contacts open.
11. VFD to accept an additional N. C. contact to interface with the Hand-Off-Auto switch for remote Stop/Start control.
12. VFD shall accept a 4 to 20MA, 0 to 5Vdc, or 0 to 10Vdc signal (if required).

L. Adjustments.

1. Maximum speed, adjustable 50 to 100% base speed.
2. Minimum speed, adjustable 0 to 50% base speed.
3. Acceleration time, adjustable 30 to 60 seconds.
4. Deceleration time, adjustable 3 to 60 seconds with override circuit to prevent nuisance trips if decel time is set too short.
5. Current limit, adjustable 0 to 110%.
6. Overload trip set point.
7. Offset and gain to condition the input speed signal.

M. Service Conditions.

1. Ambient temperature, 32 to 104°F (0 to 40°C).
2. 0 to 95% relative humidity, non-condensing.
3. Elevation to 3,300 feet (1,000 meters) without derating.
4. AC line voltage variation, -10 to +10% of nominal.

N. Special Features.

1. The following special features shall be included in the VFD enclosure. The unit shall maintain its UL or ETL listing.

   a. Manual bypass and starter shall provide all the circuitry necessary to transfer the motor from the VFD to the power line, or from the line to the controller. The bypass circuitry shall be mounted in a separate section of the VFD enclosure. Motor overload protection shall be provided in both drive and bypass modes.
   b. A door interlocked, pad lockable drive disconnect switch shall be provided to disconnect power from the VFD only.
   c. A second fused disconnect switch or circuit breaker shall be provided as a means of disconnecting all power to both the VFD and bypass circuits, as well as providing short circuit and locked rotor protection to the motor while in the bypass mode.
   d. The disconnect and bypass functions shall be accomplished with a four position drive/off/line/test switch with motor starter and bypass fuses.

O. Quality Assurance.

1. To ensure quality and minimize infantile failures at the jobsite, the complete VFD shall be tested by the manufacturer. The VFD shall operate a dynamometer at full load and the load and speed shall be cycled during the test.
2. All optional features shall be functionally tested at the factory for proper operation.

PART 3 – EXECUTION

3.1 START-UP SERVICE

A. The manufacturer shall provide start-up commissioning of the variable frequency drive and its optional circuits by a factory certified service technician who is experienced in start-up and repair services. The commissioning personnel shall be the same personnel that will provide the factory service and warranty repairs at the customer's site. Sales personnel and other agents who are not factory certified technicians for drive field repair shall not be acceptable as commissioning agents.

B. Start-up services shall include checking for verification of proper operation and installation for the VFD, its options and its interface wiring to the building automation system. Included in this service shall be (as a minimum):

1. Verification of contractor wire terminations to the VFD and its optional circuitry.
2. Installation verification for proper operation and reliability of the VFD, the motor being driven, and the building automation system.
3. Up to one hour of customer operator training on operation and service diagnostics at the time of the equipment commissioning.
4. Measurement for verification of proper operation on each of the following items:

   a. Motor voltage and frequency. Verification of proper motor operation.

b. Control input for proper building automation system interface and control calibration.
c. Calibration check for the following set points (and adjustment as necessary((1) minimum speed, (2) maximum speed, (3) acceleration and deceleration rates.

C. Warranty.

1. The VFD shall be warranted by the manufacturer for a period of 36 months from date of shipment. The warranty shall include parts, labor, travel costs and living expenses incurred by the manufacturer to provide factory authorized on-site service.
2. The motor(s) which are directly connected to the VFD shall be warranted by the VFD manufacturer against insulation breakdown which is directly attributed to the VFD. The length of the motor insulation warranty shall be the same as the VFD warranty. The motor must never have been driven by another VFD.

3.2 EXAMINATION

A. Contractor to verify that jobsite conditions for installation meet factory recommended and code required conditions for VFD installation prior to start-up. These shall include as a minimum:

1. Clearance spacing.
2. Temperature, contamination, dust, and moisture of the environment.
3. Separate conduit installation of the motor wiring, power wiring, and control wiring.
4. Installation per the manufacturer's recommendations.

END OF SECTION 230510

SECTION 230540 – VIBRATION AND SEISMIC CONTROL

PART 1 - GENERAL

1.1 GENERAL

A. All vibration isolation and seismic control materials specified herein shall be provided by a single manufacturer to assure single responsibility for their proper performance. Installation of all vibration and seismic control materials specified herein shall be accomplished following the manufacturer's written instructions.

B. The Contractor shall furnish a complete set of shop drawings and other necessary information, of all mechanical equipment to receive vibration isolation and seismic devices, to the vibration isolation and seismic control materials manufacturer. The information to be furnished shall include operating weight of the equipment to be isolated, distribution of weight to support points and dynamic characteristics along with any internal isolation systems to be analyzed. The Contractor shall also furnish a complete layout of piping and ductwork to be isolated, including vertical risers, showing size or weight and support points of the piping and ductwork system, to the vibration isolation and seismic control materials manufacturer, for selection and layout of mountings.

C. The vibration and seismic control materials manufacturer shall use the above listed information to design a complete system of vibration and seismic mounts in accordance with the contract documents along with the 2018 International Building Code Chapter 16, SMACNA "Seismic Restraint Manual", and ASHRAE 2019, Chapters 49 and 56. The vibration and seismic control materials Contractor shall analyze all "multiple degree of freedom" systems, and provide properly designed isolation systems avoiding all resonance frequencies. To accomplish this, the vibration and seismic control materials supplier shall employ an Engineer registered in the State of South Carolina to design all isolation and restraint systems and prepare a complete set of calculations and shop drawing submittals with his professional Engineer's seal certifying that the design meets all requirements of these contract documents. A seismic design "errors and omissions" insurance certificate must accompany submittals from the vibration and seismic Engineer. Manufacturer's product liability insurance certificates are not acceptable.

D. The vibration and seismic control Engineer or his designated representative shall inspect the project upon completion of the applicable work and provide written certification that the installation is in compliance with the approved shop drawing submittals. This certification shall also bear the professional Engineer's seal and shall become part of the contract closeout documents. All seals shall be signed and dated appropriately.

E. Vibration and seismic control systems shall be provided by Vibration Mounting and Controls, Mason Industries, Consolidated Kinetics, or prior approved equal.

PART 2 - PRODUCTS AND EXECUTION

2.1 VIBRATION ISOLATION

A. All mechanical equipment shall receive external vibration isolation. Internal component isolation of equipment shall not be considered equivalent, but shall be considered when analyzing systems with multiple degrees of freedom.

B. Vibration isolators shall be selected based upon known operating weight distributions and dynamic characteristics of the isolated equipment, with the quantity and location as required by the component drawing. Isolator type shall be tabulated for each isolated piece of equipment. Complete calculations of vibration analysis shall be included with submittals, including but not limited to fundamental and harmonic frequencies.

C. Isolators shall have either known non-deflected heights of spring element or calibration markings so that, after adjustment, when carrying their load, the deflection under load can be verified to determine if the load is within the proper range of tile isolator and if the correct degree of vibration isolation is being provided.

D. Isolators shall function in the linear portion of the load versus deflection curve. Theoretical vertical natural frequency shall not differ from the design objectives by more than ± 10%.

E. Spring mounts shall have seismic housings as required by Paragraph 2.02.

F. Isolation of equipment shall be as follows:

1. Suspended equipment shall be isolated from the building structure by means of noise and vibration isolators. Units shall be supported with spring and neoprene type isolators, springs to be as described above. Isolators shall be VMC Series RSH.
2. Roof mounted equipment shall be isolated from the building structure by means of a structural aluminum or hot dipped galvanized structural steel isolation curb. The structural spring isolation curbs shall bear directly on the roof support structure and be flashed and waterproofed into the roofs membrane waterproofing system. Roof curbs shall be designed to match pitch of roof. Equipment manufacturers or field fabricated curbs shall not be used. The curb shall consist of a rigid lower section containing properly spaced pockets with fully adjustable spring isolators. All springs shall be color coded for proper identification and spring pocket shall allow for easy removal or replacement of any spring without disturbance of the supported equipment. Pockets shall have removable waterproof covers to allow for spring adjustment. Spring pockets shall contain combination vertical and horizontal restraint in conjunction with a 1/4 inch thick neoprene rubber bushing which will resist wind and seismic forces. All springs shall be installed in series with a 1/4 inch thick neoprene acoustical cup or pad. Curbs supplied shall be factory acoustically lined with 1 inch 3 PCF duct liner. An air tight neoprene seal shall be incorporated into the curb design to prevent air leakage or infiltration. Air seal must not be exposed so that it could be damaged or that in the event of the air seal failure, water could leak into the curb's interior. Wood nailer and flashing shall be provided and curbs shall be manufactured to NRCA standards. Curbs shall include a means of incorporating a sound banier package, consisting of two layers of waterproof gypsum board furnished and installed by the Mechanical Contractor. Individual pier supported curbs are not acceptable. Roof equipment supports to be VMC type P or R.
3. Mechanical equipment as noted shall be mounted on a rigid structural steel base. The equipment including the base shall be mounted on or suspended from vibration isolators as applicable. Base shall be VMC Type WFB.
4. Floor mounted equipment as noted shall be provided with a noise and vibration isolated structural steel concrete slab inertia base mounted on isolators. Spring mounts shall be recessed at comers. Inertia base shall be VMC Type MPF or WPF as applicable.

2.2 SEISMIC CONTROL

A. All mechanical equipment, piping, ductwork, etc. shall be provided with seismic restraints in accordance with the 2018 International Building Code, 2018 International Mechanical Code, and SMACNA Seismic Restraint Manual, Latest Edition requirements, as a minimum.

1. All equipment isolated or not, shall be bolted to the structure to allow for seismic acceleration with no failure or displacement. All connections shall be positive bolted type; no friction clamps of any kind are allowed.
2. Provide cable and connection sets for suspended equipment at each of four comers secured to the building structure.
3. Floor mounted equipment shall be provided with seismically housed springs or springs with seismic snubbers as determined by the equipment to be isolated.

END OF SECTION 230540

SECTION 230590 – TESTING, ADJUSTING, AND BALANCING

PART 1 - GENERAL

1.1 SCOPE

A. The provisions of Section 230500 apply to all the work in this Section.

B. Work shall be performed by an independent balancing company certified by AABC or NEBB. Technicians shall be competent in the trade of testing and balancing environmental systems and shall be done in an organized manner utilizing appropriate test and balance forms.

C. The test and balance contractor shall be selected and retained (under separate contract) by Horry County Schools.

D. Contractor shall cooperate fully and coordinate with the Owner's TAB agent. Equipment changes parts and labor shall be by the contractor.

E. The test and balance report shall be submitted prior to the final inspection. The TAB sub-contractor shall attend the final to spot check air and water flows.

F. Out-of-tolerance data: This phase means a measurement taken during TAB field testing which does not fall within the range of plus 10 to minus 5 percent of the original measurement reported on the TAB Report for a specific parameter.

1.2 SUBMITTALS

A. Submit the following in accordance with Section 230500:

1. Manufacturer's cut sheets and calibration information for all equipment to be used.
2. Sample balancing charts and forms. Include all components that to be Tested and Balanced complete with balance values and tolerances.
3. Preliminary report for review and comment.
4. Completed final balancing data.

PART 2 - PRODUCTS

2.1 INSTRUMENTATION

A. Instruments for use in the test and balancing procedures shall be of first quality and be accurately calibrated at the time of use. The following list is provided to indicate the instruments expected, however, other instruments as necessary to properly perform the work will be provided and subject to approval of the Architect.

1. Inclined manometer calibrated in no less that .006-inch divisions.
2. Combination inclined and vertical manometer (0 to 10 inch is generally the most useful).
3. Pitot Tubes. (Usually and 18 and 48 inch tube covers most balance requirements.
4. Tachometer. This instrument should be of the high quality self-timing type.
5. Clamp-on ampere meter with voltage scales.
6. Deflecting vane anemometer.
7. Rotating vane anemometer.
8. Thermal type (hot wire) anemometer.

9. Hook gage.
10. Dial and glass stem thermometers.
11. Sling psychrometer.

B. The accuracy of calibration of the field instruments used is of the utmost importance. All field instruments used in the balance should have been calibrated at least within the previous three months. Calibration standards shall be traceable to NIST. Naturally, any suspect instruments should be checked more frequently.

PART 3 - EXECUTION

3.1 SYSTEM START-UP

A. Starting date for mechanical system shall be scheduled well in advance of expected completion date and shall be established a minimum of two weeks prior to acceptance date. The system shall be in full operation with all equipment functional prior to acceptance date.

B. Performance readings shall be taken and recorded on all air and water distribution devices and the system shall be balanced out prior to acceptance. Balancing of the system shall be accomplished with duct dampers. Grille dampers may not be used for balancing. Record and submit results in table form along side of scheduled quantities.

C. All controls shall be calibrated by qualified personnel prior to acceptance date. Thermostats shall be in close calibration with one another and shall operate their respective units without interference from adjacent units.

D. All units shall be checked out thoroughly and the following information recorded on each machine which shall include, but not be limited to information listed below. Check sheets shall be included in Operating and Maintenance instructional Manual.

1. Pumps

   a. Pump No.
   b. Manufacturer and Model
   c. Motor Manufacturer, Frame and Nameplate Data
   d. Water Flow Rate, GPM
   e. Water Pressure Increase (Ft. H_20)
   f. Motor Amperage
   g. Voltage
   h. RPM
   i. Check Lead-Lag Controls

2. Closed Circuit Cooling Tower

   a. Manufacturer and Model
   b. Fan nameplate Data
   c. Amb. Conditions (WB and DB Temperatures)
   d. Fan Motor Amps.
   e. Voltage
   f. Make Up Water Valve Operation
   g. Basin Heater Operation

3.2 SPECIAL REQUIREMENTS

A. Variable Volume Pumping System Differential Pressure Setpoint: TAB contractor shall determine the optimum differential pressure setpoint as follows: Determine and record in the TAB report, the hydraulically most remote coil. Lock its control valve in fully open position and open the balancing valve. Set all other coils downstream of control differential pressure transmitter to balanced flow with control valve in wide open position. Adjust variable volume pump speed manually until most remote coil flow equals its design value. Record the corresponding sensed differential pressure at the differential pressure sensor location as the optimum differential pressure setpoint. If necessary to provide diversity, coil control valves that are not downstream of the duct pressure transmitter may be closed.

B. Variable Volume Pumping System Pump Balancing: After optimum differential pressure setting has been determined as described above, open all coil control valves and balance coil flows to 120% of specified values while pump speed is under automatic control maintaining the optimum setpoint. Record pump data, including pump speed, under these conditions. Turn variable volume pump off. Start constant volume pump. Throttle pump discharge valve until control differential pressure falls to the recorded optimum setpoint. Record constant volume pump data. Do not throttle pump discharge valve on variable volume pumps. Leave discharge valve on variable volume pumps wide open.

C. Calibrate controls flow meters for condenser water.

D. Provide TAB result to controls contractor for use in control logic.

END OF SECTION 230590

SECTION 230700 – INSULATION (HVAC)

PART 1 - GENERAL

1.1 DESCRIPTION

A. This section of specifications and related drawings describe requirements pertaining to insulation.

B. Provide all insulation in conjunction with equipment, piping and ductwork furnished under this division.

C. The provisions of Section 230500 apply to all the work in this section.

1.2 QUALITY ASSURANCE

A. Products of the manufacturers listed under MATERIALS will be acceptable for use for the specific functions noted. Adhesives, sealers, vapor barriers, and coatings shall be compatible with the materials to which they are applied, and shall not corrode, soften or otherwise attack such material in either the wet or dry state.

B. Materials shall be applied subject to their temperature limits. Any methods of application of insulating materials or finishes not specified in detail herein shall be in accordance with the particular manufacturer's published recommendations.

C. Insulation shall be applied by experienced workers regularly employed for this type of work.

1.3 SUBMITTALS

A. Submit the following in accordance with Section 230500:

1. Catalog cuts.
2. Materials ratings.
3. Insulation instructions.

1.4 RATING

A. Insulation and accessories such as adhesives, mastics, cements, tape and jackets, unless noted otherwise, shall have a flame spread rating of not more than 25 and a smoke developed rating of not more than 50. Materials that are factory applied shall be tested individually. No fugitive or corrosive treatments shall be employed to impart flame resistance.

B. Flame spread and smoke developed ratings shall be determined by Method of Test of Surface Burning Characteristics of Building Materials, NFPA No. 255, ASTM E-84, UL 723.

C. Products of their shipping cartons shall bear a label indicating that flame and smoke ratings do not exceed above requirements.

D. Treatment of jackets or facings to impart flame and smoke safety shall be permanent. The use or water-soluble treatment is prohibited.

E. Certify in writing, prior to installation, that products to be used will meet RATING criteria.

PART 2 – PRODUCT

2.1 PIPE INSULATION

A. Materials

1. Heavy density fiberglass.

a. Condenser Water Supply and Return piping.

B. All piping systems to be insulated followed by a kraft paper, all service jacket composed of an outer layer of vinyl, fiberglass scrim cloth, aluminum foil, and kraft paper, in that order, from outside to inside of pipe covering

C. All exposed piping, such as mechanical rooms, stairwells, crawl spaces, attics or other occupied spaces, shall have an additional layer of Kraft paper all service jacket with vapor sealing tape followed by an 8 oz./sq. yd. canvas cloth wrap, glued with two coats of sizing.

D. Thicknesses.

1. Condenser water piping

a. Pipe sizes 1 ½” and under - 1” thick, closed cellular rubber
b. Pipe sizes 2” to 4” – 2” thick, closed cellular glass
c. Pipe sizes larger than 4”, 2 ½” thick, closed cellular glass

E. All piping wall penetrations shall be continuously insulated through the penetration to ensure proper vapor barrier containment.

PART 3 - EXECUTION

3.1 PIPE INSULATION.

A. Application:

1. Insulation and surfaces to be insulated shall be clean and dry when insulation is installed and during the application of any finish.

B. Fiberglass Insulation:

1. All fiberglass pipe covering shall be furnished with self-seal lap and 3" wide butt joint strips. The release paper is pulled from adhesive edge, pipe covering closed tightly around pipe and self-seal lap rubbed hard in place with the blunt edge of an insulation knife. This procedure applies to longitudinal as well as circumferential joints. Under no circumstances will staples be allowed. Care shall be taken to keep jacket clean, as it is the finish on all exposed work. All adjoining insulation sections shall be firmly butted together before butt joint strip is applied, and all chilled water and cold water service lines shall have vapor seal mastic thoroughly coated to pipe at butt joints every 21' and at all fittings. All insulation outside shall be protected with aluminum weather-proof jacketing with lap-seal, and factory attached moisture barrier. The aluminum shall be .016 gauge (3303-H14 alloy) of embossed pattern. It shall be applied with a 2" circumferential and 1-1/2" longitudinal lap and be secured with aluminum bands 3/8" wide 8" o.c.. All elbows shall be covered with the same .016 aluminum with factory applied moisture barrier. All fittings, valve bodies, unions, and flanges shall be finished as follows:

a. Apply molded or segmental insulation to fittings equal in thickness to the insulation on adjoining pipe and wire in place with 2#14 copper wires.
b. Apply a skim coat of insulating cement to the insulated fitting, if needed, to produce a smooth surface. After cement is dry, apply Fiberglass Fitting Mastic, UL labeled.
c. Wrap the fitting with fiberglass reinforcing cloth overlapping the preceding layer by 1 to 2". Also, overlap mastic and cloth by 2" on adjoining sections of pipe insulation.
d. Apply a second coat of mastic over cloth, working it well into mesh of cloth and smooth the surface. Mastic to be applied at the rate of 40 square feet per gallon. All flanges and fittings on hot and cold lines in utility tunnels shall be insulated according to above. Omit insulation on flanges and unions over 60 degrees F. If painting is required, no sizing is necessary. To maintain the non-combustibility of the system only acrylic latex paint is to be used.
e. All piping exposed to view (equipment rooms, etc.) shall be covered with an 8 oz. canvas jacket.

END OF SECTION 230700

SECTION 230900 - BUILDING AUTOMATION AND CONTROL SYSTEM

PART 1 - GENERAL

1.1 SCOPE

A. The provisions of Section 230500 apply to the work of this section.

B. This specification section is included for information purposes only. The owner shall perform the Building Automation System (BAS) and temperature controls portion of this project under a separate contract. For coordination contact Control Management, Inc. (803) 765-9070.

C. This specification defines the minimum equipment and performance requirements for a direct digital control building control system.

D. Acceptable manufacturers are as follows:

1. Siemens – Landis Division

E. This Section includes control equipment and installation for HVAC systems and components.

1.2 SUBMITTALS/DRAWINGS

A. The Control System Contractor shall submit prior to installation a set of installation drawings and control strategies for review by the consultant and/or owner's representative. These drawings shall include the physical location of building control system equipment and system architecture. The complete sequence of operation of the control system shall be provided.

B. Upon System completion of the installation and final system adjustment, the Control Contractor shall provide a full set of as-built drawings of the installation and the control strategies. In addition, the Control Contractor shall provide a thumb drive containing the as-built control drawings in AutoCad format

C. Framed control diagrams shall be mounted on the wall inside the appropriate mechanical room.

1.3 GUARANTEE

A. The entire control system shall be installed by the control system contractor and guaranteed free of defects and shall include required servicing and maintenance for one year after final acceptance.

1.4 CONTROL AND INTERLOCK WIRING

A. All electrical work required under this section of specifications shall comply with the latest National Electrical Code. Control system power supply shall be served by a separate breaker and fused in control center for secondary protection.

B. The mechanical contractor shall furnish and turn over to the electrical contractor, motor starters for mounting and power connections through starter to motor. Disconnect switches, when required, shall be furnished by electrical contractor.

C. All control wiring shall be run in rigid conduit below grade or, on outdoor installation. Galvanized EMT may be run in dry wall construction, above ceilings, or in equipment rooms where permitted by electrical specifications.

D. Control wiring shall be color-coded #16 TFF of TFFN wire with 600 volt insulation. Run all wiring between terminal points without changing color. Color code of control wiring shall be as indicated on control wiring diagram. Multi-conductor thermostat cable will not be acceptable.

1.5 TRAINING/OWNER'S INSTRUCTION

A. The Control System Contractor shall provide two copies of an operator's manual describing all operating and routine maintenance service procedures to be used with the system. The Control System Contractor shall instruct the Owner's designated representatives in these procedures during the start-up and test period. The duration of the instruction period shall be no less that 8 hours. These instructions are to be conducted during normal working hours. The instructions shall consist of both hands-on and classroom training at the jobsite.

PART 2 - PRODUCTS

2.1 MODULAR BUILDING CONTROLLER (MBC)

A. Existing.

2.2 APPLICATION SPECIFIC CONTROLLERS

A. Provide application specific controllers (ASCs) as required for each mechanical system or piece of equipment. Each ASC shall be a microprocessor-based direct digital control unit and shall be capable of operating either as a standalone controller or on a multi-drop communications network originating at the MBC. Provide each ASC with sufficient memory to operate in a truly independent manner; that is, each ASC shall support its own inputs and outputs, operating system, database and programs necessary to perform control sequences and energy management routines.

2.3 TERMINAL EQUIPMENT CONTROLLERS

A. Terminal equipment controllers shall be provided for each piece of equipment as specified. The BMCS shall support specific controllers for the following types of equipment as a minimum:

B. Controllers shall include all point inputs and outputs necessary to perform the specified control sequences.

C. Each controller shall have connection provisions for a portable laptop or similar operator's terminal. This connection shall be possible at both the controller and at the matching room temperature sensor as previously specified. The terminal may be used for readout of system variables, override control, adjustment of control parameters, air balancing, servicing and troubleshooting. The terminal shall provide the user with the following functionality as a minimum:

1. Display system status (heating, cooling, etc.)
2. Display all point values and setpoints
3. Set and change all setpoints
4. Set and change heating/cooling deadbands
5. Set and change PID loop gains

6. Set and change system mode (occupied/unoccupied)
7. Set and change system mode times
8. Override all setpoints
9. Override all digital and analog outputs
10. Command all digital and analog outputs
11. Select application mode
12. Assign controller address

D. All communication and displays via the portable terminal shall be in full English language with accompanying English and SI (International System of Units) engineering units for all displayed data. Selection between English and SI units shall be accomplished via a single keystroke on the portable terminal.

E. In addition to local interface capabilities, all functionality as specified above may be performed both from the central operator's workstation and from any MBC on the communications network via the same portable terminal. From a terminal connected to any MBC it shall be possible to issue global commands to groups of controllers. Provide the following global commanding capabilities for all controllers as a minimum:

1. Heating/Cooling setpoint changes
2. Stage Off/On heating
3. Fan on/off control

PART 3 - EXECUTION

3.1 EXAMINATION

A. The project plans shall be thoroughly examined for control device and equipment locations. Any discrepancies, conflicts, or omissions shall be reported to the architect/engineer for resolution before rough-in work is started.

3.2. INSTALLATION

A. Provide all relays, switches, sources of emergency and electricity and all other auxiliaries, accessories and connections necessary to make a complete operable system in accordance with the sequences specified. All field wiring shall be by this contractor.

B. Install controls so that adjustments and calibrations can be readily made. Controls are to be installed by the control equipment manufacturer.

C. Mount surface-mounted control devices on brackets to clear the final finished surface on insulation.

D. Install equipment level and plumb.

E. Unless otherwise noted, install wall mounted thermostats and humidistat 60” above the floor measured to the center line of the instrument, or as otherwise directed by the Architect.

F. Install averaging elements in ducts and plenums in horizontal crossing or zigzag pattern.

G. Install outdoor sensors in perforated tube and sunshield.

H. Install damper motors on outside of duct in protected areas, not in locations exposed to outdoor temperatures.

I. Install labels and nameplates on each control panel listing the name of the panel referenced in the graphics and a list of equipment numbers served by that panel.

3.3 ELECTRICAL WIRING SCOPE

A. This contractor shall be responsible for power that is not shown on the electrical drawings, to controls furnished by this contractor. If power circuits are shown on the electrical drawings, this contractor shall continue the power run to the control device. If power circuits are not shown, this contractor shall coordinate with the electrical contractor to provide breakers at distribution panels for power to controls. This contractor is then responsible for power from the distribution panel.

1. Coordinate panel locations. If enclosures for panels are shown on the electrical drawings, furnish the enclosures according to the electrician's installation schedule.

B. This contractor shall not be responsible for power to control panels and control devices that are furnished by others, unless it is part of the control interlock wiring.

C. Refer to Coordination section for what devices this contractor is responsible to mount and which are turned over to others to mount.

D. This contractor shall be responsible for wiring of any control device that is furnished as part of this section of specification.

E. Wiring for controls furnished by others:

1. Provide control wiring for HVAC controls furnished by others. Wiring may include, but not limited to, interlocks, standalone thermostats, safeties and remote control devices such as valves, sensors, etc.

F. Class1 wiring shall be run in separate conduits from BAS associated wiring.

3.4 ELECTRICAL WIRING AND CONNECTION INSTALLATION

A. All low voltage control wiring shall be class 2. Control wiring that is not class 2 shall be run in separate conduits from class 2 wiring.

B. Floor level network wiring between terminal units can be combined with thermostat and other low voltage wiring in the same conduit. All other network wiring shall be in dedicated conduits.

C. Install raceways, boxes, and cabinets according to Division 26 Section "Raceways and Boxes."

D. Install building wire and cable according to Division 26 Section "Conductors and Cables."

E. Installation shall meet the following requirements:

1. Conceal cable and conduit, except in mechanical rooms and areas where other conduit and piping are exposed.
2. Install exposed cable in conduit raceway.
3. Install concealed cable in rigid conduit or EMT.

4. Fasten flexible conductors, bridging cabinets and doors, along hinge side; protect against abrasion. Tie and support conductors.
5. Number-code or color-code conductors for future identification and service of control system, except local individual room control cables.
6. All wiring in lab areas shall be in conduit.
7. All unsupported risers shall be rigid steel conduit. Supported risers shall be EMT.

F. Rigid conduit shall be steel, hot dip galvanized, threaded with couplings, ¾ inch minimum size, manufactured in accordance with ANSI C-80-1. Electrical metallic tubing (EMT) with compression fittings or intermediate metallic conduit (IMC) may be used as conduit or raceway where permitted by the NEC.

G. Concealed control conduit and wiring shall be provided in all spaces except in the Mechanical Equipment Rooms and in unfinished spaces. Install in parallel banks with all changes in directions made at 90 degree angles.

H. Install conduit adjacent to machine to allow service and maintenance.

I. Connect manual-reset limit controls independent of manual-control switch positions. Automatic duct heater resets may be connected in interlock circuit of power controllers.

J. Connect hand-off-auto selector switches to override automatic interlock controls when switch is in hand position.

K. Ground equipment.

3.5 SYSTEM CHECKOUT AND STARTUP

A. Inspect each termination in the MER control panels and devices to make sure all wires are connected according to the wiring diagrams and all termination are tight.

B. After the controls devices and panels are installed and power is available to the controls, perform a static checkout of all the points, including the following:

1. Inspect the setup and reading on each temperature sensor against a thermometer to verify its accuracy.
2. Inspect the setup and reading on each humidity sensor against a hygrometer to verify its accuracy.
3. Inspect the reading on each CO2 sensor using a calibration kit to verify the sensor range accuracy matches the DDC setup.
4. Inspect the reading of each status switch to verify the DDC reads the open and close correctly.
5. Command each relay to open and close to verify its operation.
6. Command each 2-position damper actuator to open and close to verify operation.
7. Command each 2-position valve to open and close to verify operation.
8. Ramp each modulating actuator to 0%, 25%, 50%, 75% and 100% to verify its operation.
9. Ramp each modulating output signal, such as a VFD speed, to verify its operation.
10. Test each safety device with a real life simulation, for instance check freezestats with ice water, water detectors with water, etc.

C. Document that each point was verified and operating correctly. Correct each failed point before proceeding to the dynamic startup.

D. Verify that each DDC controller communicates on its respective network correctly.

E. After all of the points are verified, and power is available to the mechanical system, coordinate a startup of each system with the mechanical contractor. Include the following tests:

1. Start systems from DDC.
2. Verify that each setpoint can be met by the system.
3. Change setpoints and verify system response.
4. Change sensor readings to verify system response.
5. Test safety shutdowns.
6. Verify time delays.
7. Verify mode changes.
8. Adjust filter switches and current switches for proper reactions.
9. Adjust proportional bands and integration times to stabilize control loops.

F. Perform all program changes and debugging of the system for a fully operational system.

G. Verify that all graphics at the operator workstations correspond to the systems as installed. Verify that the points on the screens appear and react properly. Verify that all adjustable setpoints and manual commands operate from the operator workstations.

H. After the sequence of operation is verified, setup the trends that are listed in the sequence of operations for logging and archiving for the commissioning procedure.

3.6 SYSTEM COMMISSIONING, DEMONSTRATION AND TURNOVER

A. The BAS Contractor shall prepare and submit for approval a complete acceptance test procedure including submittal data relevant to point index, functions, sequence, inter-locks, and associated parameters, and other pertinent information for the operating system. Prior to acceptance of the BAS by the Owner and Engineer, the BAS contractor shall completely test the BAS using the approved test procedure.

B. After the BAS contractor has completed the tests and certified the BAS is 100% complete, the Engineer shall be requested, in writing, to approve the satisfactory operation of the system, sub-systems and accessories. The BAS contractor shall submit Maintenance and Operating manuals at this time for approval. An acceptance test in the presence of the Engineer and Owner's representative shall be performed. The Owner will then shake down the system for a fixed period of time (30 days).

C. The BAS contractor shall fix punch list items within 30 days of acceptance.

D. When the system performance is deemed satisfactory in whole or in part by these observers, the system parts will be accepted for beneficial use and placed under warranty.

3.7 PROJECT RECORD DOCUMENTS

A. Project Record Documents: Submit three (3) copies of record (as-built) documents upon completion of installation. Submittal shall consist of:

1. Project Record Drawings. As-built versions of the submittal shop drawings provided as AutoCAD compatible files in electronic format and as 11 x 17 inch prints.

2. Testing and Commissioning Reports and Checklists. Completed versions of reports, checklists, and trend logs used to meet requirements in the Control System Demonstration and Acceptance section of this specification.
3. Operation and Maintenance (O & M) Manual.

    a. As-built versions of the submittal product data.
    b. Names, addresses, and 24-hour telephone numbers of installing contractors and service representatives for equipment and control systems.
    c. Operator's Manual with procedures for operating control systems, logging on and off, handling alarms, producing point reports, trending data, overriding computer control, and changing setpoints and variables.
    d. Programming manual or set of manuals with description of programming language and of statements for algorithms and calculations used, of point database creation and modification, of program creation and modification, and of editor use.
    e. Engineering, installation, and maintenance manual or set of manuals that explains how to design and install new points, panels, and other hardware; how to perform preventive maintenance and calibration; how to debug hardware problems; and how to repair or replace hardware.
    f. Documentation of all programs created using custom programming language, including setpoints, tuning parameters, and object database.
    g. Graphic files, programs, and database on electronic media.
    h. List of recommended spare parts with part numbers and suppliers.
    i. Complete original-issue documentation, installation, and maintenance information for furnished third-party hardware, including computer equipment and sensors.
    j. Complete original original-issue copies of furnished software, including operating systems, custom programming language, operator workstation software, and graphics software.
    k. Licenses, guarantees, and warranty documents for equipment and systems.

B. Operating manual to serve as training and reference manual for all aspects of day-to-day operation of the system. As a minimum include the following:

    1. Sequence of operation for automatic and manual operating modes for all building systems. The sequences shall cross-reference the system point names.
    2. Description of manual override operation of all control points in system.
    3. BMS system manufacturers complete operating manuals.

C. Provide maintenance manual to serve as training and reference manual for all aspects of day-to-day maintenance and major system repairs. As a minimum include the following:

    1. Complete as-built installation drawings for each building system.
    2. Overall system electrical power supply schematic indicating source of electrical power for each system component. Indicate all battery backup provisions.
    3. Photographs and/or drawings showing installation details and locations of equipment.
    4. Routine preventive maintenance procedures, corrective diagnostics troubleshooting procedures, and calibration procedures.
    5. Parts list with manufacturer's catalog numbers and ordering information.
    6. Lists of ordinary and special tools, operating materials supplies and test equipment recommended for operation and servicing.
    7. Manufacturer's operation, set-up, maintenance and catalog literature for each piece of equipment.
    8. Maintenance and repair instructions.
    9. Recommended spare parts.

3.8 TRAINING

A. During System commissioning and at such time as acceptable performance of the Building Automation System hardware and software has been established, the BAS contractor shall provide on-site operator instruction to the owner's operating personnel. Operator instruction during normal working hours shall be performed by a competent building automation contractor representative familiar with the Building Automation System's software, hardware and accessories.

B. At a time mutually agreed upon, during System commissioning as stated above, the BAS contractor shall give 16-hours of onsite training on the operation of all BAS equipment. Describe its intended use with respect to the programmed functions specified. Operator orientation of the automation system shall include, but not be limited to:

1. Explanation of drawings and operator's maintenance manuals.
2. Walk through of the job to locate all control components.
3. Operator workstation and peripherals.
4. DDC Controller and ASC operation/sequence.
5. Operator control functions including scheduling, alarming, and trending.
6. Explanation of adjustment, calibration and replacement procedures.

C. Additional 8-hours of training shall be given after the 30 day shakedown period.

END OF SECTION 230900

SECTION 232000 – HVAC PIPING

PART 1 GENERAL

1.1 SCOPE

A. The provisions of Section 230500 apply to all work in this Section.

B. Furnish and install all condenser wate piping as shall be required in order to provide a complete and satisfactory system.

C. The Mechanical Contractor shall furnish and install all necessary valves and specialties to make the installation complete and as specified below. All specialty items unless otherwise noted shall be for operation on at least 125 pound psig working pressure as rated in accordance with the standards of ASA.

1.2 SUBMITTAL

A. Submit the following in accordance with Section 230500:

1. Manufacturer's cuts.
2. Installation instructions.
3. Operating and Maintenance Instructions.

PART 2 - PRODUCTS

2.1 CONDENSER WATER PIPING

A. All new pipe used in entire system except where otherwise shown or specified, shall be standard weight Schedule 40 black steel pipe with weights and dimensions in accordance with American Standard Association B36-10 as manufactured by National Tube Company, Birmingham Tank Company, Bethlehem Steel Company or approved equal.

B. Piping 2” and smaller shall be hard drawn copper tubing ASTM B 88 Type "L". Fittings for copper tubing shall be ANSI B16.18 or B16.22 solder joint fittings. Ends of pipe shall be reamed, pipe and fittings cleaned. Use only 95-5 (95% tin and 5% antimony) solder with non-corrosive flux on 1-1/4" and smaller and on 1-1/2" and larger use silver solder (Minimum 12% Silver), with a melting point greater than 1000°F. Submit solder for approval.

2.2 DRAIN PIPING

A. All drain lines shall be Type “L” hard drawn copper. Drains shall be run in a neat manner to the floor drain and turned down at the floor drain, unless otherwise indicated. Minimum of 1-1/4" unless otherwise shown. Secure drain piping to floor every 24” and/or at each end of the pipe.

2.3 CONDENSER WATER PIPING –BELOW GRADE

A. Condenser water piping below grade shall be Schedule 80 CPVC Pressure Pipe ASTM D 1784. Fittings shall be ASTM D 1784 solvent cement joint fittings. Ends of pipe shall be reamed, pipe and fittings cleaned.

PART 3 - EXECUTION

3.1 GENERAL

A. Contractor shall install valves and specialties according to the best practice and manufacturer's recommendations.

3.2 PIPE AND PIPE FITTINGS

A. Provide all piping and connections to all items of equipment as shown and/or required to fully complete the system indicated, including drains and other connections. The drawings show the arrangement desired and the Contractor shall follow the drawings as accurately as possible. If conflict should arise, the Contractor shall verify all measurements on the job and cut pipe unless specifically noted for expansion loops. All piping shall be reamed or filed and cleaned to remove burrs and other obstructions.

B. The Contractor shall be responsible for installing all piping work in a neat workmanlike manner. This shall be interpreted to mean that all piping shall be neatly aligned, installed and supported in equally spaced parallel runs using trapeze hangers where applicable, install square, true and plumb with walls, equipment or other related surfaces using standard fittings. Any pipe work installed in a disorderly or unworkmanlike manner as adjudged by the Architect shall be corrected by the Contractor at the Contractor's expense.

C. Branch connections to mains shall be made from the center-line of mains on horizontal runs. No branch connections are to be made from the bottom of piping.

3.3 CONDENSER WATER PIPING

A. Piping and Pipe Work: Grade all piping properly to insure noiseless circulation of water without formation of pockets. Unless otherwise called for in the plans and specifications, horizonal pipe runs shall be graded to permit complete drainage of the system.

B. All piping 2" diameter or smaller shall be threaded. Piping 2-1/2 inches and larger shall be welded. Joints at valves and equipment in piping 2-1/2 inches and larger shall be flanged. All threads shall be cut with clean and true dies.

C. Install eccentric reducers to change size of mains installed with eccentricity up to keep the top of mains level in the piping.

D. Welding: All welding of joints in piping connections done in the field shall be in accordance with the requirements of the American Standard Code for Pressure Piping.

E. Welding may be either by Metal Arc-Welding Process of the Oxyacetylene Welding Process and in general conformance with procedures established in the latest edition of Appendix B to Section 6 of the ASA Code for Pressure Piping B31.1.

F. Welding fittings shall be used with welded piping. These shall be welding pattern in accordance with ASTM Specifications A-234 and ASA Standard B16.9. Such fittings shall be provided at all changes in direction or changes in pipe size except as hereinafter provided.

G. Weldolet or Threadolet fittings may be used in lieu of welded fittings for branch connection to size 2-1/2" and larger mains, provided branch is two or more pipe sizes smaller than the main.

H. Fittings: Fittings in welded piping shall be standard weight welding fittings, with radii of 1-1/2" the diameter and equal to Tube Turns, Ladish, Taylor Forge or approved equal. See "welding" section for lateral connections and welding fittings standards.

I. Fittings in threaded piping shall be standard weight, malleable iron, screw pattern. Except where otherwise noted, fittings shall be rated for 125 pounds per square inch gauge working pressure and shall be manufactured by Crane, Flagg, Stockham or approved equal.

J. During erection, care shall be taken to remove all dirt, scale and other foreign matter from inside the piping before tying in long sections or installing valves.

K. Copper piping:

1. Piping shall be installed so as to be free floating. 125 pound copper sweat pattern unions shall be provided in the piping as indicated on the drawings.
2. Unions shall be installed at each piece of equipment.

3.4 UNDERGROUND SYSTEMS

A. Underground systems shall be buried in a trench of not less than two (2) feet deeper than the top of the pipe and not less than eighteen inches wider than the combined O.D. of all piping systems. A minimum thickness of 24 inches of compacted backfill over the top of the pipe will meet H-20 highway loading.

B. Trench bottom shall have a minimum of 6" of sand, gravel, or clean, select fill material as a cushion for the piping. All field cutting of the pipe shall be performed in accordance with the manufacturer's installation instructions.

C. A hydrostatic pressure test, as required by project specifications, shall be performed at one and one-half times the normal system operating pressure for not less than two hours. Care shall be taken to insure all trapped air is removed from the system prior to the test. Appropriate safety precautions shall be taken to guard against possible injury to personnel in the event of a failure.

D. Field service, if required by project specifications, will be provided by a certified manufacturer's representative or company field service technician. The technician will be available at the job a minimum of three times to check unloading, storing, and handling of pipe, joint installation, pressure testing and backfilling techniques. This service will be costed as part of the project technical services required by the preinsulated pipe manufacturer.

3.5 BLOWING-OUT SYSTEM

A. All piping and equipment shall be thoroughly blown-out under pressure and clean of all foreign matter wasting condensate through temporary connections so long as necessary to thoroughly clean before system is placed in operation. Use every precaution to prevent pipe compound, scale, dirt, welding and other objectionable matter getting into piping system and equipment.

3.6 HANGERS

A. All piping shall be supported on not less than 10' centers and within 30" of each change of direction except that piping 1-1/4" size and smaller shall be supported on 8'-0" centers.

B. All piping shall be hung by means of split type wrought iron hanger rings similar to Grinnell Figure 104 except as otherwise noted. Copper piping not insulated shall be hung from copper plated hangers similar to Figure CT-97. All insulated piping shall be hung by means of clevis type hangers sized to fit outside of insulation, Grinnell Figure 260.

C. Pipe hangers shall be supported by means of iron hanger rods from the building construction or from structural steel members, and in an approved manner. Where required, piping shall be hung from angle iron slips or suitable brackets attached to sides of masonry construction.

D. All insulated piping shall be provided with insulating protection sheet metal saddles. These shall be 20 gauge galvanized iron. Saddles shall be of a length equal to two times the outside diameter of the insulation and shall extend to above the center line of the pipe.

E. Spring type isolators and wood blocking under insulation jacket shall be provided at large piping subject to vibrations as indicated in the plans and details. Contractor shall provide spring isolator submittal indicating construction, spacing, loading and efficiency.

F. Where piping passes through masonry construction, steel pipe sleeves shall be provided, sized to allow at least 1/2" clearance around pipe or insulation where pipe is insulated. Sleeves shall be flush with finished walls and extend 1/2" above finish floors. A watertight seal shall be provided between floor and sleeve and space between pipe and sleeve shall be caulked with lead wool.

3.7 TEST

A. Pressure test all condenser water piping at a pressure of 150 psig for 24 hours. Architect/Engineer shall be notified 72 hours before test is to be performed.

END OF SECTION 232000

SECTION 232010 - VALVES AND SPECIALTIES

PART 1 - GENERAL

1.1 SCOPE

A. The Mechanical Contractor shall furnish and install all necessary valves and specialties to make the installation complete and as specified below. All specialty items unless otherwise noted shall be for operation on at least 125 pound psig working pressure as rated in accordance with the standards of the ASA.

B. The provisions of Section 230500 apply to all the work of this Section.

1.2 SUBMITTAL Submit the following in accordance with Section 230500

A. Manufacturer's cuts.

B. Installation instructions.

C. Operating and Maintenance Instructions.

PART 2 - PRODUCT

2.1 VALVES

A. All new valves shall be as specified below by figure number and shall be one manufacturer throughout.

B. SCREWED ENDS, UNION BONNETS (Gates with Solid Wedge, Globes with Composition or Teflon Disc as Specified) - BRONZE VALVE LIST

Manufacturer	Gate 125#	Globes 150#	Checks 125#
NIBCO	None	T235-Y	T413-B
CRANE	None	7	37
STOCKHAM	None	B-22	B319

C. SOLDER ENDS, SCREWED BONNET GATES, UNION BONNET GLOBES, (Globes with Teflon Disc)

Manufacturer	Gates 125#	Globes 150#	Checks 125#
NIBCO	None	S235-Y	S413-B
CRANE	None	-	1342
STOCKHAM	None	B-24	B-309

D. IRON VALVE LIST

Manufacturer	Gates 125#	Globes 125#	Checks 125#
NIBCO	None	F718-B	F918-B
CRANE	None	351	373
STOCKHAM	None	G-512	G-931

Manufacturer	Gates 250#	Globes 250#	Checks 250#

NIBCO	None	F768-B	F968-B
CRANE	None	21E	39E
STOCKHAM	None	F-532	F-947

E. Spring check valves shall be installed on water lines 2-1/2 inches and above. Valves shall be non-slam type of such design that closing is controlled by spring action so designed to return disc or leaves to seat at zero velocity or before reversal of flow. Disc or leaves shall be free-flowing with no greasing or counterweights required. Body shall be semi-steel, 125 psi rated. Disc or leaves and seat shall be bronze with stainless steel spring.

Manufacturer	Wafer 125#	Flanged 125#
NIBCO	W910-B	F910-B
MUELLER	91-AP	105M-AP
MISSION		

F. Butterfly valves shall be lug type and suitable for water service. Valves shall have EPDM seats suitable for temperature up to 275 degrees Fahrenheit and pressure up to 150 psig. Body shall be cast iron, disc shall be aluminum bronze, and shafts shall be stainless steel. Valves 2" to 6" shall be interim positive lock, lever operators. Valves 8" and larger shall have encased gear operators with hand whl. Bodies shall be lug type. All working parts shall be field replaceable. All valves shall be equipped with extended neck for insulation up to 2" thick. Manufacturer must certify valves (2" through 16") to be capable of providing bubble tight seal at 200 psi when used for end of line service without the need of a flange on the downstream side. Valves 18" and larger must be capable of 150 psi end of line service.

Manufacturer	Lug 150#
NIBCO	LD2000
CRANE	14-TL
STOCKHAM	LD-711-BS3-E

G. Hose end gate valves shall be screwed connection, bronze as specified above. Hose connection shall be as specified above. Hose connection shall be suitable for 1/2" hose.

Manufacturer	Hose End 125#
NIBCO	T113-HC
CRANE	451
STOCKHAM	-

H. Ball valves shall be bronze, two piece construction rated for 125 SWP/400 WOG. Valves shall have conventional port with Teflon seats. Stem shall be of silicon bronze. When installed in insulated piping furnish extended tee handle. All isolation valves above ceiling shall be ball valves.

MANUFACTURER	THREADED 125#	SOLDER 125#
NIBCO	T580	S580
APOLLO	70-100	70-200
STOCKHAM	S214-BR-T-T	S214-BR-T-S

2.2 VALVE TAGS AND CHARTS

A. Furnish for each valve and gas cock in the H.V. and A.C. system a brass tag fitted to each valve so that it may not be removed. Each tag shall be numbered consecutively with the Numbers V-1, V-2, V-3, etc.

B. Furnish two (2) copies of a master valve chart denoting valve number, location and purpose. One (1) chart shall be in a suitable black wood frame with glass cover and mounted where directed.

2.3 SPECIALTIES

A. Gaskets: This Contractor shall furnish and install at each flange connection, Johns-Manville Service Gasket N. 60, or approved equal.

B. Flow Balance Valves: Flow balance valves, where shown, shall be auto flow valves as outlined in paragraph Q.

C. Strainers for water service with end suction pumps shall be bolted top basket type with 40-mesh monel screen. For other water service where space is insufficient for basket strainers, and for steam service strainers shall be Y-type with 40-mesh monel screen. Strainers shall have blow-down tappings, removable baskets and be iron bodied with flanged ends. All startup strainers shall be removed from equipment and tied to equipment for Owner inspection after startup is complete.

D. Pressure gauges shall be designed for the service. Gauge size shall be 4-1/2" diameter black lettering on a white field. Provide ¼ turn ball valve at each gauge. Gauge scale shall be twice the normal pressure of the line in which it is installed. Gauge shall be Bourdon tube type with bushed movement and cast aluminum case. Accuracy shall be ½%.

E. SOLAR Pipe thermometers shall be adjustable angle type and shall be provided with extensions for all thermometers mounted through insulation. Thermometers shall have ranges suitable for the service. Minimum operating light level = 10 lux.

F. Relief valves shall be ASME pressure relief valve set to 15 psi above maximum normal system operating pressure. The discharge from valves on water lines shall be piped to the nearest floor drain; valves on steam lines shall be piped to the outside.

PART 3 - EXECUTION

3.1 GENERAL

A. Contractor shall install valves and specialties according to the best practice and manufacturer's recommendations.

END OF SECTION 232010

SECTION 232120 - PUMPS

PART 1 - GENERAL

1.1 SCOPE

A. The provisions of Section 230500 apply to all the work in this Section.

B. Furnish and install pumps as required to provide a complete and satisfactory job.

1.2 SUBMITTALS

A. Submit the following in accordance with Section 230500:

1. Manufacturer's cuts.
2. Certified capacity ratings.
3. Installation instructions.
4. Operating and Maintenance Instructions.

PART 2 - PRODUCTS

2.1 END SUCTION PUMPS

A. The pump shall be of the end suction design, in cast iron and bronze fitted construction. The pump internals shall be capable of being serviced without disturbing piping connections or motor.

B. The impeller shall be of the enclosed type, dynamically balanced and keyed to the shaft and secured with a suitable lockout.

C. Pump seal shall be by:

1. Standard single mechanical seal with carbon seal ring and ceramic seat.

D. A replacement shaft sleeve shall be furnished to cover the wetted area of the shaft under the seal or packing.

E. The bearing assembly of the pump shall be fitted with re-greaseable ball bearings equivalent to electric motor bearing standards for quiet operation.

F. 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. A flexible coupler, capable of absorbing torsional vibration, shall be employed between the pump and motor, and it shall be equipped with a suitable coupling guard as required. The pumps shall have a foot mounted volute and a spacer drop out for true back pull out service.

G. The pump shall be factory tested, 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.

H. Pump manufacturer shall ensure a non-overloading condition at any point along the pump curve with the motor furnished.

2.3 VARIABLE FREQUENCY DRIVE

A. Refer to section 230510 for Variable Frequency requirements.

PART 3 - EXECUTION

3.1 INSTALLATION

A. Pump base shall be grouted to the support pad. After grouting the pump base and connecting the suction and discharge piping, the pump and motor shall be realigned in accordance with the standards of the hydraulic institute.

END OF SECTION 232120

SECTION 232500 – WATER TREATMENT

PART 1 - GENERAL

1.1 SCOPE

A. The provisions of Section 230500 apply to all the work in this Section.

B. Furnish and install water treatment including equipment required to provide a complete and satisfactory job.

1.2 SUBMITTALS

A. Submit the following in accordance with Section 230500:

1. Manufacturer's cuts.
2. Certified capacity ratings.
3. Installation instructions.
4. Operating and Maintenance Instructions.

PART 2 - PRODUCTS

2.1 GENERAL

A. The Contractor will furnish, install and provide all equipment, chemicals and the necessary service for a Water Treatment Program. Water treatment supplier for Horry County Schools is Cascade. All systems shall comply with their requirements.

2.2 PRE-OPERATIONAL SYSTEM CLEAN-OUT

A. All lines and related equipment shall be thoroughly flushed out with pre-cleaning chemicals designed to remove deposition such as pipe dope, oils, loose rust and mill scale and other extraneous materials. Add recommended dosages of pre-cleaner chemical products and circulate throughout the water system. Drain, fill and flush water system until no foreign matter is observed and total alkalinity of the rinse water is equal to that of the makeup water.

2.3 CHEMICAL FEEDING AND CONTROL EQUIPMENT - CLOSED WATER SYSTEMS

A. For each new closed water system, contractor shall install a one-shot feeder with funnel, and air release valve. The one-shot feeder shall have a minimum capacity of the five gallons and be designed to meet the pressure requirements of the system.

B. For each existing closed water system, the contractor shall reuse the existing shot feeder.

2.4 WATER TREATMENT CHEMICALS - CLOSED WATER SYSTEM

A. Furnish one year's supply of the recommended formula for scale and corrosion protection of close recirculating system. Formulation shall not contain any ingredients which are harmful to system materials of construction.

2.5 CHEMICAL FEEDING AND CONTROL EQUIPMENT – CLOSED CIRCUIT COOLER SYSTEM

A. Contractor shall install one (1) packaged controller for controlling conductivity and chemical treatment in makeup water systems (including all external piping and wiring). The controller shall have the following features and capabilities:

1. Conductivity Monitor: Will provide linear, temperature compensated measurements directly in micromhos over full scale. There will be two ranges of measurement provided, 50-1,000 micromhos and 500-10,000 micromhos, which shall be field selectable. Conductivity measurement will be displayed on a 2 inch indicating meter with 0-10 scale. Power switch, set point adjustment, test button, calibration screw, indicating lights and indicating meter shall all be front panel mounted for each access. The controller shall be insensitive to phase angle shifts and be capable of operating with input line voltage of 95 to 130 volts AC, without affecting accuracy.

2. Inhibitor Feed: Inhibitor chemical will be fed proportional to makeup water. A water meter with electric contactor shall pulse a solid state reset counter with an adjustable range of 0-99 counts. Completion of the counter cycle will initiate solid state reset timer for activating the inhibitor pumps and adjustable range of 0-10 minutes.

3. Biocide Feed: Biocide chemical feed will be controlled by a 14 day, 24 hour timer which will actuate a chemical pump whenever required up to a 14 day repeating cycle.

B. The conductivity monitor, chemical pumps and sample stream piping assembly shall be mounted on a wall frame structure. This structure shall be mounted on a wall frame structure. This structure shall be fabricated from 14 gauge, cold rolled steel, primed and painted with polyurethane enamel paint for corrosion protection. All components of the controller system on the wall frame structure shall be pre-plumbed and pre-wired to form an operational and ready to install system. The controller system shall consist of the following:

1. One (1) sample stream piping assembly consisting of:

   a. Two (2) 3/4" inlet/outlet shut-off valves rated for 125 psi service.

   b. One (1) flow switch rated for 125 psi service.

   c. Two (2) 3/4" PVC chemical injection tees.

   d. One (1) conductivity probe of PVC construction with a temperature compensating element mounted in a quick disconnect fitting.

2. One (1) - pre-piped bleed-off piping assembly consisting of inlet shut-off valve, wye strainer flush valve, throttling valve and O-PSI differential brass solenoid valve. Bleed-off piping assembly shall be sized to bleed twice the maximum design bleed-off rate of the system.

3. Two (2) - chemical feed pumps, positive displacement type with ball-type check valves, shall be provided for feed of the corrosion inhibitor and biocide. Feed rate shall be adjustable while pump is running and necessary polyethylene tubing included.

4. One (1) - corporate stop and injection assembly with PVC diffuser tube and back check valve for injecting chemicals into the recirculating line.

5. One (1) - water meter complete with electric contacting register sized to meter twice the volume of the maximum makeup water rate of the system.

2.6 WATER TREATMENT CHEMICALS - CONDENSER SYSTEM

A. Furnish one year's supply of the recommended formulas for control of scale and corrosion in the open recirculating system. Provide two separate formulas for prevention of microbiological growth in the same system. Biocide products recommended shall be properly registered with the Environmental Protection Agency and EPA registration number shall be clearly shown on all product literature and drum labels. To insure operator safety all chemical products shall be provided in liquid form for direct feed from shipping container to the cooling system.

PART 3 – EXECUTION

3.1 WATER TREATMENT SERVICE PROGRAM

A. The chemical supplier shall provide all consulting services for a period of one year from start-up of the cooling system which will include:

1. Installation and system start-up procedure recommendations.
2. Pre-operation system clean-out procedure supervision.
3. Initial water analysis and recommendations.
4. Training of operating personnel on proper feeding and control techniques.
5. Periodic field service and consultation meetings.
6. Any necessary log sheets and record forms.
7. Any required laboratory and technical assistance.

B. All services will be provided by a qualified, full-time representative of the chemical supplier.

END OF SECTION 232500

SECTION 236550 – CLOSED CIRCUIT COOLER

PART 1 – GENERAL

1.1 GENERAL

A. The provisions of Section 230500 apply to all the work in this Section.

B. Furnish and install, as shown on the plans, one factory assembled closed circuit cooling tower of induced draft, propeller fan design with vertical air discharge.

1.2 SUBMITTALS Submit the following in accordance with Section 230500

A. Manufacturer's Cuts.

B. Wiring Diagrams.

C. Installation Instructions.

D. Operating and Maintenance Instructions.

1.3 APPROVED MANUFACTURERS

A. BAC

B. Evapco

C. Marley

1.4 QUALITY ASSURANCE

A. Verification of Performance.

1. The thermal performance shall be certified by the Cooling Technology Institute in accordance with CTI Certification Standard STD-201. Lacking such certification, a field acceptance test shall be conducted within the warranty period in accordance with CTI Acceptance Test Code ATC-105, by a Certified CTI Thermal Testing Agency. The Evaporative Heat Rejection Equipment shall comply with the energy efficiency requirements of ASHRAE Standard 90.1.
2. Unit Sound Performance ratings shall be tested according to CTI ATC-128 standard. Sound ratings shall not exceed specified ratings.

B. Unit shall meet or exceed energy efficiency per ASHRAE 90.1.

1.5 WARRANTY

A. Submit a written warranty executed by the manufacturer, agreeing to repair or replace components of the unit that fail in materials and workmanship within the specified warranty period.

1. Fan Motor/Drive System: Warranty Period shall be Five (5) years from date of unit shipment from Factory (fan motor(s), fan(s), bearings, mechanical support, sheaves, bushings and belt(s).

2. The Entire Unit shall have a comprehensive one (1) year warranty against defects in materials and workmanship from startup, not to exceed eighteen (18) months from shipment of the unit.
3. Heat Transfer Coil: Warranty Period shall be One (1) year from date of unit shipment from Factory.

PART 2 - PRODUCTS

2.1 COMPONENTS

A. Description. Factory assembled and tested, induced draft counter flow closed circuit cooler complete with fan, coil, fill, louvers, accessories and rigging supports.

B. Materials of Construction.

1. All components including vertical supports, air inlet louver frames and panels up to rigging seam shall be constructed of stainless steel.

C. Fan(s).

1. Fan(s) shall be high efficiency axial propeller type with aluminum wide chord blade construction. Each fan shall be dynamically balanced and installed in a closely fitted cowl with venturi air inlet for maximum fan efficiency.

D. Drift Eliminators shall be constructed entirely of Polyvinyl Chloride (PVC) in easily handled sections. Design shall incorporate three changes in air direction and limit the water carryover to a maximum of 0.001% of the recirculating water rate.

E. Water Distribution System Spray nozzles shall be precision molded ABS with large orifice threaded into branch piping with internal sludge ring to eliminate clogging. Spray header and branches shall be schedule 40 Polyvinyl Chloride (PVC) for corrosion resistance.

F. Heat Transfer coil shall be tightly spaced elliptical tubes of prime surface steel, encased in steel framework with the entire assembly hot-dip galvanized after fabrication. The coil assembly shall be designed with sloping tubes for liquid drainage and air pressure tested to 390 psig. ASME/ANSI B31.5.

G. Tower shall have EISA close-coupled centrifugal pump with mechanical seal. The pump shall be installed in a vertical position so that water will drain from the pump when the cold water basin is emptied. Pump motor shall be totally enclosed with protective canopy for outdoor operation.

H. Provide a waste water bleed line with a manual adjustable valve provided.

I. Air Inlet Louvers. Louver screens shall be constructed from UV inhibited polyvinyl chloride (PVC) and incorporate a framed interlocking design that allows for easy removal of louver screens for access to the entire basin area for maintenance. The louver screens shall have a minimum of two changes in air direction and shall be of a non-planar design to prevent splash-out and block direct sunlight & debris from entering the basin.

J. Make up Float Valve Assembly shall be a mechanical brass valve with an adjustable plastic float.

K. Pan Strainer shall be all Type 304 Stainless Steel construction with large area removable perforated screens.

2.2 MOTORS AND DRIVES

A. General requirements for motors are specified in Division 23 Section “Motors”.

B. Fan Motor.

1. Fan motor(s) shall be totally enclosed, ball bearing type electric motor(s) suitable for moist air service. Motor(s) are Premium Efficient, Class F insulated, 1.15 service factor design. Inverter rated per NEMA MG1 Part 31.4.4.2 and suitable for variable torque applications and constant torque speed range with properly sized and adjusted variable frequency drives.

C. Fan Drive.

1. The fan drive shall be multigroove, solid back V-belt type with QD tapered bushings designed for 150% of the motor nameplate power. The belt material shall be neoprene reinforced with polyester cord and specifically designed for evaporative equipment service. Fan sheave shall be aluminum alloy construction. Belt adjustment shall be accomplished from the exterior of the unit.

D. Fan Shaft.

1. Fan shaft shall be solid, ground and polished steel. Exposed surface shall be coated with rust preventative.

E. Fan Shaft Bearings.

1. Fan Shaft Bearings shall be heavy-duty, self-aligning ball type bearings with extended lubrication lines to grease fittings located on access door frame. Bearings shall be designed for a minimum L-10 life of 100,000 hours.

2.3 MAINTENANCE ACCESS

A. Fan Section.

1. Access door shall be hinged and located in the fan section for fan drive and water distribution system access.

B. Basin Section.

1. Framed removable louver panels shall be on all four (4) sides of the unit for pan and sump access.
2. Unit shall be provided with removable panels around the coil to permit easy inspection of the coil and basin without unit entry.

C. Internal Working Platform.

1. Internal working platform shall provide easy access to the fans, belts, motors, sheaves, bearings, all mechanical equipment and complete water distribution system. The fill shall be an acceptable means of accessing these components.

PART 3 - EXECUTION

3.1 INSTALLATION

A. Cooler shall be installed in accordance with the manufacturer's recommendations.

B. Cooler shall be installed in fully accessible locations.

END OF SECTION 236550