PROJECT MANUAL

Replace Main Air Handler and Temperature Controls
Grissom Library
Newport News, Virginia

THOMPSON Consulting Engineers
Mechanical and Electrical Engineering

MJT Project No. 11007

May 12, 2011

Set No. ______
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Owner: City of Newport News
       Department of Engineering
       2400 Washington Ave
       Newport News, Virginia 23607

Owner’s Contact: Michael Griffin
                  Engineering Department
                  Phone: (757) 926-8611

Mechanical Engineer: Thompson Consulting Engineers
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END OF SECTION 00002
SECTION 00820 - SPECIAL CONDITIONS

PART 1 – GENERAL

1.1 CONTRACTOR’S RESPONSIBILITY FOR TEMPORARY HVAC COOLING DURING CONSTRUCTION

A. The contractor shall be responsible for providing temporary ventilation and cooling for all areas connected to the system being replaced. The temporary unit shall be sized in accordance with these specifications.

B. The building cooling system shall not be allowed to be down for any more that eight (8) hours to prevent excess humidity within the space. The temporary unit shall be delivered and placed on site without hindering the daily operation of the facility and occupants or illegally blocking fire safety lanes.

C. The contractor shall be responsible for removing the outdoor air louver and making temporary connection into the supply air ductwork that does not interfere with the work included in the scope of this project.

D. Basis of design manufacturer is TRANE. The Engineer may accept alternate manufacturers upon review if in full compliance with this specification. The temporary unit shall be a packaged direct expansion system and must meet the following mechanical requirements:

1. Total Capacity: 487 MBh
2. Sensible Capacity: 430 MBh
3. Supply Air CFM: 18,800
4. External static Pressure: 1.5 in. wc
5. Motor Horsepower: 20HP
6. Electrical Voltage: 460V/3ph
7. MCA: 127amps
8. Temporary ductwork provided
9. 100 ft of electrical cable
10. Provide with an integrally mounted 250 Amp, 3 pole, 480 volt circuit breaker.

E. The electrical contractor shall provide a 250 Amp, 3 pole, 480 volt circuit breaker with all necessary mounting hardware to serve the temporary cooling unit. The contractor shall install the circuit breaker in an available space in the existing Main Distribution Switchboard. The Main Distribution Switchboard is a type "QED" switchboard manufactured by SQUARE D. The feeder for the temporary cooling unit shall be provided with the manufacturer’s cooling unit. The electrical contractor
shall connect the feeder to the circuit breaker in the switchboard. At the end of the period that the temporary cooling unit is needed, the contractor shall disconnect the feeder to the cooling unit and provide a nameplate labeled "Spare" for the circuit breaker. Since power to the building will be shut off while the circuit breaker is installed in the switchboard, the contractor shall coordinate the date and time for the outage with the owner. See section 01015.

PART 2 – PRODUCTS (Not Used)

PART 3 – EXECUTION (Not Used)

END OF SECTION 00820
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**Mechanical**

- M0.1  Legend, Abbreviations, General Notes, Schedules and Notes
- M1.1  Floor Plan and Enlarged Mechanical Room Plan-Demolition and New Work
- M2.1  Mechanical Room Section and Piping Diagrams-Demolition and New Work

**Electrical**

- E0.1  Electrical Floor Plans-Demolition and New Work, Legend and Notes

END OF SECTION 00851
SECTION 01010 - SUMMARY OF WORK

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 DRAWINGS ACCOMPANYING PROJECT MANUAL

A. The Drawings accompanying this Project Manual are listed immediately following the Table of Contents in this Project Manual.

1.3 PROJECT DESCRIPTION

A. The “Work” generally includes but is not limited to the following:
   The removal and replacement of existing heating, ventilating and air conditioning unit in kind, hydronic piping, associated control valves and associated electrical work.

B. The project includes the removal of the existing pneumatic automatic temperature control system and DDC overlay system and replacement of a new direct digital control system, including retrofitting existing pneumatic actuators to electric. Contractor shall visit the site and explore the existing conditions prior to bidding. Contractor shall be aware of potential damage to building, sidewalks, roadways, and landscaping in determining the method for removal and installation of equipment. Contractor shall take special care in protecting trees that may interfere with the removal and installation of equipment.

1.4 PERMITS, FEES AND CHARGES

A. General: The Contractor shall obtain all applicable permits, fees and charges, not specifically excluded from the Contract and not specifically indicated to be obtained and paid for by the Owner.
PART 2 - PRODUCTS (Not applicable).

PART 3 - EXECUTION (Not applicable).

END OF SECTION 01010
SECTION 01015 - CONTRACTOR’S USE OF THE PREMISES

PART 1 - GENERAL

1.1 DESCRIPTION

A. Work Included: This Section applies to situations in which the Contractor or his representatives, including but not necessarily limited to suppliers, subcontractors, employees, and field engineers, enter upon the Owner’s property.

1.2 QUALITY ASSURANCE

A. Promptly, upon award of the Contract, notify all pertinent personnel regarding requirements of this Section.

B. Require that all personnel who will enter upon the Owner’s property certify their awareness of and familiarity with the requirements of this Section.

1.3 SUBMITTALS

A. Staff Names: Within 15 days of Notice to Proceed, submit a list of the Contractor's principal staff assignments, including the Superintendent and other personnel in attendance at the site; identify individuals, their duties and responsibilities; list their addresses and telephone numbers.

B. Post copies of the list in the temporary field office.

1.4 GENERAL

A. The Owner shall occupy all of the building during the entire duration of the project. The Contractor shall erect barriers to separate construction areas of the building from occupied areas of the building. During the occupied portions of the project, including the Owner’s occupancy of the building immediately after Substantial Completion of each Phase, the Contractor shall maintain a low profile and adhere to the Contract Documents as well as Owner requirements so as not to interfere with the building’s operations. The Contractor shall take all precautionary measures required by the Contract Documents, or as deemed necessary by the Owner or Engineer during the occupied portions of the contraction project, to maintain the site in a safe condition for all occupants.

B. Permission to gain access to the building shall be requested 7 calendar days in advance.
C. Limit use of the premises to construction activities in areas indicated; allow for Owner occupancy and use by the public. Confin[e operations to areas within limits indicated. Portions of the site beyond areas in which construction operations are indicated are not to be disturbed.

D. The Contractor shall protect all improvements which are to remain from damage. All improvement and ground areas damaged during construction shall be restored to like new work. All sidewalks, parking lot surfaces, and curbs shall be protected from the work. Any damaged surfaces shall be restored to new condition.

E. The Contractor shall limit staging areas to prevent scattering of construction materials and equipment throughout site. The Contractor shall indicate at the Pre-Construction meeting the location and limits of staging areas that he anticipates utilizing for approval by Owner.

F. Keep driveways and entrances serving the premises clear and available to the Owner and the Owner’s employees at all times. Do not use these areas for parking or storage of materials.

G. During the occupied portions of the project, park in designated pre-approved areas only.

H. Schedule deliveries to minimize space and time requirements for storage of materials and equipment on site.

I. Maintain the building in a weather-tight condition throughout the construction period. Repair damage caused by construction operations. Take all precautions necessary to protect the building and its occupants during the construction period.

J. The Contractor shall strictly prohibit weapons, drugs, and tobacco products of all types in all buildings and on all City owned property. The Contractor shall restrict and instruct all personnel at the project site that talking to the library staff or the public as well as using library telephones or computers is prohibited. A dress code, which requires all construction personnel to wear shirts at all times (without slogans), will be strictly enforced.

1.5 CONTRACTOR’S VEHICLES

A. Parking for Contractor’s vehicles, vehicles belonging to employees of the Contractor, and all other vehicles entering upon the Owner’s property in performance of the Work of the Contract shall only use the parking and access route as authorized by the Owner.
1.6 SECURITY

A. Restrict the access of all persons entering upon the Owner’s property in connection with the work to the access route and to the actual site of the work. Employees of all Contractors shall be required to display a photo identification badge at all times while on City property.

1.7 OWNER OCCUPANCY

A. The Owner will occupy the site and all facilities located at the site during the entire period of construction. The Contractor shall cooperate fully with the Owner and any of his representatives during construction operations to minimize conflicts and to facilitate the Owner’s full usage of the facilities. The Contractor shall perform the work so as not to interfere with the Owner’s usage and other facility operations.

1.8 CONTRACTOR’S USE OF EXISTING BUILDINGS

A. Use of the building will not be permitted, except in the actual area of the work. The Contractor shall not allow the use of the Owner’s telephone and computers by the Contractor’s personnel, subcontractor personnel, or other persons entering upon the Owner’s buildings in connection with the work unless otherwise authorized by the Owner.

1.9 PROJECT SCHEDULE AND PHASING

A. Refer to Section 01020, “Project Schedule.”

1.10 RECORD OF EXISTING DAMAGE

A. Prior to beginning work, the Contractor shall photograph or video tape all existing damage to building surfaces, finishes, furniture, equipment, and any other property left in the area of work. A copy of the record video, documentation, and photographs shall be provided to the Owner prior to beginning work. The Contractor shall be responsible for repair or replacement of all property damaged as a result of the Contractor’s work. Should a dispute occur, the video tape, documentation, or photographs shall be used to settle the dispute. Any damage not documented shall be considered the Contractor’s responsibility. Contractor shall verify the operation of all devices removed to facilitate the construction, including but not limited to speakers, clocks, motion detectors, smoke detectors, light fixtures, etc.
1.11 WORK HOURS

A. The library is open to and occupied by the general public Monday-Thursday from 9 a.m. – 9 p.m., Friday and Saturday 9 a.m. – 6 p.m., Sunday 1 p.m. – 5 p.m.

B. Construction work limited to outside of the main building in the mechanical room may be done between the hours of 7 a.m. – 9 p.m. Monday – Friday.

C. Work required to disconnect the existing duct work and to install the temporary cooling equipment and associated duct work shall be accomplished, with prior notice to the owner, on any Sunday between 7 a.m. – 12 p.m. and 6 p.m. – 9 p.m. Work required to disconnect the temporary cooling equipment and associated duct work and to install the new duct work connecting the new AHU shall also be accomplished during these time frames.

1.12 SYSTEM SHUTDOWNS

A. The Contractor shall schedule the work in such a manner as to complete the work so that system downtime will be at a minimum. Under no circumstances shall the Contractor shut down any systems without Owner’s approval.

B. The Contractor shall not interfere with the operation of equipment and services in those areas of the facility where work is not scheduled and where the Owner, employees, and others occupy the facility, facilities, and/or site.

C. The Owner’s representative shall be informed at least 7 calendar days in advance of each scheduled shutdown. The Owner shall approve the shutdown schedule in writing.

1.13 CONTRACTOR’S DUMPSTER

A. Contractor shall provide and dump regularly a minimum 10 cubic yard dumpster on site during the construction period for construction debris disposal.

1.14 MANNER OF CONDUCTING THE WORK

A. Daily Cleanup: The Contractor shall regularly clean up work in a manner consistent with this Specification. The Contractor shall provide daily cleanup of dust and debris to preclude the potential of contamination of new materials and equipment or existing equipment. All building entrances, corridors, sidewalks, and exterior pavement shall be cleaned of debris and materials daily to provide clean and unobstructed vehicular and walk paths. The work shall be so executed, and such temporary facilities furnished, as to preclude interference with access within and
between the existing building areas and structures and to cause no possible interference with the operation of any essential service thereof. If daily cleanup is not performed to the satisfaction of the Owner, the Owner reserves the right to perform cleanup after 24 hours notice and backcharge Contractor at rate of $30.00 per hour.

B. Existing Utilities and Equipment: Do not operate or disturb the setting of valves, switches, or electrical equipment on the service lines to the building, and service within the building, except by proper previous arrangement with the Owner and in the presence of the Owner or his authorized representative.

C. Coordination: Schedule this work so as to cause no disruption of existing building operation and minimum delay of the work. Notify the Owner a minimum of 7 calendar days in advance of anticipated utility outages, and schedule such work so as not interrupt normal building operations. Coordinate with the City Fire Marshal all fire alarm system work and adhere to all requirements of the Fire Marshal for protection of the building.

D. Damage to Existing Facilities: Restore existing work, including concealed work not indicated or specified to be modified, and which is damaged or otherwise affected by the Contractor’s operations, to a condition equal to that which existed before the work was commenced. Join new work to existing work in such a manner as to make the joining as inconspicuous as possible. Obvious patching of damaged work will not be acceptable. At the completion, ensure that the buildings and grounds are in first-class condition within the intent of these Specifications, and all facilities in full working condition.

E. Protection of Existing Floors, Desks, Carpets, Chairs, and Cabinetry and Other Furnishings: Protect all existing floors, carpets, desks, chairs, cabinetry, and any other attached or unattached furnishings in the project areas with a minimum 6-mil polyethylene sheeting. Secure polyethylene sheeting to baseboards to protect floors. Protect wall finishes as required by construction activities. Wall finishes damaged by the attachment of protective sheeting shall be repaired and painted to match surrounding surfaces. Carpet shall be protected with a minimum of two layers of 6-mil polyethylene sheets.

F. Prior to beginning work, the Contractor shall photograph or video tape all existing damage to building surfaces, finishes, furniture, equipment, HVAC equipment, lights, computers and peripherals, intercom, security system, computer drops, and any other property left in the area of work. A copy of the record video and photographs shall be provided to the Owner prior to beginning work. The Contractor shall be responsible for repair or replacement of all property damaged as a result of the Contractor’s work. Should a dispute occur, the video tape or
photographs shall be used to settle the dispute. Any damage not documented shall be considered the Contractor’s responsibility.

G. Final Cleaning: Provide professional cleaners using commercial quality building maintenance equipment and materials to clean the building in accordance with Section 01710, “Cleaning,” prior to the date of Substantial Completion.

H. Containment: Maintain containment barriers of the project areas as indicated and as required to preclude construction-generated dust and dirt from entering non-construction areas.

I. In the event the Contractor does not comply with the construction documents, the Owner may procure the services of another qualified Contractor and deduct his costs from the Contract amount.

END OF SECTION 01015
SECTION 01020 – PROJECT SCHEDULE

PART 1 - GENERAL

1.1 PURPOSE

A. The project schedule calls for the work to be done in a single construction phase in order to minimize the disruption of the library staff and the public in and around the building.

PART 2 – PRODUCTS

Not Used

PART 3 – EXECUTION

Not Used

END OF SECTION 01020
SECTION 01027 - APPLICATIONS FOR PAYMENT

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

A. This Section specifies administrative and procedural requirements governing the Contractor's Applications for Payment.

B. Coordinate the Schedule of Values and Applications for Payment with the Contractor's Construction Schedule, List of Subcontracts, and Submittal Schedule.

C. The Contractor's Construction Schedule and Submittal Schedule are included in Section "Submittals".

1.3 SCHEDULE OF VALUES

A. Coordinate preparation of the Schedule of Values with preparation of the Contractor's Construction Schedule.

B. Correlate line items in the Schedule of Values with other required administrative schedules and forms, including:

1. Contractor's construction schedule.
2. Application for Payment form.
3. List of subcontractors.
4. List of products.
5. List of principal suppliers and fabricators.

C. Submit the Schedule of Values to the Engineer within ten (10) days after receipt of the Notice to Proceed, unless otherwise directed by the Owner.

D. Use the Project Manual Table of Contents as a guide to establish the format for the Schedule of Values.
E. Include the following Project identification on the Schedule of Values:

1. Project name and location.
2. Name of the Engineer.
3. Project number.
4. Contractor's name and address.
5. Date of submittal.

F. Arrange the Schedule of Values in a tabular form with separate columns to indicate the following for each item listed:

1. Generic name.
2. Related Specification Section.
3. Name of subcontractor.
4. Name of manufacturer or fabricator.
5. Name of supplier.
6. Change Orders (numbers) that have affected value.
7. Dollar value.
8. Percentage of Contract Sum to the nearest one-hundredth percent, adjusted to total 100 percent.

G. Provide a breakdown of the Contract Sum in accordance with requirements of the General Conditions and in sufficient detail to facilitate continued evaluation of Applications for Payment and progress reports. Break principal subcontract amounts down into several line items.

H. Round amounts off to the nearest whole dollar; the total shall equal the Contract Sum.

I. For each part of the Work where an Application for Payment may include materials or equipment, purchased or fabricated and stored, but not yet installed, provide separate line items on the Schedule of Values for initial cost of the materials, for each subsequent stage of completion, and for total installed value of that part of the Work.

J. Margins of Cost: Show line items for indirect costs, and margins on actual costs, only to the extent that such items will be listed individually in Applications for Payment. Each item in the Schedule of Values and Applications for Payment shall be complete including its total cost and proportionate share of general overhead and profit margin.

K. At the Contractor's option, temporary facilities and other major cost items that are not direct cost of actual work-in-place may be shown as separate line items in the Schedule of Values or distributed as general overhead expense.
L. Schedule Updating: Update and resubmit the Schedule of Values when Change Orders or Construction Change Directives result in a change in the Contract Sum.

1.4 APPLICATIONS FOR PAYMENT:

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

B. The initial Application for Payment, the Application for Payment at time of Substantial Completion, and the final Application for Payment involve additional requirements.

C. Payment Application Times: Each progress payment date is as indicated in the General Conditions. The period of construction Work covered by each Application or Payment is the period indicated in the General Conditions.

D. Payment Application Forms: Use forms provided by the owner.

E. Application Preparation: Complete every entry on the form, including notarization and execution by person authorized to sign legal documents on behalf of the Owner. Incomplete applications will be returned without action.

1. Entries shall match data on the Schedule of Values and Contractor's Construction Schedule. Use updated schedules if revisions have been made.
2. Include amounts of Change Orders and Construction Change Directives issued prior to the last day of the construction period covered by the application.

F. Transmittal: Submit 3 executed copies of each Application for Payment to the Engineer by means ensuring receipt within 24 hours; one copy shall be complete, including waivers of lien, invoices for stored on site material, and similar attachments, when required.

G. Transmit each copy with a transmittal form listing attachments, and recording appropriate information related to the application in a manner acceptable to the Architect.

H. Waivers of Mechanics Lien: With each Application for Payment submit waivers of mechanics liens from subcontractors or sub-subcontractors and suppliers for the construction period covered by the previous application.

1. Submit partial waivers on each item for the amount requested, prior to deduction for retainage, on each item.
2. When an application shows completion of an item, submit final or full waivers.
3. The Owner reserves the right to designate which entities involved in the Work must submit waivers.
4. Submit final Application for Payment with or preceded by final waivers from every entity involved with performance of Work covered by the application who could lawfully be entitled to a lien.

I. Waiver Forms: Submit waivers of lien on forms, and executed in a manner, acceptable to Owner.

J. Initial Application for Payment: Administrative actions and submittals that must precede or coincide with submittal of the first Application for Payment include the following:

1. List of subcontractors.
2. Schedule of Values.
3. Contractor's Construction Schedule (preliminary if not final).
4. Submittal Schedule (preliminary if not final).
5. Copies of building permits
7. Initial progress report.
9. Certificates of insurance and insurance policies.
10. Performance and payment bonds (if required).
11. Data needed to acquire Owner's insurance.

K. Application for Payment at Substantial Completion: Following issuance of the Certificate of Substantial Completion, submit an Application for Payment; this application shall reflect any Certificates of Partial Substantial Completion issued previously for Owner occupancy of designated portions of the Work.

1. Administrative actions and submittals that shall proceed or coincide with this application include:

   a. Occupancy permits and similar approvals.
   b. Test/adjust/balance records.
   c. Maintenance instructions.
   d. Start-up performance reports.
   e. Change-over information related to Owner's use, operation and maintenance.
   f. Final cleaning.
   g. Application for reduction of retainage, and consent of surety.
   h. Advice on shifting insurance coverages.
i. List of incomplete Work, recognized as exceptions to Architect's Certificate of Substantial Completion.

j. Waivers of Mechanics Liens.

k. Items required by the General Conditions.

L. Final Payment Application: Administrative actions and submittals which must precede or coincide with submittal of the final payment Application for Payment include the following:

1. Completion of Project closeout requirements.
2. Completion of items specified for completion after Substantial Completion.
3. Assurance that unsettled claims will be settled.
4. Assurance that Work not complete and accepted will be completed without undue delay.
5. Transmittal of required Project construction records to Owner.
6. Proof that tax, fees and similar obligations have been paid.
7. Removal of temporary facilities and services.
8. Removal of surplus materials, rubbish and similar elements.
10. Items required by the General Conditions.

PART 2 - PRODUCTS (Not Applicable)

PART 3 - EXECUTION (Not Applicable)

END OF SECTION 01027
SECTION 01035 - MODIFICATION PROCEDURES

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

A. This Section specifies administrative and procedural requirements for handling and processing contract modifications.

1.3 MINOR CHANGES IN THE WORK

A. The Engineer will issue supplemental instructions authorizing minor changes in the Work, not involving adjustment to the Contract Sum or Contract Time, on AIA Form G710, Architect's Supplemental Instructions.

1.4 CHANGE ORDER PROPOSAL REQUESTS

A. Owner-Initiated Proposal Requests: The Engineer will issue a detailed description of proposed changes in the Work that will require adjustment to the Contract Sum or Contract Time. If necessary, the description will include supplemental or revised Drawings and Specifications.

B. Proposal requests issued by the Engineer are for information only. Do not consider them as an instruction either to stop work in progress or to execute the proposed change.

C. Within 10 days of receipt of a proposal request, submit an estimate of cost necessary to execute the change to the Engineer for the Owner's review.

1. Include a list of quantities of products required and unit costs, with the total amount of purchases to be made. Where requested, furnish survey data to substantiate quantities.

2. Indicate applicable taxes, delivery charges, equipment rental, and amounts of trade discounts.

3. Include a statement indicating the effect the proposed change in the Work will have on the Contract Time.
D. Contractor-Initiated Proposals: When latent or unforeseen conditions require modifications to the Contract, the Contractor may propose changes by submitting a request for a change to the Engineer.

1. Include a statement outlining the reasons for the change and the effect of the change on the Work. Provide a complete description of the proposed change. Indicate the effect of the proposed change on the Contract Sum and Contract Time.
2. Include a list of quantities of products required and unit costs, with the total amount of purchases to be made. Where requested, furnish survey data to substantiate quantities.
3. Indicate applicable taxes, delivery charges, equipment rental, and amounts of trade discounts.
4. Comply with requirements in Section "Product Substitutions" if the proposed change requires substitution of one product or system for a product or system specified.


1.5 CONSTRUCTION CHANGE DIRECTIVE

A. When the Owner and the Contractor disagree on the terms of a Proposal Request, the Owner may issue a Construction Change Directive. The Construction Change Directive instructs the Contractor to proceed with a change in the Work. Payment shall be as later determined as referred to City of Newport News, Department of Engineering, Standard Specs.

B. The Construction Change Directive contains a complete description of the change in the Work. It also designates the method to be followed to determine change in the Contract Sum or Contract Time.

C. Documentation: Maintain detailed records on a time and material basis of work required by the Construction Change Directive.

D. After completion of the change, submit an itemized account and supporting data necessary to substantiate cost and time adjustments to the Contract.

1.6 CHANGE ORDER PROCEDURES

A. Upon the Owner's approval of a Proposal Request, the Owner will issue a Change Order for signatures on the owners forms.
PART 2 - PRODUCTS (Not Applicable)

PART 3 - EXECUTION (Not Applicable)

END OF SECTION 01035
SECTION 01040 - PROJECT COORDINATION

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

A. This Section specifies administrative and supervisory requirements necessary for Project coordination including, but not necessarily limited to:

1. Coordination.
2. Administrative and supervisory personnel.
4. Cleaning and protection.

B. Progress meetings, coordination meetings and pre-installation conferences are included in Section "Project Meetings".

C. Requirements for the Contractor's Construction Schedule are included in Section "Submittals".

1.3 COORDINATION

A. Coordinate construction activities included under various Sections of these Specifications to assure efficient and orderly installation of each part of the Work. Coordinate construction operations included under different Sections of the Specifications that are dependent upon each other for proper installation, connection, and operation.

1. Where installation of one part of the Work is dependent on installation of other components, either before or after its own installation, schedule construction activities in the sequence required to obtain the best results.

2. Where availability of space is limited, coordinate installation of different components to assure maximum accessibility for required maintenance, service and repair.

3. Make adequate provisions to accommodate items scheduled for later installation.
B. Where necessary, prepare memoranda for distribution to each party involved outlining special procedures required for coordination. Include such items as required notices, reports, and attendance at meetings.

1. Prepare similar memoranda for the Owner and separate Contractors where coordination of their Work is required.

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

1. Preparation of schedules.
2. Installation and removal of temporary facilities.
3. Delivery and processing of submittals.
4. Progress meetings.
5. Project Close-out activities.

1.4 SUBMITTALS

A. Staff Names: Within 15 days of Notice to Proceed, submit a list of the Contractor's principal staff assignments, including the Superintendent and other personnel in attendance at the site; identify individuals, their duties and responsibilities; list their addresses and telephone numbers.

B. Post copies of the list in the temporary field office.

PART 2 - PRODUCTS (Not Applicable).

PART 3 - EXECUTION

3.1 GENERAL INSTALLATION PROVISIONS

A. Inspection of Conditions: Require the Installer of each major component to inspect both the substrate and conditions under which Work is to be performed. Do not proceed until unsatisfactory conditions have been corrected in an acceptable manner.

B. Manufacturer's Instructions: Comply with manufacturer's installation instructions and recommendations, to the extent that those instructions and recommendations are more explicit or stringent than requirements contained in Contract Documents.
C. Inspect materials or equipment immediately upon delivery and again prior to installation. Reject damaged and defective items.


E. Visual Effects: Provide uniform joint widths in exposed Work. Arrange joints in exposed Work to obtain the best visual effect. Refer questionable choices to the Engineer for final decision.

F. Recheck measurements and dimensions, before starting each installation.

G. Install each component during weather conditions and Project status that will ensure the best possible results. Isolate each part of the completed construction from incompatible material as necessary to prevent deterioration.

H. Coordinate temporary enclosures with required inspections and tests, to minimize the necessity of uncovering completed construction for that purpose.

I. Mounting Heights: Where mounting heights are not indicated, install individual components at standard mounting heights recognized within the industry for the particular application indicated. Refer questionable mounting height decisions to the Engineer for final decision.

3.2 CLEANING AND PROTECTION

A. During handling and installation, clean and protect construction in progress and adjoining materials in place. Apply protective covering where required to ensure protection from damage or deterioration at Substantial Completion.

B. Clean and maintain completed construction as frequently as necessary through the remainder of the construction period. Adjust and lubricate operable components to ensure operability without damaging effects.

C. Limiting Exposures: Supervise construction activities to ensure that no part of the construction, completed or in progress, is subject to harmful, dangerous, damaging, or otherwise deleterious exposure during the construction period. Where applicable, such exposures include, but are not limited to, the following:

1. Excessive static or dynamic loading.
2. Excessive internal or external pressures.
3. Excessively high or low temperatures.
4. Thermal shock.
5. Excessively high or low humidity.
6. Air contamination or pollution.
7. Water or ice.
8. Solvents.
10. Light.
11. Radiation.
12. Puncture.
13. Abrasion.
14. Heavy traffic.
15. Soiling, staining and corrosion.
16. Bacteria.
17. Rodent and insect infestation.
19. Electrical current.
20. High speed operation.
21. Improper lubrication.
22. Unusual wear or other misuse.
23. Contact between incompatible materials.
24. Destructive testing.
25. Misalignment.
26. Excessive weathering.
27. Unprotected storage.
28. Improper shipping or handling.
29. Theft.
30. Vandalism.

END OF SECTION 01040
SECTION 01095 - REFERENCE STANDARDS AND DEFINITIONS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 DEFINITIONS

A. General: Basic Contract definitions are included in the General Conditions.

B. Indicated: The term "indicated" refers to graphic representations, notes, or schedules on the Drawings, other paragraphs or schedules in the Specifications, and similar requirements in the Contract Documents. Where terms such as "shown," "noted," "scheduled," and "specified" are used, it is to help the reader locate the reference; no limitation on location is intended.

C. Directed: Terms such as "directed," "requested," "authorized," "selected," "approved," "required," and "permitted" mean "directed by the Engineer," "requested by the Engineer," and similar phrases.

D. Approve: The term "approved," where used in conjunction with the Engineer's action on the Contractor's submittals, applications, and requests, is limited to the Engineer's duties and responsibilities as stated in General and Supplementary Conditions.

E. Regulation: The term "Regulations" includes laws, ordinances, statutes, and lawful orders issued by authorities having jurisdiction, as well as rules, conventions, and agreements within the construction industry that control performance of the Work.

F. Furnish: The term "furnish" means supply and deliver to the Project Site, ready for unloading, unpacking, assembly, installation, and similar operations.

G. Install: The term "install" is used to describe operations at project site including the actual "unloading, unpacking, assembly, erection, placing, anchoring, applying, working to dimension, finishing, curing, protecting, cleaning, and similar operations.

H. Provide: The term "provide" means "to furnish and install, complete and ready for the intended use."
I. Installer: An "Installer" is the Contractor or an entity engaged by the Contractor, either as an employee, subcontractor, or sub-subcontractor, for performance of a particular construction activity, including installation, erection, application, and similar operations. Installers are required to be experienced in the operations they are engaged to perform.

J. The term "experienced" when used with the term "Installer" means having a minimum of 5 previous Projects similar in size and scope to this Project, being familiar with the precautions required, and having complied with requirements of the authority having jurisdiction.

K. Trades: Use of titles such as "carpentry" is not intended to imply that certain construction activities must be performed by accredited or unionized individuals of a corresponding generic name, such as "carpenter." It also does not imply that requirements specified apply exclusively to tradespersons of the corresponding generic name.

L. Assignment of Specialists: Certain Sections of the Specifications require that specific construction activities shall be performed by specialists who are recognized experts in the operations to be performed. The specialists must be engaged for those activities, and assignments are requirements over which the Contractor has no choice or option. Nevertheless, the ultimate responsibility for fulfilling Contract requirements remains with the Contractor.

1. This requirement shall not be interpreted to conflict with enforcement of building codes and similar regulations governing the Work. It is also not intended to interfere with local trade union jurisdictional settlements and similar conventions.

M. Project Site is the space available to the Contractor for performance of construction activities, either exclusively or in conjunction with others performing other work as part of the Project. The extent of the Project Site is shown on the Drawings and may or may not be identical with the description of the land upon which the Project is to be built.

N. Testing Laboratories: A "testing laboratory" is an independent entity engaged to perform specific inspections or tests, either at the Project Site or elsewhere, and to report on and, if required, to interpret results of those inspections or tests.

1.3 SPECIFICATION FORMAT AND CONTENT EXPLANATION

A. Specification Format: These Specifications are organized into Divisions and Sections based on the Construction Specifications Institute's 16-Division format and MASTERFORMAT numbering system.
B. Specification Content: This Specification uses certain conventions in the use of language and the intended meaning of certain terms, words, and phrases when used in particular situations or circumstances. These conventions are explained as follows:

C. Abbreviated Language: Language used in Specifications and other Contract Documents is the abbreviated type. Implied words and meanings will be appropriately interpreted. Singular words will be interpreted as plural and plural words interpreted as singular where applicable and the full context of the Contract Documents so indicates.

D. Imperative and streamlined language is used generally in the Specifications. Requirements expressed in the imperative mood are to be performed by the Contractor. At certain locations in the text, for clarity, subjective language is used to describe responsibilities that must be fulfilled indirectly by the Contractor, or by others when so noted.

1. The words "shall be" shall be included by inference wherever a colon (:) is used within a sentence or phrase.

1.4 INDUSTRY STANDARDS

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

B. Publication Dates: Where the date of issue of a referenced standard is not specified, comply with the standard in effect as of date of Contract Documents.

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

1. Minimum Quantity or Quality Levels: The quantity or quality level shown or specified shall be the minimum provided or performed. The actual installation may comply exactly with the minimum quantity or quality specified, or it may exceed the minimum within reasonable limits. In complying with these requirements, indicated numeric values are minimum or maximum, as appropriate for the context of the requirements. Refer uncertainties to the Engineer for a decision before proceeding.
D. Copies of Standards: Each entity engaged in construction on the Project is required to be familiar with industry standards applicable to that entity's construction activity. Copies of applicable standards are not bound with the Contract Documents.

1. Where copies of standards are needed for performance of a required construction activity, the Contractor shall obtain copies directly from the publication source.

E. Abbreviations and Names: Trade association names and titles of general standards are frequently abbreviated. Where such acronyms or abbreviations are used in the Specifications or other Contract Documents, they mean the recognized name of the trade association, standards generating organization, authority having jurisdiction, or other entity applicable to the context of the text provision. Refer to the "Encyclopedia of Associations," published by Gale Research Co., available in most libraries.

1.5 GOVERNING REGULATIONS/AUTHORITIES

A. The Engineer has contacted authorities having jurisdiction where necessary to obtain information necessary for preparation of Contract Documents; that information may or may not be of significance to the Contractor. Contact authorities having jurisdiction directly for information and decisions having a bearing on the Work.

1.6 SUBMITTALS

A. Permits, Licenses, and Certificates: For the Owner's records, submit copies of permits, licenses, certifications, inspection reports, releases, jurisdictional settlements, notices, receipts for fee payments, judgments, and similar documents, correspondence, and records established in conjunction with compliance with standards and regulations bearing upon performance of the Work.

PART 2 - PRODUCTS (Not Applicable)

PART 3 - EXECUTION (Not Applicable)

END OF SECTION 01095
SECTION 01200 - PROJECT MEETINGS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

A. This Section specifies administrative and procedural requirements for project meetings including but not limited to:
   1. Pre-Construction Conference.
   2. Progress Meetings.

B. Construction schedules are specified in another Division-1 Section.

1.3 PRE-CONSTRUCTION CONFERENCE

A. Schedule a pre-construction conference and organizational meeting at the Project site or other convenient location no later than 15 days after execution of the Agreement and prior to commencement of construction activities. Conduct the meeting to review responsibilities and personnel assignments.

B. Attendees: The Owner, Engineer, General Contractor and its superintendent, major subcontractors, manufacturers, suppliers and other concerned parties shall each be represented at the conference by persons familiar with and authorized to conclude matters relating to the Work.

C. Agenda: Discuss items of significance that could affect progress, including such topics as:
   1. Tentative construction schedule.
   2. Critical Work sequencing.
   3. Designation of responsible personnel.
   4. Procedures for processing field decisions and Change Orders.
   5. Procedures for processing Applications for Payment.
   7. Submittal of Shop Drawings, Product Data and Samples.
   8. Preparation of record documents.
   9. Use of the premises.
10. Office, Work and storage areas.
11. Equipment deliveries and priorities.
12. Safety procedures.
13. First aid.
15. Housekeeping.
16. Working hours.

D. Reporting: No later than 7 days after the pre-construction conference date, the Engineer will distribute copies of minutes of the conference to each party present and to other parties concerned who were not present. Included will be summaries, in narrative form, of all discussions, agreements, decisions and matters concluded.

1.4 PROGRESS MEETINGS

A. Conduct progress meetings at the Project site at regularly scheduled intervals. Coordinate dates of alternate meetings with preparation of the payment request. The Engineer will chair the meeting.

B. Attendees: In addition to representatives of Owner and Engineer, each subcontractor, supplier or other entity concerned with current progress or involved in planning, coordination or performance of future activities shall be represented at these meetings by persons familiar with the Project and authorized to conclude matters relating to progress.

C. Agenda: Review and correct or approve minutes of the previous progress meeting. Review other items of significance that could affect progress. Include topics for discussion as appropriate to the current status of the Project, and topics required by the General Conditions.

D. Contractor's Construction Schedule: Review progress since the last meeting. Determine where each activity is in relation to the Contractor's Construction Schedule, whether on time or ahead or behind schedule. Determine how construction behind schedule will be expedited; secure commitments from parties involved to do so. Discuss whether schedule revisions are required to ensure that current and subsequent activities will be completed within the Contract Time.

E. Review the present and future needs of each entity present, including such items as:

1. Interface requirements.
2. Time.
4. Deliveries.
5. Off-site fabrication problems.
7. Site utilization.
8. Temporary facilities and services.
9. Hours of Work.
10. Hazards and risks.
11. Housekeeping.
12. Quality and Work standards.
13. Change Orders.
14. Documentation of information for payment requests.

F. Reporting: No later than 3 days after each progress meeting date the Engineer will distribute copies of minutes of the meeting to each party present and to other parties who should have been present. The Contractor shall provide a brief summary, in narrative form, of progress since the previous meeting and report, to be attached to the minutes.

G. Schedule Updating: Revise the construction schedule after each progress meeting where revisions to the schedule have been made or recognized. Issue the revised schedule concurrently with the report of each meeting.

PART 2 – PRODUCTS (Not Applicable)

PART 3 - EXECUTION

3.1 PRECONSTRUCTION CONFERENCE FORMAT

A. The format of the Agenda for the Preconstruction Conference shall generally be as follows:
PRE-CONSTRUCTION CONFERENCE FORMAT

PRE-CONSTRUCTION CONFERENCE FOR:

OWNER: ________________________________________________
PROJECT: ________________________________________________
LOCATION: _______________________________________________
COMM. NO.: _______________ TIME:________DATE:_____________

AGENDA AND MINUTES

1. GENERAL

a. Introductions and Registrations of Attendees (sign attached sheet)
b. Conference Format and Agenda
c. Agreement, Performance and Payment Bonds and Insurance
d. Notice to Proceed
e. Responsibilities of Owner, Contractor, Engineer, and Inspector

2. PROJECT COMMUNICATION AND CORRESPONDENCE

a. With Contractor:

Field Superintendent will be:______________________________
Company: _______________________________________________
Street: _________________________________________________
P. O. Box: (if any)________________________________________
City & Zip: ______________________________________________
Attention: _______________________________________________

   OFFICE       FIELD       CELL
Telephone: _______ _______ _______

b. With Engineer:

Project Engineer will be:______________________________
Company: _______________________________________________
Street: _________________________________________________
P. O. Box: (if any)________________________________________
City & Zip: ______________________________________________
Attention: _______________________________________________
OFFICE FIELD CELL

Telephone: _______ _______ _______

(1) For questions, information, etc., Attention: ___________________________

In the absence of Mr. _________________________, if necessary, contact first
______________________________, and second ____________________________.

(2) For shop drawings and other submittals, use:

______________________________

(3) Discuss submittals and other points on shop drawings, samples, test data, brochures and other submittals.

c. With Owner – Inspector will be __________________________________________.

Project Manager: ________________________________________________________.

(1) Copies of correspondence
(2) Through Inspector and Engineer
(3) Project Identification
d. With material suppliers and subcontractors
e. Other

3. SCHEDULE, ESTIMATES, CHANGE ORDERS, AND TIME EXTENSIONS

a. Project Schedule: CPM, bar chart, other
b. Schedule of Values (Lump Sum Breakdown)
c. Monthly requests for payment

(1) Closing date
(2) Format
(3) Preliminary approval by Inspector and Engineer copy to Owner
(4) Work done and materials on hand
(5) Place and projection of materials on hand
(6) Conformance to schedule
d. List of subcontractors and major suppliers
e. Change Orders

(1) Request for Proposal and Response
(2) Acceptance by Engineer and Owner
(3) Change Order execution by Contractor, Engineer, and Owner
(4) Time extension, if any
(5) Not official until approved by Contractor and Owner
f. Time extensions (other than Change Orders) all are to be on change order request.
4. CONSTRUCTION

a. Manner of conducting the work
b. Construction plant area
   (1) On-site
   (2) Off-site
   (3) Disposal of wastes
c. Project sign(s)
d. Temporary facilities
e. Traffic maintenance
f. Safety – Public, on-site, personnel
g. Contractor’s Quality Plan and Owner’s Quality Assurance Plan
   (1) Certificates – mfg.
   (2) Construction quality

5. PROJECT CLOSEOUT
a. Final cleanup
b. Guarantees
c. Punchlists and final inspections
   (1) Testing and Adjusting
   (2) O & M instructions and manuals
d. Final payment, Affidavits for Payments of Debts and Claims, Consent of Surety, Release or Waiver of Liens
e. Record drawings
f. Assessment of Roles in Construction Project
g. Other

6. ADDED COMMENTS BY OWNER

7. ADDED COMMENTS BY CONTRACTOR

8. ADDED COMMENTS BY PRINCIPAL SUBCONTRACTORS

END OF SECTION 01200
SECTION 01300 - SUBMITTALS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

A. This Section specifies administrative and procedural requirements for submittals required for performance of the Work, including:

1. Contractor's Construction Schedule.
2. Submittal Schedule.
3. Daily Construction Reports.
4. Shop Drawings.
5. Product Data.
6. Samples.

B. Administrative Submittals: Refer to other Division-1 Sections and other Contract Documents for requirements for administrative submittals. Such submittals include, but are not limited to:

1. Permits.
2. Applications for Payment.
4. Insurance Certificates.
5. List of Subcontractors.

C. Related Sections:

1. Division 1 Section "Applications for Payment" specifies requirements for submittal of the Schedule of Values.
2. Division 1 Section "Project Meetings" specifies requirements for submittal and distribution of meeting and conference minutes.
3. Division 1 Section "Quality Control" specifies requirements for submittal of inspection and test reports.
4. Division 1 Section "Contract Closeout" specifies requirements for submittal of Project Record Documents and warranties at project closeout.
1.3 SUBMITTAL PROCEDURES

A. Coordination: Coordinate preparation and processing of submittals with performance of construction activities. Transmit each submittal sufficiently in advance of performance of related construction activities to avoid delay.

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

C. Coordinate transmittal of different types of submittals for related elements of the Work so processing will not be delayed by the need to review submittals concurrently for coordination.

   1. The Engineer reserves the right to withhold action on a submittal requiring coordination with other submittals until related submittals are received.
   2. All samples, shop drawings, and product data for finish materials requiring color selection or verification by the Engineer shall be submitted as follows: All interior finish materials shall be submitted at one time, and the Engineer will take no action on any one submittal until all items have been submitted.

D. Processing: Allow sufficient review time so that installation will not be delayed as a result of the time required to process submittals, including time for re-submittals.

   1. Allow 14 days for initial review. Allow additional time if processing must be delayed to permit coordination with subsequent submittals. The Engineer will promptly advise the Contractor when a submittal being processed must be delayed for coordination.
   2. If an intermediate submittal is necessary, process the same as the initial submittal.
   3. Allow 14 days for reprocessing each submittal.
   4. No extension of Contract Time will be authorized because of failure to transmit submittals to the Engineer sufficiently in advance of the Work to permit processing.

E. General Contractor's Review: All submittals shall be reviewed and approved by the General Contractor for conformance to the Contract Requirements and coordination with the work of other trades prior to submission to the Engineer. Any submittals submitted without the General Contractor's stamp of approval will not be considered or reviewed by the Engineer and will be returned to the General Contractor.
F. Submittal Preparation: Place a permanent label or title block on each submittal for identification. Indicate the name of the entity that prepared each submittal on the label or title block.

1. Provide a space approximately 4" x 5" on the label or beside the title block on Shop Drawings to record the Contractor's review and approval markings and the action taken.

2. Include the following information on the label for processing and recording action taken.
   a. Project name.
   b. Date.
   c. Transmittal Number.
   d. Transmittal Item Number.
   e. Name and address of Engineer.
   f. Name and address of Contractor.
   g. Name and address of subcontractor.
   h. Name and address of supplier.
   i. Name of manufacturer.
   j. Number and title of appropriate Specification Section.
   k. Drawing number and detail references, as appropriate.

G. Submittal Transmittal: Package each submittal appropriately for transmittal and handling. Transmit each submittal from Contractor to Engineer using a transmittal form. Submittals received from sources other than the Contractor will be returned without action.

1. On the transmittal record relevant information and requests for data. On the form, or separate sheet, record deviations from Contract Document requirements, including minor variations and limitations. Include Contractor's certification that information complies with Contract Document requirements.

H. Completion of transmittal form by the Contractor shall be as follows:

1. Transmittal Number: Number each form consecutively as submitted. Re-submittals shall bear the number of the original submission with a letter suffix (A) added to identify it as the first resubmission. The suffix letters (B), (C), etc. shall be used if additional resubmissions are necessary.
2. Date all transmittals.
3. Restrict use of each transmittal form to submittals for one section of Specifications per form.
4. Restrict each transmittal form to a submission in only one of the following categories:
   a. For approval.
   b. Resubmission for approval.
   c. Substitution for approval.

5. Item Number: Number consecutively each item submitted with each transmittal form.

6. Specification section and/or drawing number which describes or requires the item(s) shall be included for each item submitted.

7. Subcontractor: Indicate the Subcontractor for items submitted on each transmittal form.

8. Contractor, or his authorized representative shall sign each transmittal form.

I. Transmittal Form: Use the sample form at the end of this Section for transmittal of submittals.

1.4 CONTRACTOR'S CONSTRUCTION SCHEDULE

A. Critical Path Method (CPM) Bar Chart Type Schedule: Prepare a fully developed, critical path method horizontal bar-chart type Contractor's Construction Schedule. Submit within 15 days of the date established for "Commencement of the Work".

1. Provide a separate time bar for each significant construction activity. Provide a continuous vertical line to identify the first working day of each week. Use the same breakdown of units of the Work as indicated in the "Schedule of Values".

2. Within each time bar indicate estimated completion percentage in 10 percent increments. As Work progresses, place a contrasting mark in each bar to indicate Actual Completion.

3. Prepare the schedule on a sheet, or series of sheets, of stable transparency, or other reproducible media, of sufficient width to show data for the entire construction period.

4. Secure time commitments for performing critical elements of the Work from parties involved. Coordinate each element on the schedule with other construction activities; include minor elements involved in the sequence of the Work. Show each activity in proper sequence. Indicate graphically sequences necessary for completion of related portions of the Work.
5. Coordinate the Contractor's construction schedule with the Schedule of Values, list of subcontracts, submittal schedule, progress reports, payment requests and other schedules.
6. Indicate completion in advance of the date established for Substantial Completion. Indicate Substantial Completion on the schedule to allow time for the Engineer's procedures necessary for certification of Substantial Completion.

B. Distribution: Following response to the initial submittal, print and distribute copies to the Engineer, Owner, subcontractors, and other parties required to comply with scheduled dates. Post copies in the Project temporary field office.

1. When revisions are made, distribute to the same parties and post in the same locations. Delete parties from distribution when they have completed their assigned portion of the Work and are no longer involved in construction activities.

C. Schedule Updating: Revise the schedule after each meeting or activity, where revisions have been recognized or made. Issue the updated schedule concurrently with report of each meeting.

1.5 SUBMITTAL SCHEDULE

A. After development and acceptance of the Contractor's Construction Schedule, prepare a complete schedule of submittals. Submit the schedule within 10 days of the date required for establishment of the Contractor's construction schedule.

B. Coordinate submittal schedule with the list of subcontracts, schedule of values and the list of products as well as the Contractor's construction schedule.

C. Prepare the schedule in chronological order; include submittals required during the first 10 days of construction. Provide the following information:

1. Scheduled date for the first submittal.
2. Related Section number.
3. Submittal category.
4. Name of subcontractor.
5. Description of the part of the Work covered.
6. Scheduled date for re-submittal
7. Scheduled date the Engineer's final release or approval.

D. Distribution: Following response to initial submittal, print and distribute copies to the Engineer, Owner, subcontractors, and other parties required to comply with submittal dates indicated. Post copies in the Project and field office.
1. When revisions are made, distribute to the same parties and post in the same locations. Delete parties from distribution when they have completed their assigned portion of the Work and are no longer involved in construction activities.

E. Schedule Updating: Revise the schedule after each meeting or activity, where revisions have been recognized or made. Issue the updated schedule concurrently with report of each meeting.

1.6 DAILY CONSTRUCTION REPORTS

A. Prepare a daily construction report, recording the following information concerning events at the site; and submit copies to the Engineer and Owner at weekly intervals:

1. List of subcontractors at the site.
2. Approximate count of personnel at the site.
3. High and low temperatures, general weather conditions.
4. Accidents and unusual events.
5. Include measured amount of precipitation at project site, occurring daily during period since previous report.
6. Meetings and significant decisions.
7. Stoppages, delays, shortages, losses.
8. Meter readings and similar recordings.
10. Orders and requests of governing authorities.
11. Change Orders received, implemented.
12. Services connected, disconnected.
13. Equipment or system tests and start-ups.
15. Substantial Completions authorized.

1.7 SHOP DRAWINGS

A. Submit newly prepared information, drawn to accurate scale. Highlight, encircle, or otherwise indicate deviations from the Contract Documents. Do not reproduce Contract Documents or copy standard information as the basis of Shop Drawings. Standard information prepared without specific reference to the Project is not considered Shop Drawings.

B. Shop Drawings include fabrication and installation drawings, setting diagrams, schedules, patterns, templates and similar drawings. Include the following information:

1. Dimensions.
2. Identification of products and materials included.
3. Compliance with specified standards.
4. Notation of coordination requirements.
5. Notation of dimensions established by field measurement.

C. Sheet Size: Except for templates, patterns and similar full-size Drawings, submit Shop Drawings on sheets at least 8-1/2" x 11" but no larger than 30" x 40".

D. Submittals: Submit one correctable translucent reproducible print and four blue- or black-line prints for the Engineer's review; the reproducible print will be returned.

E. Distribution: Furnish copies of final submittal to the installers, subcontractors, suppliers, manufacturers, fabricators, and others required for performance of construction activities. Show distribution on transmittal forms.

F. Do not proceed with installation until a copy of applicable Shop Drawings is in the installer's possession.

G. Do not use Shop Drawings without an appropriate final stamp indicating action taken in connection with construction.

H. Engineer will make distribution to the Owner.

1.8 PRODUCT DATA

A. Collect Product Data into a single submittal for each element of construction or system. Product Data includes printed information such as manufacturer's installation instructions, catalog cuts, standard color charts, roughing-in diagrams and templates, standard wiring diagrams and performance curves. Where Product Data must be specially prepared because standard printed data is not suitable for use, submit as "Shop Drawings."

B. Mark each copy to show applicable choices and options. Where printed Product Data includes information on several products, some of which are not required, mark copies to indicate the applicable information. Include the following information:

1. Manufacturer's printed recommendations.
2. Compliance with recognized trade association standards.
3. Compliance with recognized testing agency standards.
4. Application of testing agency labels and seals.
5. Notation of dimensions verified by field measurement.
6. Notation of coordination requirements.
7. Material Safety Data Sheets (MSDS).
C. Do not submit Product Data until compliance with requirements of the Contract Documents has been confirmed.

D. Submittals: Submit nine copies of each required submittal. The Engineer will retain four, and will return the other marked with action taken and corrections or modifications required.

1. Unless noncompliance with Contract Document provisions is observed, the submittal may serve as the final submittal.

E. Distribution: Furnish copies of final submittal to the installers, subcontractors, suppliers, manufacturers, fabricators, and others required for performance of construction activities. Show distribution on transmittal forms.

F. Do not proceed with installation until an applicable copy of Product Data applicable is in the installer's possession.

G. Do not permit use of unmarked copies of Product Data in connection with construction.

H. Engineer will make distribution to the Owner.

1.9 QUALITY ASSURANCE SUBMITTALS

A. Submit quality-control submittals, including design data, certifications, manufacturer's instructions, manufacturer's field reports, and other quality-control submittals as required under other Sections of the Specifications.

B. Certifications: Where other Sections of the Specifications require certification that a product, material, or installation complies with specified requirements, submit a notarized certification from the manufacturer certifying compliance with specified requirements.

1. Signature: Certification shall be signed by an officer of the manufacturer or other individual authorized to sign documents on behalf of the company.

C. Inspection and Test Reports: Requirements for submittal of inspection and test reports from independent testing agencies are specified in Division 1 Section "Quality Control."
1.10 ENGINEER'S ACTION

A. Except for submittals for record, information or similar purposes, where action and return is required or requested, the Engineer will review each submittal, mark to indicate action taken, and return promptly.

B. Compliance with specified characteristics is the Contractor's responsibility.

C. Action Stamp: The Engineer will stamp each submittal with a uniform, self-explanatory action stamp. The stamp will be appropriately marked, as follows, to indicate the action taken:

D. Final Unrestricted Release: Where submittals are “FURNISH AS SUBMITTED,” that part of the Work covered by the submittal may proceed provided it complies with requirements of the Contract Documents; final acceptance will depend upon that compliance.

E. Final-But-Restricted Release: When submittals are marked "FURNISH AS CORRECTED," that part of the Work covered by the submittal may proceed provided it complies with notations or corrections on the submittal and requirements of the Contract Documents; final acceptance will depend on that compliance.

F. Final-But-Restricted Release Requiring Resubmission: When submittals are marked "REVISE AND RESUBMIT," that part of the Work covered by the submittal may proceed provided it complies with notations or corrections on the submittal and requirements of the Contract Documents; final acceptance will depend on that compliance. Revise or prepare new submittal in accordance with the notations; resubmit without delay.

G. Returned for Re-submittal: When submittal is marked "REJECTED," do not proceed with that part of the Work covered by the submittal, including purchasing, fabrication, delivery, or other activity. Revise or prepare a new submittal in accordance with the notations; resubmit without delay. Repeat if necessary to obtain a different action mark.

1. Do not permit submittals marked "REJECTED" to be used at the Project site, or elsewhere where Work is in progress.

H. Other Action: Where a submittal is primarily for information or record purposes, special processing or other activity, the submittal will be returned, marked "RECEIPT ACKNOWLEDGED".

I. Unsolicited Submittals: The Engineer will return unsolicited submittals to the sender without action.
PART 2 - PRODUCTS (Not Applicable).

PART 3 - EXECUTION (Not Applicable).

END OF SECTION 01300
SECTION 01500 - TEMPORARY FACILITIES AND PROTECTION OF PROPERTY

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

   A. This Section specifies requirements for temporary services and facilities, including utilities, construction and support facilities, security and protection of property.

   B. Temporary utilities required include but are not limited to:

      1. Use of electric power and water.
      2. Provision of cellular telephone service.
      3. Sanitary facilities, including drinking water.

   C. Temporary construction and support facilities required include but are not limited to:

      1. Waste disposal services.
      2. Construction aids and miscellaneous services and facilities.

   D. Security and protection facilities required include but are not limited to:

      1. Staging and storage areas.
      2. Temporary fire protection.
      3. Barricades, warning signs, lights.
      4. Protection of installed work.
      5. Security against theft and vandalism.

1.3 SUBMITTALS

   A. Drawings: Submit partial site plans that indicate the following:

      1. Proposed locations of fenced temporary storage areas for material and equipment.
      2. Dimensions of fenced storage locations indicating gates.
      3. Contractor parking area.
1.4 QUALITY ASSURANCE

A. Regulations: Comply with industry standards and applicable laws and regulations if authorities having jurisdiction, including but not limited to:

1. Building Code requirements.
2. Health and safety regulations.
3. Utility company regulations.
4. Police, Fire Department and Rescue Squad rules.
5. Environmental protection regulations.


1.5 PROJECT CONDITIONS

A. Conditions of Use: Keep temporary services and facilities clean and neat in appearance. Operate in a safe and efficient manner. Take necessary fire prevention measures. Do not overload facilities, or permit them to interfere with progress. Do not allow hazardous dangerous or unsanitary conditions, or public nuisances to develop or persist on the site.

B. Maintain security against theft and vandalism for the site and the building at all times until the date of Substantial Completion.

1.6 DESCRIPTION OF REQUIREMENTS

A. Definitions: Specific administrative and procedure minimum actions are specified in this section, as extensions of provisions in General Conditions and other contract documents. These requirements have been included for special purposes as indicated. Nothing in this section is intended to limit types and amount of temporary work required, and no omission from this section will be recognized as an indication by the Engineer that such temporary activity is not required for successful completion of the work and compliance with requirements of contract documents. Provisions of this section are applicable to, but not limited to utility services, construction facilities, security/protection provisions and support facilities.

B. It shall be the responsibility of the Contractor to determine the applicable requirements to initiate and maintain all required safety and health programs, and to follow the recommendations of Federal, State and Local officials.
1.7 JOB OFFICE

A. Provide job office for the resident superintendent and his assistants to be located in an Owner approved location. Maintain during the entire construction period. Maintain construction and record documents at the job office. Include the following as a minimum in the office:

1. Work table, minimum size 36" x 72''.
2. Telephone and fax machine.
3. Air conditioning, ventilation, and lighting.

1.8 TEMPORARY ELECTRIC POWER AND WATER

A. The contractor may utilize existing permanent electric power and water within the facility during the construction phase of the work. Coordinate connection requirements with Owner’s representative. All connection costs shall be borne by the Contractor. Usage costs shall be borne by the Owner. Contractor’s use of Owner’s existing permanent power and water shall in no way limit availability of these utilities to the Owner’s facilities. Contractor shall restore Owner’s permanent utilities to pre-construction conditions after removal of temporary utility connections.

1.9 TEMPORARY TELEPHONE AND FAX

A. Provide a job telephone and fax machine through the completion of all punch list items until Substantial Completion and Owner occupancy.

B. Pay for installation, maintenance, removal and all local and long distance charges.

1.10 SANITARY FACILITIES

A. Provide and maintain temporary toilets as necessary for use of all construction personnel. Place toilets in convenient locations as approved by the owner, and maintain in sanitary condition. Provide portable container or sanitary bubbler drinking fountains.

B. Provide adequate washing facilities for all construction personnel. Place in convenient locations as approved by the owner.

C. Existing toilet facilities shall not be used by construction personnel.

D. Sanitary facilities shall be located as directed by Owner. Provide sanitary facilities for the duration of the project including the punch list period.
1.11 SIGNS

A. A project sign may be provided in accordance with the Owner’s standards.

1.12 FIRE PROTECTION

A. Provide temporary fire protection as required by authorities having jurisdiction throughout the entire construction period. Maintain access to the site and to the building at all times for Fire Department apparatus and personnel. Maintain access to fire protection devices at all times.

1.13 STAGING AND STORAGE AREAS

A. Locate staging and storage areas within areas designated or approved by the Owner. Provide gates, double gates, fencing and locks as required to secure all construction materials and protect from vandalism. Remove any potentially hazardous or flammable materials, including all welding materials, from the site at the end of each workday. Materials which will be installed in the project area shall not be stored in uncontrolled exterior locations where they may be susceptible to temperature, humidity, rain, dirt, and dust.

B. Provide and maintain weathertight storage as required.

1.14 PROTECTION OF INSTALLED WORK

A. Protect installed work from elevated temperature and humidity, dust, and dirt. Provide special protection where specified in individual Specification Sections.

B. Provide protective coverings at openings in air-handling units, ductwork, chases, walls, and other items of construction to prevent damage, contamination by dust, and transmission of dust to other spaces.

C. Provide temporary and removable protection for installed products. Control activity in immediate work area to minimize damage.

D. Use all means necessary to protect the site, the building, and all materials stored or installed at all times, including the employment of a watchman or guard when required.

1.15 REMOVAL

A. Remove all temporary facilities from the site and leave the site and affected off-site areas in a clean and finished condition prior to final acceptance.
1.16 OSHA (Occupational Safety and Health Act)
   A. Comply with all requirements of the Occupational Safety and Health Act for job
      safety and health standards.

1.17 CONSTRUCTION AIDS
   A. Provide all temporary stairs, ladders, ramps, runways, hoists, chutes, and other
      facilities necessary for the proper execution of the work. Provide guard rails and
      warning lights as required for job safety.

PART 2 - PRODUCTS

2.1 MATERIALS
   A. General: Provide materials suitable for the use intended.

2.2 EQUIPMENT
   A. General: Provide equipment suitable for use intended.

PART 3 - EXECUTION

3.1 INSTALLATION
   A. Use qualified personnel for installation of temporary facilities. Locate facilities where
      they will serve the Project adequately and result in minimum interference with
      performance of the Work. Relocate and modify facilities as required.

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

   C. Telephones: Provide cellular telephone service for all personnel engaged in
      construction activities, throughout the construction period, until final completion.

   D. Sanitary facilities include temporary toilets, wash facilities and drinking water
      fixtures. Comply with regulations and health codes for the type, number, location,
      operation and maintenance of fixtures and facilities. Install where facilities will best
      serve the Project's needs.
E. Provide toilet tissue, paper towels, paper cups and similar disposable materials for each facility. Provide covered waste containers for used material.

F. Toilets: Install self-contained toilet units. Shield toilets to ensure privacy. Use of pit-type privies will not be permitted.

G. Wash Facilities: Install wash facilities supplied with potable water at convenient locations for personnel involved in handling materials that require wash-up for a healthy and sanitary condition. Dispose of drainage properly. Supply cleaning compounds appropriate for each condition.

H. Drinking Water Facilities: Provide containerized tap-dispenser bottled-water type drinking water units, including paper supply.

3.2 TEMPORARY CONSTRUCTION AND SUPPORT FACILITIES INSTALLATION

A. Maintain temporary construction and support facilities until near Substantial Completion. Remove prior to Substantial Completion, unless otherwise indicated. Personnel remaining after Substantial Completion will be permitted to use permanent facilities, under conditions acceptable to the Owner.

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

C. Project Identification and Temporary Signs: Signs are not permitted.

D. Collection and Disposal of Debris and Waste: Collect debris and waste from construction areas and elsewhere daily. Comply with requirements of NFPA 241 for removal of combustible waste material and debris. Enforce requirements strictly. Do not hold materials more than 7 days during normal weather or 3 days when the temperature is expected to rise above 80 deg F (27 deg C). Handle hazardous, dangerous, or unsanitary waste materials separately from other waste by containerizing properly. Dispose of material in a lawful manner.

E. Burying of waste materials on the site will not be permitted. Washing waste materials down sewers or into waterways will not be permitted.

F. Provide rodent proof containers located convenient to areas of construction.

G. Provide a dumpster for use by all subcontractors.
3.3 SECURITY AND PROTECTION FACILITIES INSTALLATION

A. Do not change over from use of temporary security to permanent facilities until Substantial Completion, or longer as requested by the Engineer and/or Owner.

1. Store combustible materials in containers in fire-safe locations.
2. Maintain unobstructed access to fire extinguishers, fire hydrants, stairways and other access routes for fighting fires. Prohibit smoking in hazardous fire exposure areas.

B. Provide supervision of welding operations, combustion type temporary heating units, and similar sources of fire ignition.

C. Barricades, Warning Signs and Lights: Comply with standards and code requirements for erection of structurally adequate barricades. Paint with appropriate colors, graphics and warning signs to inform personnel and the public of the hazard being protected against. Where appropriate and needed provide lighting, including flashing red or amber lights.

D. Security Enclosure and Lockup: Install substantial temporary enclosure of partially completed areas of construction. Provide locking entrances to prevent unauthorized entrance, vandalism, theft and similar violations of security.

E. Storage: Where materials and equipment must be stored, and are of value or attractive for theft, provide a secure lockup. Enforce discipline in connection with the installation and release of material to minimize the opportunity for theft and vandalism.

F. Environmental Protection: Provide protection, operate temporary facilities and conduct construction in ways and by methods that comply with environmental regulations, and minimize the possibility that air, waterways and subsoil might be contaminated or polluted, or that other undesirable effects might result. Avoid use of tools and equipment which produce harmful noise. restrict use of noise making tools and equipment to hours that will minimize complaints from persons or firms near the site.

3.4 OPERATION, TERMINATION AND REMOVAL

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

B. Maintenance: Maintain facilities in good operating condition until removal. Protect from damage by freezing temperatures and similar elements.
1. Maintain operation of temporary enclosures, heating, cooling, humidity control, ventilation and similar facilities on a 24-hour day basis where required to achieve indicated results and to avoid possibility of damage.

C. Termination and Removal: Unless the Engineer requests that it be maintained longer, remove each temporary facility when the need has ended, or when 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 the temporary facility. Repair damaged Work, clean exposed surfaces and replace construction that cannot be satisfactorily repaired.

D. Materials and facilities that constitute temporary facilities are property of the Contractor. The Owner reserves the right to take possession of Project identification signs.

E. Repair or replace street paving, curbs and sidewalks damaged by construction activities to match surrounding conditions.

F. Seed the staging and storage areas within construction fences and any other areas on the library property where damage has occurred due to trucks, cranes, excavations, or other construction activities.

G. A satisfactory stand of turf from the seeding operation is defined as a minimum of 15 grass plants per square foot. Bare spots can be no larger than 6" square. Total bare spots must be less than 2% of the total seeded area.

H. Contractor is responsible for maintenance of seeded area until acceptance by Owner.

END OF SECTION 01500
SECTION 01600 - MATERIALS AND EQUIPMENT

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

A. This Section specifies administrative and procedural requirements governing the Contractor's selection of products for use in the Project.

B. The Contractor's Construction Schedule and the Schedule of Submittals are included under Section "Submittals."

C. Standards: Refer to Section "Definitions and Standards" for applicability of industry standards to products specified.

D. Administrative procedures for handling requests for substitutions made after award of the Contract are included under Section "Product Substitutions."

1.3 DEFINITIONS

A. Definitions used in this Article are not intended to change the meaning of other terms used in the Contract Documents, such as "specialties," "systems," "structure," "finishes," "accessories," and similar terms. Such terms are self-explanatory and have well recognized meanings in the construction industry.

B. "Products" are items purchased for incorporation in the Work, whether purchased for the Project or taken from previously purchased stock. The term "product" includes the terms "material," "equipment," "system," and terms of similar intent.

C. "Named Products" are items identified by manufacturer's product name, including make or model designation, indicated in the manufacturer's published product literature, that is current as of the date of the Contract Documents.

D. "Materials" are products that are substantially shaped, cut, worked, mixed, finished, refined or otherwise fabricated, processed, or installed to form a part of the Work.
E. "Equipment" is a product with operational parts, whether motorized or manually operated, that requires service connections such as wiring or piping.

1.4 SUBMITTALS

A. Product List Schedule: Prepare a schedule showing products specified in a tabular form acceptable to the Engineer. Include generic names of products required. Include the manufacturer's name and proprietary product names for each item listed.

B. Coordinate the product list schedule with the Contractor's Construction Schedule and the Schedule of Submittals.

C. Form: Prepare the product listing schedule with information on each item tabulated under the following column headings:

1. Related Specification Section number.
2. Generic name used in Contract Documents.
3. Proprietary name, model number and similar designations.
4. Manufacturer's name and address.
5. Supplier's name and address.
6. Installer's name and address.
7. Projected delivery date, or time span of delivery period.

D. Completed Schedule: Within 30 days after date of commencement of the Work, submit 6 copies of the completed product list schedule. Provide a written explanation for omissions of data, and for known variations from Contract requirements.

E. Engineer's Action: The Engineer will respond in writing to the Contractor within 14 days of receipt of the completed product list schedule. No response within this time period constitutes no objection to listed manufacturers or products, but does not constitute a waiver of the requirement that products comply with Contract Documents. The Engineer's response will include the following:

1. A list of unacceptable product selections, containing a brief explanation of reasons for this action.

1.5 QUALITY ASSURANCE

A. Source Limitations: To the fullest extent possible, provide products of the same kind, from a single source.

B. Compatibility of Options: When the Contractor is given the option of selecting between two or more products for use on the Project, the product selected shall be
compatible with products previously selected, even if previously selected products were also options.

C. Nameplates: Except for required labels and operating data, do not attach or imprint manufacturer's or producer's nameplates or trademarks on exposed surfaces of products which will be exposed to view in occupied spaces or on the exterior.

D. Labels: Locate required product labels and stamps on a concealed surface or, where required for observation after installation, on an accessible surface that is not conspicuous.

E. Equipment Nameplates: Provide a permanent nameplate on each item of service-connected or power-operated equipment. Locate on an easily accessible surface which is inconspicuous in occupied spaces. The nameplate shall contain the following information and other essential operating data:

1. Name of product and manufacturer.
2. Model and serial number.
3. Capacity.
4. Speed.
5. Ratings.

1.6 PRODUCT DELIVERY, STORAGE, AND HANDLING

A. Deliver, store and handle products in accordance with the manufacturer's recommendations, using means and methods that will prevent damage, deterioration and loss, including theft.

B. Schedule delivery to minimize long-term storage at the site and to prevent overcrowding of construction spaces.

C. Coordinate delivery with installation time to ensure minimum holding time for items that are flammable, hazardous, easily damaged, or sensitive to deterioration, theft and other losses.

D. Deliver products to the site in the manufacturer's original sealed container or other packaging system, complete with labels and instructions for handling, storing, unpacking, protecting and installing.

E. Inspect products upon delivery to ensure compliance with the Contract Documents, and to ensure that products are undamaged and properly protected.

F. Store products at the site in a manner that will facilitate inspection and measurement of quantity or counting of units.
G. Store heavy materials away from the Project structure in a manner that will not endanger the supporting construction.

H. Store products subject to damage by the elements above ground, under cover in a weathertight enclosure, with ventilation adequate to prevent condensation. Maintain temperature and humidity within range required by manufacturer's instructions.

PART 2 - PRODUCTS

2.1 PRODUCT SELECTION

A. General Product Requirements: Provide products that comply with the Contract Documents, that are undamaged and, unless otherwise indicated, unused at the time of installation.

B. Provide products complete with all accessories, trim, finish, safety guards and other devices and details needed for a complete installation and for the intended use and effect.

C. Standard Products: Where available, provide standard products of types that have been produced and used successfully in similar situations on other projects.

D. Product Selection Procedures: Product selection is governed by the Contract Documents and governing regulations, not by previous Project experience. Procedures governing product selection include the following:

E. Semi-proprietary Specification Requirements: Where three or more products or manufacturers are named, provide one of the products indicated. No substitutions will be permitted.

F. Where products or manufacturers are specified by name, accompanied by the term "or equal," or "or approved equal" comply with the Contract Document provisions concerning "substitutions" to obtain approval for use of an unnamed product.

G. Non-Proprietary Specifications: When the Specifications list products or manufacturers that are available and may be incorporated in the Work, but do not restrict the Contractor to use of these products only, the Contractor may propose any available product that complies with Contract requirements. Comply with Contract Document provisions concerning "substitutions" to obtain approval for use of an unnamed product.
H. Descriptive Specification Requirements: Where Specifications describe a product or assembly, listing exact characteristics required, with or without use of a brand or trade name, provide a product or assembly that provides the characteristics and otherwise complies with Contract requirements.

I. Performance Specification Requirements: Where Specifications require compliance with performance requirements, provide products that comply with these requirements, and are recommended by the manufacturer for the application indicated. General overall performance of a product is implied where the product is specified for a specific application.

1. Manufacturer's recommendations may be contained in published product literature, or by the manufacturer's certification of performance.

J. Compliance with Standards, Codes and Regulations: Where the Specifications only require compliance with an imposed code, standard or regulation, select a product that complies with the standards, codes or regulations specified.

K. Visual Matching: Where Specifications require matching an established Sample, the Engineer's decision will be final on whether a proposed product matches satisfactorily.

1. Where no product available within the specified category matches satisfactorily and also complies with other specified requirements, comply with provisions of the Contract Documents concerning "substitutions" for selection of a matching product in another product category, or for noncompliance with specified requirements.

L. Visual Selection: Where specified product requirements include the phrase "...as selected from manufacturer's standard colors, patterns, textures..." or a similar phrase, select a product and manufacturer that complies with other specified requirements. The Engineer will select the color, pattern and texture from the product line selected.

PART 3 - EXECUTION

3.1 INSTALLATION OF PRODUCTS:

A. Comply with manufacturer's instructions and recommendations for installation of products in the applications indicated. Anchor each product securely in place, accurately located and aligned with other Work.
B. Clean exposed surfaces and protect as necessary to ensure freedom from damage and deterioration at time of Substantial Completion.

END OF SECTION 01600
SECTION 01631 - PRODUCT SUBSTITUTIONS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

A. This Section specifies administrative and procedural requirements for handling requests for substitutions made after award of the Contract.

B. The Contractor's Construction Schedule and the Schedule of Submittals are included under Section "Submittals."

C. Standards: Refer to Section "Definitions and Standards" for applicability of industry standards to products specified.

D. Procedural requirements governing the Contractor's selection of products and product options are included under Section "Materials and Equipment."

1.3 DEFINITIONS

A. Definitions used in this Article are not intended to change or modify the meaning of other terms used in the Contract Documents.

B. Substitutions: Requests for changes in products, materials, equipment, and methods of construction required by Contract Documents proposed by the Contractor after award of the Contract are considered requests for "substitutions." The following are not considered substitutions:

1. Substitutions requested by Bidders during the bidding period, and accepted prior to award of Contract, are considered as included in the Contract Documents and are not subject to requirements specified in this Section for substitutions.

2. Revisions to Contract Documents requested by the Owner.


4. The Contractor's determination of and compliance with governing regulations and orders issued by governing authorities.
1.4 SUBMITTALS

A. Substitution Request Submittal: Requests for substitution will be considered if received within 30 days after commencement of the Work. Requests received more than 30 days after commencement of the Work may be considered or rejected at the discretion of the Engineer.

B. Submit 6 copies of each request for substitution for consideration. Submit requests in the form and in accordance with procedures required for Change Order proposals.

C. Identify the product, or the fabrication or installation method to be replaced in each request. Include related Specification Section and Drawing numbers. Provide complete documentation showing compliance with the requirements for substitutions, and the following information, as appropriate:

1. Product Data, including Drawings and descriptions of products, fabrication and installation procedures.
2. Samples, where applicable or requested.
3. A detailed comparison of significant qualities of the proposed substitution with those of the Work specified. Significant qualities may include elements such as size, weight, durability, performance and visual effect.
4. Coordination information, including a list of changes or modifications needed to other parts of the Work and to construction performed by the Owner and separate Contractors, that will become necessary to accommodate the proposed substitution.
5. A statement indicating the substitution's effect on the Contractor's Construction Schedule compared to the schedule without approval of the substitution. Indicate the effect of the proposed substitution on overall Contract Time.
6. Cost information, including a proposal of the net change, if any in the Contract Sum.
7. Certification by the Contractor that the substitution proposed is equal-to or better in every significant respect to that required by the Contract Documents, and that it will perform adequately in the application indicated. Include the Contractor's waiver of rights to additional payment or time, that may subsequently become necessary because of the failure of the substitution to perform adequately.

D. Engineer's Action: Within 10 days of receipt of the request for substitution, the Engineer will request additional information or documentation necessary for evaluation of the request. Within 14 days of receipt of the request, or 14 days of receipt of the additional information or documentation, which ever is later, the Engineer will notify the Contractor of acceptance or rejection of the proposed
substitution. If a decision on use of a proposed substitute cannot be made or obtained within the time allocated, use the product specified by name. Acceptance will be in the form of a Change Order.

PART 2 - PRODUCTS

2.1 SUBSTITUTIONS

A. Conditions: The Contractor's substitution request will be received and considered by the Engineer when one or more of the following conditions are satisfied, as determined by the Engineer; otherwise requests will be returned without action except to record noncompliance with these requirements.

B. Extensive revisions to Contract Documents are not required.

C. Proposed changes are in keeping with the general intent of Contract Documents.

D. The request is timely, fully documented and properly submitted.

E. The request is directly related to an "or equal" clause or similar language in the Contract Documents.

F. The specified product or method of construction cannot be provided within the Contract Time. The request will not be considered if the product or method cannot be provided as a result of failure to pursue the Work promptly or coordinate activities properly.

G. The specified product or method of construction cannot receive necessary approval by a governing authority, and the requested substitution can be approved.

H. A substantial advantage is offered the Owner, in terms of cost, time, energy conservation or other considerations of merit, after deducting offsetting responsibilities the Owner may be required to bear. Additional responsibilities for the Owner may include additional compensation to the Engineer for redesign and evaluation services, increased cost of other construction by the Owner or separate Contractors, and similar considerations.

I. The specified product or method of construction cannot be provided in a manner that is compatible with other materials, and where the Contractor certifies that the substitution will overcome the incompatibility.
J. The specified product or method of construction cannot be coordinated with other materials, and where the Contractor certifies that the proposed substitution can be coordinated.

K. The specified product or method of construction cannot provide a warranty required by the Contract Documents and where the Contractor certifies that the proposed substitution provide the required warranty.

The Contractor's submittal and Engineer's acceptance of Shop Drawings, Product Data or Samples that relate to construction activities not complying with the Contract Documents does not constitute an acceptable or valid request for substitution, nor does it constitute approval.

PART 3 - EXECUTION (Not Applicable)

END OF SECTION 01631
SECTION 01700 - PROJECT CLOSEOUT

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

A. This Section specifies administrative and procedural requirements for project closeout, including but not limited to:

1. Inspection procedures.
2. Project record document submittal.
3. Operating and maintenance manual submittal.
4. Submittal of warranties.
5. Final cleaning.

B. Closeout requirements for specific construction activities are included in the appropriate Sections in Divisions-2 through -16.

1.3 SUBSTANTIAL COMPLETION

A. Preliminary Procedures: Before requesting inspection for certification of Substantial Completion, complete the following. List exceptions in the request.

1. In the Application for Payment that coincides with, or first follows, the date Substantial Completion is claimed, show 100% completion for the portion of the Work claimed as substantially complete. Include supporting documentation for completion as indicated in these Contract Documents and a statement showing an accounting of changes to the Contract Sum.

a. If 100% completion cannot be shown, include a list of incomplete items, the value of incomplete construction, and reasons the Work is not complete.

2. Advise Owner of pending insurance change-over requirements.
3. Submit specific warranties, workmanship bonds, maintenance agreements, final certifications and similar documents.
4. Obtain and submit releases enabling the Owner unrestricted use of the Work and access to services and utilities; include occupancy permits, operating certificates and similar releases.

5. Submit record drawings, operations and maintenance manuals, and similar final record information. Operations and maintenance manuals shall be furnished to Owner 14 days before date operation and maintenance instructions and demonstrations are to occur.

6. Deliver tools, spare parts, extra stock, and similar items.

7. Make final change-over of permanent locks and transmit keys to the Owner. Advise the Owner's personnel of change-over in security provisions.

8. Complete start-up testing of systems, and instruction of the Owner's operating and maintenance personnel.

9. Discontinue or change over and remove temporary facilities from the site, along with construction tools, mock-ups, and similar elements.

10. Complete final clean up requirements, including touch-up painting. Touch-up and otherwise repair and restore marred exposed finishes.

B. Contractor's Inspection Report: Prepare a complete list of all work remaining to be completed, deficiencies to be corrected, and any other items or requirements not yet fulfilled.

C. Inspection Procedures: On receipt of a request for inspection and the Contractor's Inspection Report, the Engineer will either proceed with inspection or advise the Contractor of unfilled requirements. The Engineer will prepare the Certificate of Substantial Completion following inspection, or advise the Contractor of construction that must be completed or corrected before the certificate will be issued.

D. The Engineer will repeat inspection when requested and assured that the Work has been substantially completed.

E. Results of the completed inspection will form the basis of requirements for final acceptance.

1.4 FINAL ACCEPTANCE

A. Preliminary Procedures: Before requesting final inspection for certification of final acceptance and final payment, complete the following. List exceptions in the request.

1. Submit the final payment request with releases and supporting documentation not previously submitted and accepted. Include certificates of insurance for products and completed operations where required.
2. Submit an updated final statement, accounting for final additional changes to the Contract Sum.

3. Submit a certified copy of the Engineer's final inspection list of items to be completed or corrected, stating that each item has been completed or otherwise resolved for acceptance, and the list has been endorsed and dated by the Engineer.

4. Submit final meter readings for utilities, a measured record of stored fuel, and similar data as of the date of Substantial Completion, or when the Owner took possession of and responsibility for corresponding elements of the Work.

5. Submit Consent of Surety to Final Payment.

6. Submit a final liquidated damages settlement statement.

7. Submit evidence of final, continuing insurance coverage complying with insurance requirements.

8. See Project Closeout Checklist at the end of this Section for additional requirements.

B. Re-inspection Procedure: The Engineer will re-inspect the Work upon receipt of notice that the Work, including inspection list items from earlier inspections, has been completed, except items whose completion has been delayed because of circumstances acceptable to the Engineer.

1. Upon completion of re-inspection, the Engineer will prepare a certificate of final acceptance, or advise the Contractor of Work that is incomplete or of obligations that have not been fulfilled but are required for final acceptance.

2. Only if absolutely necessary, will the re-inspection procedure be repeated. It is the Contractor's responsibility to inspect the Work and have all items completed prior to requesting a re-inspection. All Engineer's cost incurred beyond the initial re-inspection shall be borne by the Contractor.

PART 2 - PRODUCTS (Not Applicable)

PART 3 - EXECUTION

3.1 CLOSEOUT PROCEDURES

A. Operating and Maintenance Instructions: Arrange for each installer of equipment that requires regular maintenance to meet with the Owner's personnel to provide instruction in proper operation and maintenance. If installers are not experienced in procedures, provide instruction by manufacturer's representatives. Two weeks prior to all demonstrations, such as the mechanical and electrical controls and
equipment, the Owner shall have in his possession all related manuals of operation and maintenance for the system. The Owner shall be notified one week in advance of intended time and date of all above demonstrations. Include a detailed review of the following items:

1. Maintenance manuals.
2. Record documents.
3. Spare parts and materials.
4. Tools.
5. Lubricants.
6. Fuels.
7. Identification systems.
8. Control sequences.
9. Hazards.
10. Cleaning.
11. Warranties and bonds.
12. Maintenance agreements and similar continuing commitments.

B. As part of instruction for operating equipment, demonstrate the following procedures:

1. Start-up.
2. Shutdown.
3. Emergency operations.
5. Safety procedures.
7. Effective energy utilization.
8. Trouble-shooting procedures and corrections (explain most frequent causes of failure).
**PROJECT CLOSEOUT CHECKLIST**

The following items must be submitted prior to processing Final Application and Certificate for Payment and Closeout of Project.

<table>
<thead>
<tr>
<th>ITEM</th>
<th>STATUS</th>
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<tbody>
<tr>
<td>Certificate of Substantial Completion</td>
<td>Engineer will provide</td>
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<tr>
<td>Letter from Contractor indicating that items on the Punch List have</td>
<td></td>
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<tr>
<td>been completed, corrected and accepted by the Engineer</td>
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<tr>
<td>Consent of the Surety Company to final payment</td>
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<tr>
<td>General Release from Contractor</td>
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<tr>
<td>Release of Liens from Major Subcontractors</td>
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<tr>
<td>Affidavit of the Contractor that all Subcontractors and material</td>
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<td>men have been paid in full</td>
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<td>Written certification from the Contractor to the Engineer and Owner</td>
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<td>that no asbestos containing materials or products were included in</td>
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<td>the Project</td>
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<td>Record Drawings</td>
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<tr>
<td>Record Specifications</td>
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END OF SECTION 01700
SECTION 01710 - FINAL CLEANING

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

A. This Section specifies administrative and procedural requirements for final cleaning at Substantial Completion.

B. Special cleaning requirements for specific elements of the Work area included in appropriate Sections of Divisions-2 through -16.

C. General Project closeout requirements are included in Section "Project Closeout."

D. General cleanup and waste removal requirements are included in Section "Temporary Facilities."

E. Environmental Requirements: Conduct cleaning and waste disposal operations in compliance with local laws and ordinances. Comply fully with federal and local environmental and anti-pollution regulations.

1. Do not dispose of volatile wastes such as mineral spirits, oil or paint thinner in storm or sanitary drains.
2. Burying of debris, rubbish or other waste material on the premises will not be permitted.

PART 2 - PRODUCTS

2.1 MATERIALS

A. Cleaning Agents: Use cleaning materials and agents recommended by the manufacturer or fabricator of the surface to be cleaned. Do not use cleaning agents that are potentially hazardous to health or property, or that might damage finished surfaces.
PART 3 - EXECUTION

3.1 FINAL CLEANING

A. General: Provide final cleaning operations when indicated. Employ experienced workers or professional cleaners for final cleaning. Clean each surface or unit of Work to the condition expected from a commercial building cleaning and maintenance program. Comply with manufacturer's instructions.

B. Complete the following cleaning operations before requesting inspection for Certification of Substantial completion for the entire Project or a portion of the Project.

C. Clean the Project site, yard and grounds, in areas disturbed by construction activities, including landscape development areas, of rubbish, waste materials, litter and foreign substances. Sweep paved areas broom clean. Remove petro-chemical spills, stains and other foreign deposits. Rake grounds that are neither planted nor paved, to a smooth even-textured surface.

D. Remove tools, construction equipment, machinery and surplus material from the site.

E. Clean exposed exterior and interior hard-surfaced finishes to a dirt-free condition, free of stains, films and similar foreign substances. Avoid disturbing natural weathering of exterior surfaces. Restore reflective surfaces to their original condition.

F. Remove debris and surface dust from limited access spaces, including roofs, plenums, and similar spaces.

G. Remove labels that are not permanent labels.

H. Touch-up and otherwise repair and restore marred exposed finishes and surfaces. Replace finishes and surfaces that can not be satisfactorily repaired or restored, or that show evidence of repair or restoration. Do not paint over "UL" and similar labels, including mechanical and electrical name plates.

I. Wipe surfaces of mechanical and electrical equipment. Remove excess lubrication, paint and mortar droppings and other foreign substances.

J. Leave the Project clean and ready for occupancy.
K. Removal of Temporary Protection: Remove temporary protection and facilities installed during construction to protect previously completed installations during the remainder of the construction period.

L. Compliances: Comply with governing regulations and safety standards for cleaning operations. Remove waste materials from the site and dispose of in a lawful manner.

M. Where extra materials of value remain after completion of associated construction have become the Owner's property, dispose of these materials as directed.

END OF SECTION 01710
SECTION 01720 - PROJECT RECORD DOCUMENTS

PART 1 - GENERAL

1.1 DESCRIPTION

A. Work Included:

1. Throughout progress of the work, maintain an accurate record of changes in the Contract Documents, as described in this Section.
2. Upon completion of the work, transfer the recorded changes to a set of Record Documents, as described in this Section. Cross reference all changes to addenda, change orders, etc.

B. Related Work:

1. Documents affecting work of this Section include but are not necessarily limited to the Special Conditions and Sections in Division 1 of these Specifications.
2. Other requirements affecting the Project Record Documents may appear in pertinent other Sections of these Specifications.

1.2 QUALITY ASSURANCE

A. Assign the responsibility for maintenance of Record Documents to one person on the Contractor’s staff as approved by the Engineer.

B. Accuracy of Records:

1. Thoroughly coordinate changes within the Record Documents, making adequate and proper entries on each page of the Specifications and each sheet of drawings and other documents where such entry is required to show the change properly.
2. Accuracy of records shall be such that future search for items shown in the Contract Documents may rely reasonably on information obtained from the approved Project Record Documents.

C. Make entries within 24 hours after receipt of information that the change has occurred.
1.3 SUBMITTALS

A. The Engineer’s approval of the current status of Project Record Documents is a prerequisite to the Engineer’s approval of requests for progress payment and request for final payment under the Contract.

B. Prior to submitting each request for progress payment, secure the Engineer’s approval of the current status of the Project Record Documents.

C. Prior to submitting request for final payment, submit the final Project Record Documents to the Engineer and secure his approval.

1.4 PRODUCT HANDLING

A. Maintain the job set of Record Documents completely protected from deterioration and from loss and damage until completion of the work and transfer of all recorded data to the final Project Record Documents.

B. In the event of loss of the recorded data, use means necessary to again secure the data to the Engineer’s approval.

   1. Such means shall include, if necessary in the opinion of the Engineer, removal and replacement of concealed materials.

   2. In such case, provide replacements to the standards originally required by the Contract Documents.

1.5 RECORD DOCUMENTS

A. Job Set: Promptly following receipt of the Owner’s Notice to Proceed, secure from the Engineer at no charge to the Contractor one complete set of all documents comprising the Contract.

B. Final Record Documents: At a time nearing the completion of the work, secure from the Engineer at no charge to the Contractor one complete set of sepia transparencies of all drawings in the Contract.

1.6 MAINTENANCE OF JOB SET

A. Immediately upon receipt of the job set described in this Section, identify each of the documents with the title, “RECORD DOCUMENTS - JOB SET.”
B. Preservation of Documents:

1. Considering the Contract completion time, the probable number of occasions upon which the job set must be taken out for new entries and for examination, and the conditions under which these activities will be performed, devise a suitable method for protecting the job set suitable to the Engineer.

2. Do not use the job set for any purpose except entry of new data and for review by the Engineer, until start of transfer of data to the final Project Record Documents.

3. Maintain the job set at the site of work as that site is designated by the Engineer.

C. Making Entries on Drawings:

1. Using an erasable colored pencil (not ink or indelible pencil), clearly describe the change by graphic line and note as required. Colors that are not reproducible using standard printing procedures shall not be used.

2. Date all entries.

3. Call attention to the entry by drawing a box or other shape in a manner that avoids confusion with the original shapes and elements on the drawing around the area or areas affected.

4. In the event of overlapping changes, use different colors for the overlapping changes.

D. Make entries in the pertinent other documents as approved by the Engineer.

E. Conversion of Schematic Layouts:

1. In some cases on the drawings, arrangements of conduits, circuits, piping, ducts, and similar items, are shown schematically and are not intended to portray precise physical layout.

   a. Final physical arrangement is determined by the Contractor, subject to the Engineer’s approval.

   b. However, design of future modifications of the facility may require accurate information as to the final physical layout of items which are shown only schematically on the drawings.

2. The Engineer may waive the requirements for conversion of schematic layouts where, in the Engineer’s judgment, conversion served no useful purpose. However, do not rely upon waivers being issued except as specifically issued in writing by the Engineer.
1.7 FINAL PROJECT RECORD DOCUMENTS

A. The purpose of the final Project Record Documents is to provide factual information regarding all aspects of the work, both concealed and visible, to enable future modification of the work to proceed without lengthy and expensive site measurement, investigation, and examination.

B. Approval of Recorded Data Prior to Transfer:

1. Following receipt of the transparencies described in this Section, and prior to start of transfer of recorded data thereto, secure the Engineer’s approval of all recorded data.
2. Make required revisions.

C. Transfer of Data to Drawings:

1. Carefully transfer change data shown on the job set of Record Drawings to the corresponding transparencies, coordinating the changes as required.
2. Clearly indicate at each affected detail and other drawings a full description of changes made during construction, and the actual location of items described in this Section.
3. Call attention to the entry by drawing a box or other shape in a manner that avoids confusion with the original shapes and elements on the drawing around the area or areas affected.
4. Make changes neatly, consistently, and with proper media to assure longevity and clear reproduction.

D. Transfer of Data to Other Documents:

1. If the documents other than drawings have been kept clean during progress of the work and if entries thereon have been orderly to the approval of the Engineer, the job set of those documents other than drawings will be accepted as final Record Documents.
2. If any such document is not approved by the Engineer, secure a new copy of that document from the Engineer at the Engineer’s usual charge for reproduction and handling, and carefully transfer the change data to the new copy to the approval of the Engineer.

E. Review and Submittal:

1. Submit the completed set of Project Record Documents to the Engineer for approval.
2. Make required changes and promptly deliver the final Project Record Documents to the Engineer.

1.8 CHANGES SUBSEQUENT TO ACCEPTANCE

A. The Contractor has no responsibility for recording changes in the work subsequent to final completion, except for changes resulting from work performed under warranty.

PART 2 – PRODUCTS
Not Used

PART 3 – EXECUTION
Not Used

END OF SECTION 01720
SECTION 01730 - OPERATION AND MAINTENANCE DATA

PART 1 - GENERAL

1.1 DESCRIPTION

A. Work Included: To aid the continued instruction of operating and maintenance personnel, and to provide a positive source of information regarding the products incorporated into the work, furnish and deliver the data described in this section and in pertinent other sections of these Specifications.

B. Related Work: Required contents of submittals also may be amplified in pertinent other sections of these Specifications.

1.2 QUALITY ASSURANCE

A. In preparing data required by this Section, use only personnel who are thoroughly trained and experienced in the operation and maintenance of the described items, completely familiar with the requirements of this Section, and skilled communicating the essential data.

1.3 SUBMITTALS

A. Unless otherwise directed in other sections, or in writing by the Engineer, submit three copies of the final manual to the Engineer for approval prior to indoctrination of operation and maintenance personnel.

PART 2 - PRODUCTS

2.1 INSTRUCTION MANUALS

A. Where instruction manuals are required to be submitted under other Sections of these Specifications, prepare in accordance with the provisions of this Section.

B. Format

1. Size: 8-1/2" x11"
3. Text: Typed (Hand printed or written is not acceptable)
4. Drawings: 11" x 8" preferable; bind in with text; foldouts are acceptable; larger drawings are acceptable if folded to fit within the manual
and provide a drawing pocket inside rear cover or bind in with text.

5. Fly Sheets: Separate each portion of the manual with neatly prepared Fly Sheets or tabbed index sheets briefly describing the contents of the ensuing portion. Fly Sheets or index tabs may be in color.

6. Binding: Use heavy-duty plastic covers with binding mechanism concealed inside the manual; 3-ring binders or GBC binding is acceptable. All binding is subject to the Engineer’s approval.

C. Provide front and back covers for each manual, using durable plastic material approved by the Engineer, and clearly identified on the front cover with at least the following information:

OPERATING AND MAINTENANCE INSTRUCTIONS

FOR

(Name, addresses, and telephone numbers of Contractor and subcontractors)

(name and address of Engineer)

(Engineer’s approval and date approved)

D. Contents:

1. Neatly prepared and typewritten detailed table of contents.
2. Complete instructions regarding operation and maintenance of all equipment involved, including lubrication, disassembly, and re-assembly.
3. Complete nomenclature of all parts of all equipment.
4. Complete nomenclature and part number of all replaceable parts, name and address of nearest vendor, and all other data pertinent to procurement procedures.
5. Copy of all guarantees and warranties issued.
6. Manufacturer’s bulletin, cuts, and descriptive data, where pertinent, clearly indicating the precise items included in this installation and deleting, or otherwise clearly indicating, all manufacturers’ data with which this installation is not concerned.
7. Such other data as required in pertinent Sections of these Specifications.

PART 3 - EXECUTION
3.1 INSTRUCTION MANUALS

A. Final Manuals: Complete the Manuals in strict accordance with the Specifications and the Engineer’s review comments.

B. Submit one copy of the manual to Engineer for review.

C. Revisions: Following the indoctrination and instruction of operation and maintenance personnel, review all proposed revisions of the Manual with the Engineer.

D. Submit three copies of manual and a CD containing an electronic version of the Manual in PDF format to Engineer after completion of reviews.

END OF SECTION 01730
SECTION 01740 - WARRANTIES AND BONDS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

A. This Section specifies general administrative and procedural requirements for warranties and bonds required by the Contract Documents, including manufacturers’ standard warranties on products and special warranties.

B. Refer to the General Conditions for terms of the Contractor's special warranty of workmanship and materials.

C. General closeout requirements are included in Section "Project Closeout."

D. Specific requirements for warranties for the Work and products and installations that are specified to be warranted are included in the individual Sections of Divisions 2 through 16.

E. Certifications and other commitments and agreements for continuing services to Owner are specified elsewhere in the Contract Documents.

F. Disclaimers and Limitations: Manufacturer's disclaimers and limitations on product warranties do not relieve the Contractor of the warranty on the Work that incorporates the products, nor does it relieve suppliers, manufacturers, and subcontractors required to countersign special warranties with the Contractor.

1.3 DEFINITIONS

A. Standard Product Warranties are preprinted written warranties published by individual manufacturers for particular products and are specifically endorsed by the manufacturer to the Owner.

B. Special Warranties are written warranties required by or incorporated in the Contract Documents, either to extend time limits provided by standard warranties or to provide greater rights for the Owner.
1.4 WARRANTY REQUIREMENTS

A. Related Damages and Losses: When correcting warranted Work that has failed, remove and replace other Work that has been damaged as a result of such failure or that must be removed and replaced to provide access for correction of warranted Work.

B. Reinstatement of Warranty: When Work covered by a warranty has failed and been corrected by replacement or rebuilding, reinstate the warranty by written endorsement. The reinstated warranty shall be equal to the original warranty with an equitable adjustment for depreciation.

C. Replacement Cost: Upon determination that Work covered by a warranty has failed, replace or rebuild the Work to an acceptable condition complying with requirements of Contract Documents. The Contractor is responsible for the cost of replacing or rebuilding defective Work regardless of whether the Owner has benefited from use of the Work through a portion of its anticipated useful service life.

D. Owner's Recourse: Written warranties made to the Owner are in addition to implied warranties, and shall not limit the duties, obligations, rights and remedies otherwise available under the law, nor shall warranty periods be interpreted as limitations on time in which the Owner can enforce such other duties, obligations, rights, or remedies.

E. Rejection of Warranties: The Owner reserves the right to reject warranties and to limit selections to products with warranties not in conflict with requirements of the Contract Documents.

F. The Owner reserves the right to refuse to accept Work for the Project where a special warranty, certification, or similar commitment is required on such Work or part of the Work, until evidence is presented that entities required to countersign such commitments are willing to do so.

1.5 SUBMITTALS

A. Submit written warranties directly to the Owner, with copies to the Engineer prior to the date of final payment.

B. When a designated portion of the Work is completed and occupied or used by the Owner, by separate agreement with the Contractor during the construction period, submit properly executed warranties to the Engineer within fifteen days of completion of that designated portion of the Work.
C. Form of Submittal: At Final Completion compile three copies of each required warranty and bond properly executed by the Contractor, or by the Contractor, subcontractor, supplier, or manufacturer. Organize the warranty documents into an orderly sequence based on the table of contents of the Project Manual.

D. Bind warranties and bonds in heavy-duty, commercial quality, durable 3-ring vinyl covered loose-leaf binders, one for each set, thickness as necessary to accommodate contents, and sized to receive 8-1/2" by 11" paper.

1. Provide heavy paper dividers with celluloid covered tabs for each separate warranty. Mark the tab to identify the product or installation. Provide a typed description of the product or installation, including the name of the product, and the name, address and telephone number of the installer.

2. Identify each binder on the front and the spine with the typed or printed title "WARRANTIES AND BONDS, the Project title or name, and the name of the Contractor.

E. When operating and maintenance manuals are required for warranted construction, provide additional copies of each required warranty, as necessary, for inclusion in each required manual.

PART 2 - PRODUCTS (not applicable).

PART 3 - EXECUTION (not applicable).

END OF SECTION 01740
SECTION 02070 - SELECTIVE DEMOLITION

PART 1 - GENERAL

1.1 SUMMARY

A. This Section includes the following:

1. Demolition and removal of selected elements.

1.2 DEFINITIONS

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

1.3 MATERIALS OWNERSHIP

A. Except for items or materials indicated to be reused, salvaged, reinstalled, or otherwise indicated to remain Owner’s property, demolished materials shall become Contractor’s property and shall be removed from Project site.

1.4 QUALITY ASSURANCE

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 A10.6 and NFPA 241.

1.5 PROJECT CONDITIONS

A. Maintain access to existing walkways, corridors, and other adjacent occupied or used facilities.

1. Do not close or obstruct walkways, corridors, or other occupied or used facilities without written permission from authorities having jurisdiction.

B. Owner assumes no responsibility for condition of areas to be selectively demolished.

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

C. Hazardous Materials: Hazardous materials may be encountered in the Work.
1. Hazardous materials will be removed by Owner before start of the Work.
2. If materials suspected of containing asbestos are encountered, do not disturb; immediately notify Engineer and Owner. Asbestos will be removed by Owner.

D. Storage or sale of removed items or materials on-site will not be permitted.

E. Utility Service: Maintain 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

Not Used

PART 3 - EXECUTION

3.1 EXAMINATION

A. Verify that utilities have been disconnected and capped.

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

C. 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 Engineer.

D. Perform surveys as the Work progresses to detect hazards resulting from selective demolition activities.

3.2 UTILITY SERVICES

A. Existing Utilities: Maintain services indicated to remain and protect them against damage during selective demolition operations.

B. Do not interrupt existing utilities serving occupied or operating facilities unless authorized in writing by Owner and authorities having jurisdiction. Provide temporary services during interruptions to existing utilities, as acceptable to Owner and to authorities having jurisdiction.
1. Provide at least 72 hours’ notice to Owner if shutdown of service is required during changeover.

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. Do not close or obstruct streets, walks, walkways, or other adjacent occupied or used facilities without permission from Owner and authorities having jurisdiction. Provide alternate routes around closed or obstructed traffic ways if required by governing regulations.
2. Erect temporary protection, such as walks, fences, railings, canopies, and covered passageways, where required by authorities having jurisdiction.
3. Protect existing site improvements, appurtenances, and landscaping to remain.

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.

3.4 POLLUTION CONTROLS

A. Dust Control: Use water mist, temporary enclosures, and other suitable methods to limit spread of dust and dirt. Comply with governing environmental-protection regulations.

1. Do not use water when it may damage existing construction or create hazardous or objectionable conditions, such as ice, flooding, and pollution.

B. Disposal: Remove and transport debris in a manner that will prevent spillage on adjacent surfaces and areas.

C. Cleaning: 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.

3.5 SELECTIVE DEMOLITION

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. 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.

2. Cut or drill from the exposed or finished side into concealed surfaces to avoid marring existing finished surfaces.

3. 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 portable fire-suppression devices during flame-cutting operations.

4. Maintain adequate ventilation when using cutting torches.

5. Remove decayed, vermin-infested, or otherwise dangerous or unsuitable materials and promptly dispose of off-site.

6. Locate selective demolition equipment and remove debris and materials so as not to impose excessive loads on supporting walls, floors, or framing.

7. Dispose of demolished items and materials promptly.

8. Return elements of construction and surfaces that are to remain to condition existing before selective demolition operations began.

3.6 DISPOSAL OF DEMOLISHED MATERIALS

A. General: Promptly dispose of demolished materials. Do not allow demolished materials to accumulate on-site.

B. Burning: Do not burn demolished materials.

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

END OF SECTION 02070
SECTION 03300 – CAST-IN-PLACE CONCRETE

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and General Provisions of Contract, including Special Conditions and Division 1 Specification Sections, apply to this Section.

1.2 SUMMARY

A. This Section specifies cast-in-place concrete, including reinforcement, concrete materials, mix design, placement procedures, and finishes.

1.3 SUBMITTALS

A. General: In addition to the following, comply with submittal requirements in ACI 301.

B. Product Data: For each type of manufactured material and product indicated.

C. Design Mixes: For each concrete mix.

1.4 QUALITY ASSURANCE

A. Installer Qualifications: An experienced installer who has completed concrete work similar in material, design, and extent to that indicated for this Project and whose work has resulted in construction with a record of successful in-service performance.

B. Manufacturer Qualifications: A firm experience in manufacturing ready-mixed concrete products complying with ASTM C94 requirements for production facilities and equipment.

C. Source Limitations: Obtain each type of cement of the same brand for the same manufacturer’s plant, each aggregate from one source, and each admixture from the same manufacturer.

D. Comply with ACI 301, “Specification for Structural Concrete,” including the following, unless modified by the requirements of the Contract Documents.

1. General requirements, including submittals, quality assurance, acceptance of structure, and protection of in-place concrete.
2. Steel reinforcement and supports.
3. Concrete mixtures.
4. Handling, placing, and constructing concrete.

PART 2 - PRODUCTS

2.1 STEEL REINFORCEMENT

A. Reinforcing Bars: ASTM A615/A 615M, Grade 60 (Grade 420), deformed.

B. Plain-Steel Wire: ASTM A82, as drawn.

2.2 CONCRETE MATERIALS

A. Portland Cement: ASTM C150, Types I or II.

B. Normal-Weight Aggregate: ASTM C33, uniformly graded, not exceeding 1-1/2" nominal size.

C. Water: Potable and complying with ASTM C94.

2.3 ADMIXTURES

A. General: Admixtures certified by manufacturer to contain not more than 0.1% water-soluble chloride ions by mass of cement and to be compatible with other admixtures. Do not use admixtures containing calcium chloride.

B. Water-reducing Admixture: ASTM C494, Type A.

C. High-range, Water-reducing Admixture: ASTM C494, Type F.

D. Water-reducing and Accelerating Admixture: ASTM C494, Type E.

E. Water-reducing and Retarding Admixture: ASTM C494, Type D.

2.4 CURING MATERIALS

A. Absorptive Cover: AASHTO M 182, Class 2, burlap cloth made from jute or kenaf, weighing approximately 9 oz./sq. yd. dry.

B. Moisture-retaining cover: ASTM C171, polyethylene film or white burlap-polyethylene sheet.
2.5 CONCRETE MIXES

A. Comply with ACI 301 requirements for concrete mixtures.

B. Prepare design mixes, proportioned according to ACI 301, for normal-weight concrete determined by either laboratory trial mix or field test databases, as follows:
   2. Slump: 4".

2.6 CONCRETE MIXING

A. Ready-mixed Concrete: Comply with ASTM C94 and ASTM C1116.

   1. When air temperature is between 85 and 90°F, reduce mixing and delivery time from 1-1/2 hours to 75 minutes; when air temperature is above 90°F, reduce mixing and delivery time to 60 minutes.

PART 3 - EXECUTION

3.1 STEEL REINFORCEMENT

A. Comply with CRSI “Manual of Standard Practice” for fabricating, placing, and supporting reinforcement.

3.2 CONCRETE PLACEMENT

A. Comply with recommendations in ACI 304R for measuring, mixing, transporting, and placing concrete.

B. Do not add water to concrete during delivery, at Project site, or during placement.

3.3 FINISHING UNFORMED SURFACES

A. General: Comply with ACI 302.1R for screeding, restraightening, and finishing operations for concrete surfaces. Do not wet concrete surfaces.

3.4 TOLERANCES

3.5 CONCRETE PROTECTION AND CURING

A. General: Protect freshly placed concrete from premature drying and excessive cold or hot temperatures. Comply with ACI 306.1 for cold-weather protection, and follow recommendations in ACI 305R for hot-weather protection during curing.

B. Evaporation Retarder: Apply evaporation retarder to concrete surfaces if hot, dry, or windy conditions cause moisture loss approaching 0.2 lb/sq. ft. x h before and during finishing operations. Apply according to manufacturer’s written instructions after placing, screeding, and bull floating or darbying concrete, but before float finishing.

C. Begin curing after finishing concrete, but not before free water has disappeared from concrete surface.

D. Curing Methods: Cure formed and unformed concrete for at least 7 days by moisture curing, moisture-retaining-cover curing, curing compound, or a combination of these as follows:

1. Moisture Curing: Keep surfaces continuously moist for not less than 7 days with the following materials:
   a. Water.
   b. Continuous water-fog spray.
   c. Absorptive cover, water saturated and kept continuously wet. Cover concrete surfaces and edges with 12” lap over adjacent absorptive covers.

2. Moisture-retaining-cover Curing: Cover concrete surfaces with moisture-retaining cover for curing concrete, placed in widest practicable width, with sides and ends lapped at least 12”, and sealed by waterproof tape or adhesive. Immediately repair any holes or tears during curing period using cover material and waterproof tape.

3.6 FIELD QUALITY CONTROL

A. Testing Agency: Owner will engage in qualified independent testing and inspecting agency to sample materials, perform tests, and submit test reports during concrete placement. Tests will be performed according to ACI 301.

1. Testing Frequency: Obtain one composite sample for each day’s pour of each concrete mix less than 25 cu. yd., plus one set for each additional 50 cu. yd. or fraction thereof.
3.7 REPAIRS

A. Remove and replace concrete that does not comply with requirements in this Section.

END OF SECTION 03300
SECTION 15010 - MECHANICAL GENERAL PROVISIONS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

B. This Section forms a part of all Division 15 Sections.

1.2 APPLICABLE SPECIFICATIONS, CODES, AND STANDARDS

A. Latest effective publications of following Specifications, regulations, standards, codes, etc., as applicable, form a part of these Specifications the same as if written fully herein and shall be followed as minimum requirements.

Codes and ordinances of local governing agencies

AMCA Air Moving and Conditioning Association
ANSI American National Standard Institute
ASHRAE American Society of Heating, Refrigerating, and Air-conditioning Engineers
ASME American Society of Mechanical Engineers
ASTM American Society for Testing and Materials
IEEE Institute of Electrical and Electronics Engineers
NAFM National Association of Fan Manufacturers
NEC2005 National Electrical Code
NEMA National Electrical Manufacturers Association
NFPA National Fire Protection Association
OSHA Occupational Safety and Health Administration
SMACNA Sheet Metal and Air-conditioning Contractors National Association
UFAS Uniform Federal Accessibility Standards
UL Underwriters Laboratories, Inc.
VFSR Virginia Fire Safety Regulations
VUSBC Virginia Uniform Statewide Building Code, 2006 Edition
1.3 DRAWINGS

A. General arrangements of indicated piping, ductwork, and equipment are diagrammatic only, do not scale. Where rearrangement is necessary, submit drawings of proposed changes for approval. Due to scale of drawings, offsets, fittings, and accessories may not be indicated. Work indicated, but having details omitted, shall be provided complete to perform function intended without extra cost. Investigate structural and finish conditions in building affecting plumbing, heating, ventilating, and air-conditioning work, etc., and arrange work accordingly. Furnish fittings, traps, vents, valves, and accessories required. Install equipment in accordance with manufacturer’s recommendations and clearance requirements.

1.4 COORDINATION

A. Coordinate piping, ducts, and equipment with electrical plans and work in order to avoid omissions and to eliminate any interference. Report in writing discrepancies, if found, to the Engineer as soon as possible after discovery.

1.5 WORKMANSHIP

A. Workmanship shall be first class and of best quality in accordance with approved contemporary construction practices. Defective equipment and materials, or material damaged in the course of installation and tests, shall be replaced or repaired in an approved manner.

1.6 CUTTING

A. Cutting shall be carefully done. Repair damage to the building, piping, wiring, or equipment as a result of cutting for installation, using skilled mechanics of trade involved.

1.7 APPROVAL OF MATERIALS, FIXTURES, AND EQUIPMENT

A. See Specification Section 01300, “Submittals,” for shop drawing submittal procedures. Within 30 days after award of the Contract and before any purchases are made, submit for approval a complete list of materials, fixtures, and equipment proposed, together with names of manufacturers and catalog numbers for each Specification Section. Furnish other detailed information where directed. No consideration will be given to partial lists submitted from time to time. Approval of materials shall be based on manufacturer’s published ratings. Materials, fixtures, and equipment listed which are not in accordance with specified requirements shall be rejected. Contractor shall make resubmission of items not approved within 30 days from date of rejections. Submission shall be complete with description, ratings,
dimensions, and related items and any additional information required by the Engineer.

B. Materials and equipment shall be new, conforming to these Specifications.

C. Two or more units of same class of equipment shall be product of single manufacturer; however, component parts of system need not be product of same manufacturer.

D. Mechanical design has given full consideration to space requirements for equipment specified. Contractor is responsible for selecting equipment that will be accommodated by this space. Equipment not conforming to space allotted shall be rejected.

E. Mechanical design has given full consideration for electrical requirements for equipment. Contractor is responsible for selecting equipment that will be accommodated by the electrical design indicated. Equipment not conforming to the electrical design provided under Division 16 is the Contractor’s responsibility. All electrical changes required to accommodate the equipment provided shall be furnished and installed by the Contractor without change in Contract price or time of completion. This shall include but not be limited to wiring, conduit, circuit breakers, disconnect switches, starters, and controllers.

F. Submit one copy of equipment installation manuals to the Engineer for his use.

1.8 EQUIPMENT DESIGN

A. Equipment and accessories not specifically described or identified by manufacturer’s catalog numbers shall be designed in conformity with ASME, ANSI, IEEE, or other applicable technical standards, suitable for maximum working pressure, and shall have neat and finished appearance.

1.9 SUPERVISION

A. The Contractor for each Section under this Division shall maintain a competent foreman on the job at all times to supervise the work and coordinate with other trades for the installation of the system. Submit foreman’s qualifications, including master’s trade license, to the Engineer for approval.

1.10 NOTICES AND FEES

A. Give all required notices, obtain all necessary permits (including a separate permit for the installation of refrigerant lines if required by the local “Authority Having Jurisdiction”), and pay all required fees.
1.11 RECORD DRAWINGS

A. Refer to Specification Section 01720 “Project Record Documents”.

1.12 OPERATION AND MAINTENANCE MANUALS

A. Refer to Specification Section 01730 “Operation and Maintenance Data”.

1.13 OWNER’S TRAINING

A. Upon completion of work and at a time designated by the Owner, the services of competent persons shall be provided as required to instruct Owner’s representative in operation and maintenance of systems.

1.14 WARRANTY-GUARANTEE

A. Contractor shall furnish written warranty, countersigned and guaranteed by the General Contractor, stating that work executed under this Section of the Specifications shall be free from defects of materials and workmanship for a period of 12 months from date of Final Acceptance.

B. Contractor shall service the systems for 12 months from date of Final Acceptance. Such service shall include all emergency services and adjustments, except cleaning of filters and screens.

1.15 WELDER’S CERTIFICATIONS

A. Submit welder’s certifications to the Engineer/Architect for approval.

PART 2 - PRODUCTS

2.1 STEEL PIPE FITTINGS

A. Welding fittings shall be carbon-steel buttwelding type, conforming to ASME B16.9 and B16.28. Flanges shall be carbon steel, conforming to ANSI B16.5.

B. In lieu of welding fittings, BONNEY FORGE “Weldolets,” “Sockolets,” and “Threadolets” may be used for branch connections when the diameter of the branch connection does not exceed 50% of the diameter of the main.

C. Copper piping shall be assembled with wrought-copper fittings using 95-5 solder.
2.2 PIPE SLEEVES, PIPE HANGERS, PIPE SUPPORTS, DUCT SUPPORTS, AND FIXTURE SUPPORTS

A. Provide pipe sleeves, hangers, supports, duct supports, and fixture supports. Contractor shall be responsible for proper and permanent location. Pipe and duct shall not be permitted to pass through footings, beams, or ribs, unless indicated and/or approved.

B. Install pipe sleeves and properly secure in place with grout where pipes pass through masonry or concrete and at all fire-rated assemblies. Pipe sleeves, except in footings, shall be sufficient diameter to provide approximately 1/4" clearance around insulation or pipe. Fill void between insulation or pipe and sleeve with mineral wool to prevent sound transmission. Pipe sleeves in footings or foundation walls shall be cast iron, 4" larger in diameter than pipe installed. Pipe sleeves in walls, floors, and partitions shall be Schedule 40 steel pipe. Extend sleeves above floor at least 1", pack space around pipe with fireproof material, and make watertight. Where pipes pass through waterproofing membranes, provide flashing sleeves with integral flashing flanges or clamping device of 16-ounce soft-sheet copper; extend at least 8" from sleeve. Thoroughly mop flashing flanges and shields into membrane.

C. Hang horizontal overhead runs of pipe with adjustable clevis-type hangers spaced not over 10 feet apart. Provide hangers other than aforementioned, if pipe size or other features make spacing at shorter intervals necessary. Pipe hangers shall be provided within 4 feet of all changes in direction of pipe. Pipe hangers shall not be installed on pipe fittings where fitting could bear the weight of connected pipe but instead shall be installed on pipe at intervals previously specified. Chain, strap, perforated bar, or wire hanger will not be permitted. Hangers shall have short turnbuckles or approved means of adjustment. Use spring-type hangers where required. Use trapeze hangers on pipes running parallel and close together. Hangers, including rods and clamps, shall be galvanized except as otherwise specified.

D. Submit all hangers and accessories to the Engineer for approval. Other materials installed without approved shop drawings shall be rejected.

E. Hanger supports for piping, ductwork, and equipment, where suspended from ceilings, shall be in accordance with these Specifications. Supports from structural tee slabs shall be located and installed only as approved by the Engineer. Supports for piping, ductwork, and equipment shall be attached to a structural member, not bridging.

F. In areas supported by steel beams, secure hanger rods directly to beams.
MECHANICAL GENERAL PROVISIONS

G. Beam clamps shall be permitted to be attached to the bar joist provided that they do not exceed 150 lbs per hanger.

H. Provide galvanized steel shields or protection saddles to protect insulation at area of contact with hangers and supports. Where shields are used on pipes 1-1/2" and larger, provide insulation inserts at points of hangers and supports. Refer to Section 15250 for details.

I. Support and fasten fixtures and equipment in an approved manner.

J. Piping, ductwork, and equipment shall not be attached to structural joist bridging or metal roof decking. Provide additional steel supports spanning between joists or beams for hanger attachments. Additional steel supports shall be approved by the Structural Engineer.

K. Ductwork shall be supported in accordance with SMACNA, HVAC Duct Construction Standards, unless otherwise noted or indicated. Ductwork shall be supported using threaded rod or solid metal strap as required by SMACNA. No other materials, such as perforated metal strap, or cloth strap, are acceptable. Wire may be used to hang round duct smaller than 10"; however, solid metal strap shall be used to wrap around duct. Wire shall not be used for rectangular duct or round duct larger than 10".

2.3 UNIONS

A. Unions shall be installed on each side of all control valves and similar items and one side of all pieces of equipment, such as pumps, etc., so that such equipment shall be readily disconnected and removed if necessary.

2.4 DIELECTRIC CONNECTIONS

A. Dielectric connections shall be provided at all connections between ferrous and nonferrous piping or metals, except drain piping connections at drain pans for cooling coils and valves having cast-bronze adapters.

2.5 ELECTRICAL WORK FOR EQUIPMENT UNDER MECHANICAL SYSTEMS

A. All non-integrated motor controllers and starters serving equipment installed under Division 15 Sections shall be furnished under those Sections and shall be turned over to Electrical Contractor, for installation by Electrical Contractor. Controllers shall be equipped with all auxiliary contacts, poles, or devices necessary to permit interlocking and control required.
B. Motors larger than 1/2 HP shall be 3-phase, 60 cycles, of voltages indicated on the electrical drawings, and conforming to the electrical service, except where indicated otherwise. Motors shall conform to latest NEMA requirements.

C. All electrical power wiring required for equipment installed under Division 15 Sections shall be provided under Division 16 Sections with all necessary approved wiring diagrams and guidance provided under Division 15 Sections, with the exception of power wiring to Automatic Temperature Control panels which shall be provided by the Automatic Temperature Control Contractor.

D. Raceways shall be 1/2" minimum. All wiring in rooms with exposed structure shall be installed in conduit. Label the front face of the cover on each junction box with indelible black marker indicating the number of each circuit contained in or running through the box. In areas where exposed construction is the final finished condition and conduit and junction boxes are called out to be painted, label the inside face of the covers.

E. All control and power wiring required for temperature control system and all interlocking and accessory control wiring required for equipment installed under Division 15 Sections shall be installed by the Plumbing, Mechanical, and Temperature Control Contractors.

F. Three-phase motors shall have magnetic across-the-line starters unless hereinafter indicated or required by Power Company to be otherwise. Provide overload relay in each phase or motor lead. Operation of any overload relay shall simultaneously open all phases.

G. Manual starters shall be manual single-, double-, or three-pole type designed for flush or surface mounting, with overload protection in each phase.

H. Starters for motors under automatic control shall have built-in “hand-off-auto” selector switch.

I. Push-button stations shall have “start-stop” momentary contacts, having one normally open and one normally closed set of contacts, with indicating lights to indicate when motors are running. Stations shall be heavy-duty type designed for flush or surface mountings as required.

J. All starters and controls shall be NEMA rated and NEMA I enclosed where mounted inside building, except in kitchens which shall be NEMA 4X. Starters and controls mounted outside or where specifically called for shall be NEMA 3R. Explosion-proof enclosures shall be used in hazardous areas and where specifically called for. Combination switch and magnetic starters shall be provided where indicated.
K. Auxiliary 120-Volt contacts shall be provided to give control and interlocking as required or as indicated.

L. Where control voltages are different from motor voltages, a control-voltage transformer shall be provided as a part of the starter.

M. The Contractor shall be responsible for coordinating with the Division 16 Contractor for providing properly sized circuit breakers to serve equipment and motors furnished which differ from that specified or indicated. This shall be further understood to include branch circuit wiring, conduit, disconnect switches, etc., in accordance with the appropriate codes and specifications. The cost of providing this increased electrical service and related work shall be included under the applicable section under which the equipment and motors are being furnished, at no additional cost to Owner.

N. The Automatic Temperature Controls Contractor shall be responsible for providing circuit breakers and power wiring and conduit from electrical panels installed under Division 16 to Automatic Temperature Controls panels.

2.6 MACHINERY ACCESSORIES

A. Provide oil-level gages, grease cups, and grease-gun fittings for machinery bearings as recommended by machinery manufacturer; where these lubricating means are not easily accessible, extend to locations as directed. Furnish all grease-gun fittings of uniform type.

2.7 AIR BALANCING DEVICES

A. Furnish any additional material or equipment, such as sheaves, belts, motors, and balancing devices, required to complete and/or adjust and balance the systems as recommended by the TAB Agency at no additional cost to the Owner. Failure to provide additional means of adjusting and balancing will not relieve the Contractor of responsibility for properly adjusting and balancing the various systems as intended.

2.8 DUCT SEALANT

A. Where duct is indicated to be sealed, utilize a fire resistive, water based, indoor/outdoor, U.V. resistant, non-fibrated sealant, FOSTER DUCT-FAS 32-19 duct sealant or approved equal.

B. Sealant shall have a volatile organic compound (VOC) rating of 24 g/L, less water.
C. Sealant shall meet all SMACNA pressure classes up to 10” w.g. and SMACNA seal classes A, B, and C.

D. Apply sealant with brush working sealant into all joints. Follow manufacturer’s instructions for all application requirements.

E. The use of duct sealing tape of any kind is unacceptable.

PART 3 - EXECUTION

3.1 PIPE INSTALLATION

A. Pipe systems shall be complete. Pipe shall be of size indicated or, where not indicated, shall be of size required to produce capacities of the equipment specified. No pipe shall be buried in floors, unless specifically indicated or approved.

B. Install runs of piping as indicated. Cut pipe accurately to measurements established at the building by the Contractor and work into place without springing or forcing. Do not cut or move any structural portions of the building without approval. Run piping above ground, parallel with lines of buildings, unless otherwise shown or specified.

C. Install piping to allow for expansion and contraction, using offsets, swing joints, expansion joints, anchors, and related items as may be necessary. Make connections to coils, pumps, and other equipment in such manner as to eliminate undue strains in piping and equipment and to prevent noise transmission. Provide necessary fittings and bends to avoid springing of pipes during assembly. Weld expansion loops using long-radius ells. Make changes in pipe sizes with reducing fittings.

D. Pipe outlets of vent valves, safety valves, drip pans, overflow drains, condensate drains, and other drain points to floor drain unless otherwise indicated. Gages, thermometers, and related items shall be carefully leveled. Thoroughly clean and flush piping in presence of the Owner’s representative as installed and before automatic vents are installed.

E. Unless otherwise indicated, connections to equipment shall be as shown by manufacturer’s data. Make piping connections to equipment with unions or flanged connections arranged so that equipment can be dismantled without disturbing the piping installation. Unions shall be accessible after building is complete. Provide valves to isolate equipment for service or removal.

F. Run horizontal water piping with pitch of at least 1" in 40'-0" and arrange to drain to minimum number of low points. Equip low points with drain valves and hose
nipples not smaller than 3/4". Eccentric reducing fittings or eccentric reducing couplings must be installed where indicated or as required to bring bottoms of mains in line and prevent pockets.

G. Close pipe openings with caps or plugs during installation. Cover fixtures and equipment tightly and protect against dirt, water, and chemical or mechanical injury. Carefully free interior of pipe of superfluous material as work progresses. Upon completion of work, thoroughly clean fixtures, materials, and equipment and deliver in approved unblemished condition. Pitch closed loop water piping to vent at high points. Provide a manual air vent ball valve at all high points in the piping system.

H. Ream pipe after cutting and before threading and remove burrs. Make screwed joints with graphite and oil or approved graphite compound applied to threads only. Cut threads full, and not more than three threads on pipe shall remain exposed. Caulking of threaded joints to stop or prevent leaks will not be permitted. Provide unions where required for disconnection. Use swing joints for branch connections to risers and mains.

I. Make copper tubing sweat joints with noncorrosive flux and lead-free solder recommended for service encountered or as indicated.

J. The Contractor may, except at unions, weld pipe 2-1/2" and larger, using welding fittings. Welding material and labor shall be in accordance with welding procedure of Heating and Piping Contractor’s National Association or approved procedure conforming to ASME Power Boiler Code or ANSI Piping Code. Welders shall be fully qualified by an approved Welding Bureau or locally recognized testing authority. Welding shall be electric arc welding method. Welding of galvanized pipe inside the building shall not be permitted without approved ventilation.

3.2 EQUIPMENT INSTALLATION

A. Erect equipment in neat and workmanlike manner. Align, level, and adjust for satisfactory operation. Install so that connecting of piping and accessories can be made readily and so that parts are easily accessible for inspection, operation, maintenance, and repair. Minor deviation from indicated arrangements may be made as approved by Engineer.

3.3 EQUIPMENT SUPPORTS AND FOUNDATIONS

A. Design and construct supporting structures of strength to safely withstand stresses to which they may be subjected and to distribute properly the load and impact over building areas. Conform to applicable technical societies’ standards, also to codes and regulations of agencies having jurisdiction. Obtain approval before fabrication.
B. Where concrete foundations or pedestals are indicated or required, use concrete mix, reinforcement where required, and methods as specified under Section 03300, “Cast-In-Place Concrete.”

C. Finish exposed parts of concrete foundation with cement mortar. Fill voids, trowel smooth, bevel edges and corners to make neat appearance.

3.4 NOISE AND VIBRATION

A. Mechanical and electrical equipment shall operate without objectionable noise or vibration as determined by the Engineer.

B. If such objectionable noise or vibration should be produced and transmitted to occupied portions of building by apparatus, piping, ducts, or other parts of mechanical and electrical work, make necessary changes and additions as approved, without extra cost to the Owner.

C. Isolators shall prevent, as far as practicable, the transmission of vibration, noise, or hum to any part of building.

D. Isolators shall suit vibration frequency to be absorbed. Provide isolator units of area and distribution to obtain proper resiliency under load and impact.

3.5 PROTECTION OF EQUIPMENT AND MATERIALS

A. Responsibility for care and protection of mechanical equipment rests with Contractor until Substantial Completion of the work.

B. After delivery, before and after installation, protect equipment and materials against theft, injury, the environment, or damages from all causes.

C. Protect equipment outlets and pipe openings with temporary plugs or caps.

D. During construction, seal off all openings into interior of equipment and ductwork with sheet metal or taped polyethylene sheathing to prevent infiltration of dust.

E. Temporary filters shall be provided a minimum of every 14 days for all fans that are operated during construction, and new filters shall be installed after all construction dirt has been removed from the building just prior to Final Completion. Prior to Final Completion, ducts shall be inspected for dust and dirt. Contractor shall provide a signed statement to indicate that new filters for each piece of equipment were installed soon after Substantial Completion and before Final Completion. Construction filters shall be removed and not be used as the final set of filters.
Provide a written statement that includes equipment identifications and dates of filter installation to the Engineer for review.

F. Provide a spare filter (or sets of filters for equipment that require multiples) for each piece of equipment. Turn filters over to Owner with proper transmittal prior to Final Completion.

G. Equipment not designed for exterior installation (i.e., air handling unit) shall not be delivered to the job site until a location protected from the environment is provided. Location must be approved by the Architect and Engineer prior to delivery.

3.6 CONTRACTOR’S RESPONSIBILITY FOR TESTING, ADJUSTING, AND BALANCING (TAB)

A. Provide the TAB Agency a full set of Contract Documents (drawings and technical specifications), all manufacturers’ approved submittal data, and copies of revised data as soon as possible.

B. Ensure that a current TAB Engineer’s certification certificate is kept on file.

C. Ensure all systems have been installed and are in 100% working order before the TAB Engineer is called to the job site, including but not limited to ductwork, piping, terminals, electrical, and ATC. The Contractor shall verify that each item of the Pre-TAB Checklist (see Appendix A) has been completed, and shall deliver a signed copy of the Pre-TAB Checklist to the Owner’s Representative and the TAB Agency attesting that the project is complete and ready for TAB work to begin.

D. Ensure that all ductwork requiring SMACNA – ADLTM duct leakage testing has been tested in the presence of the TAB Engineer and Owner’s Representative and has met the referenced requirements.

E. Provide adequate access to all points of measurement and adjustment and ensure that all dampers operate freely.

F. Provide a factory representative for all major pieces of equipment as requested by the TAB Agency to assist in operation and performance verification of equipment.

G. Cooperate with the TAB Agency to help operate and adjust the control systems directly related to TAB work and provide any specialties required to make such adjustments.

H. Carefully review the drawings and Specifications for the various systems noting all facilities incorporated in the design for purposes of adjusting and balancing. Should
it be deemed necessary to provide additional dampers, baffles, valves, or other devices which would aid in the required adjusting and balancing, same shall be provided by the installing contractor.

3.7 CLEANING, PAINTING, AND IDENTIFICATION

A. Remove from site excess material, equipment protection, etc. Thoroughly clean piping, hangers, equipment, fixtures, and trimmings and leave every part in perfect condition ready for use, painting, or insulation as required.

B. Paint exterior surfaces of equipment supports and other ferrous metal work, except that which is galvanized, with one coat of RUSTOLEUM damp-proof red primer, or approved equal.

C. Exposed piping and equipment in main mechanical equipment room shall be completely painted under the requirements of Section 09900, "Painting."

D. Piping service and flow direction shall be indicated with vinyl labels which identify the service by name (not initials) and the flow direction by arrows. Labels shall be used wherever piping is exposed, except in finished spaces, and at all unit connections.

E. All new valves in equipment room(s) shall be identified with 1-1/2" diameter, permanently stamped, brass tags. Secure tags to valve item or wheel with brass jack chain or copper meter seals. Conform to Owner’s labeling format.

3.8 EQUIPMENT MARKING

A. Label all mechanical equipment, including starters, control panels, and air-handling units.

B. Labels shall be machine engraved, laminated, Bakelite, nameplate type. Labels shall be black faces with white letters.

C. Labels shall have 1/4" high letters.

D. Labels shall be rigidly attached using rivets or screws. Adhesive backing is not acceptable.
APPENDIX A

PRE-TAB CHECKLIST

A. GENERAL

1. All components of the HVAC system have been installed, including controls and control wiring.
2. Power wiring has been installed and energized to all motorized equipment. Also, all line voltage control wiring required has been installed.
3. All equipment has been started and run tested through all specified sequences of operation. Where specifications require start-up by factory-authorized representatives, this has been accomplished and all safety controls have been verified to be operational.
4. All required testing of piping and duct systems has been completed in accordance with the drawings and specifications.
5. Duct leakage testing, where required, shall be witnessed by the Owner’s Representative and/or the TAB Agency.

B. HVAC WATER DISTRIBUTION SYSTEMS

1. Piping systems have been flushed thoroughly, strainers have been removed, cleaned, and replaced as required. There is no evidence of plugged piping, coils, heat transfer equipment, valves, or flow measuring devices.
2. All air has been vented from the hydronic piping systems, equipment, and coils.
3. Pressure reducing/regulator valves in make-up water piping have been set for the required fill pressure of each hydronic system.
4. Correct pump rotation has been verified. Pumps are not cavitating. Vibration isolators and flexible connectors have been installed where required. Vibration is not excessive with pumps operating. Pumps have been lubricated.
5. All control valves are installed and functioning properly according to the specified sequences of operation.
6. All required pressure, temperature, and flow measuring devices and balancing valves have been installed. All taps and adjustment dials are accessible and adequate clearances have been provided for connection of instrument hoses and adjustment taps, dials, and scales are free of paint, insulation mastic, and other foreign matter.
7. System contains correct amount of water treatment chemicals and glycol where required.
C. AIR DISTRIBUTION AND VENTILATION SYSTEMS

1. All air system filters have been replaced with new filters. The air moving equipment, ductwork, and air terminals are installed and connected. All air systems are unobstructed and free of debris.

2. All manual volume control dampers required are installed and properly connected to adjustment handles. All damper handles are accessible and not covered by insulation or draw bands. All automatic dampers required have been installed with linkages connected and adjusted to provide the specified sequence of operation.

3. Access doors have been installed where required to allow inspection and servicing of duct-mounted dampers, equipment, and components.

4. All ductwork and connections of duct to air terminals have been checked, and no visible or audible leakage exists.

5. Fans are rotating in correct direction. Fans have been lubricated. Drive pulleys are aligned and belt tension is correct. Setscrews are tight securing keys into key-ways. Fan wheels turn freely and are balanced. Belt guards are in place.

6. Vibration isolators and flexible connectors have been installed where required. With fans in operation, there is no excessive vibration of fan assemblies or ductwork.

I, ______________________, an authorized representative of ______________________, (Signature and Title) (Company)

attest that all items contained in the above Pre-Tab Checklist have been completed and verified as of this date: ______________________.
SECTION 15250 - MECHANICAL INSULATION

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions, Division 1 Specification Sections, and Section 15010, “Mechanical General Provisions,” apply to this Section.

1.2 SUBMITTALS

A. Submit manufacturers’ data on all insulation products, schedule which indicates where each product is to be used, and thickness of each product.

1.3 WARRANTY-GUARANTEE

A. Contractor shall furnish written warranty, countersigned and guaranteed by the General Contractor, stating that work executed under this Section of the Specifications shall be free from defects of materials and workmanship for a period of 12 months from date of Substantial Completion.

PART 2 - PRODUCTS

2.1 INSULATION - GENERAL

A. All insulation shall have a composite (insulation, jacket or facing, and adhesive used to adhere the facing or jacket to the insulation) fire and smoke rating as requested by ASTM E84, NFPA 255, and UL 723, not exceeding:

Flame spread 25
Smoke developed 50

B. Accessories, such as adhesive, mastics, cements, tapes, and fire-resistant cloth for fittings, shall have same fire and smoke ratings as components listed above.

C. Installation of insulation shall be accomplished in strict accordance with manufacturer’s recommendations and shall be CERTAINTEED, OWENS-CORNING, or JOHNS MANVILLE for glass fiber insulation.
2.2 PIPE INSULATION
   A. Glass fiber insulation having a thermal conductivity not greater than 0.24 Btu x in./hr. x sq.ft. x °F in a mean temperature of 75°F. Insulation shall have factory-applied all-purpose jacket.

2.3 DUCT INSULATION
   A. Board Type: Glass fiber, 3.0-lbs./cu.ft., foil faced, vapor-sealed board insulation. Thermal conductivity shall not exceed 0.23 Btu x in./hr x sq.ft. x °F.

2.4 CALCIUM SILICATE PIPE INSULATION INSERTS
   A. Calcium silicate meeting ASTM C533, Type I; rigid molded pipe; asbestos-free JOHN MANVILLE Thermo-12/Gold, or approved equal.
   B. Thermal conductivity of 0.45 Btu at 300°F mean temperature as tested in accordance with ASTM C335.
   C. Minimum compressive strength of 100 psi to produce 5% compression at 1-1/2" thickness.
   D. Non-combustible as determined by test complying with ASTM E136.
   E. Inserts shall have sufficient compressive strength to adequately support the pipe without compressing the inserts to a thickness less than the adjacent insulation. Insulation inserts shall cover the bottom half of the pipe circumference 180 degrees and be not less in length than the protection shield. Vapor-barrier facing of the insert shall be of the same material as the facing on the adjacent insulation.

2.5 PVC PIPE JACKET FITTING COVERS
   A. One-piece molded-type PVC plastic fitting covers and jacketing material, color matching JOHN MANVILLE Zeston 2000, or approved equal.
   B. Connections shall be made using pressure-sensitive color matching vinyl tape.
PART 3 - EXECUTION

3.1 INSTALLATION

A. Insulation shall be installed by a licensed applicator and in strict accordance with the manufacturer’s instructions. Deliver all materials to the job site and store in a safe, dry place. Use all means necessary at the job site to protect materials from dust, dirt, moisture, and physical abuse before and during installation. Insulation that becomes damaged prior to installation shall not be installed and shall be removed from the job site. Insulation that becomes damaged after installation shall be removed and disposed of and replaced with new insulation.

B. Surfaces to be insulated shall be cleaned free of dirt, scale, moisture, oil, and grease prior to installation of the insulation.

C. Insulation that becomes wet before or after installation shall be removed and disposed of and replaced with new insulation.

D. Provide new insulation for all new piping, ductwork, and equipment and for all existing piping and ductwork where existing insulation is disrupted by the work of this contract.

3.2 PIPING (GLASS FIBER INSULATION, UNLESS OTHERWISE NOTED)

A. Schedule:

<table>
<thead>
<tr>
<th>Application</th>
<th>Thickness</th>
</tr>
</thead>
<tbody>
<tr>
<td>Chilled Water</td>
<td>1&quot; thickness for pipe sizes up to 1-1/2&quot;, and 1-1/2&quot; thickness for pipe sizes over 1-1/2&quot;.</td>
</tr>
<tr>
<td>Hot Water Heating</td>
<td>1&quot; thickness for pipe sizes up to 1-1/2&quot;, and 2&quot; thickness for pipe sizes over 1-1/2&quot;.</td>
</tr>
<tr>
<td>Condensate Drain</td>
<td>1/2&quot; thickness</td>
</tr>
<tr>
<td>Above Floor</td>
<td></td>
</tr>
</tbody>
</table>

B. Fittings and valves on insulated piping smaller than 4" shall be insulated with fiberglass blanket to thickness equal to adjoining pipe insulation unless otherwise noted. Fittings and valves for insulated piping 4" and larger shall be insulated with segments of molded insulation, secured in place. On all fittings and valves, insulation shall be finished with a preformed PVC jacket.

C. All valves and piping accessories above ceilings handling cold or chilled water piping shall be completely insulated to prevent condensation.
D. No piping shall be insulated until it has been tested and thoroughly cleaned.

E. Provide calcium silicate insert between pipe hanger support shield and piping on piping 1-1/2" diameter or larger. Insulation inserts shall not be less in length than the following:

- 1-1/2" to 2-1/2" pipe size 10" long
- 3" to 6" pipe size 12" long

F. Hangers and supports for chilled water piping shall not injure or pierce insulation.

3.3 DUCTWORK

A. Definitions:

1. Exposed: Ductwork which is permanently in view, typically found in mechanical, storage, electrical, or other unfinished space.

B. Schedule:

- Exposed Supply, Return and Outside Air Ductwork 1-1/2" thickness rigid board
- Externally Insulated

- Factory Insulated Casings Not Required
- And Plenums:

C. Insulation on ductwork over 16" in height or width must be attached with stick pins. When using self-adhesive pins, prepare surface to be applied to ensure adhesion.

D. Tape all edges of insulation to ensure that no insulation is exposed.

END OF SECTION 15250
SECTION 15800 - HEATING, VENTILATING, AND AIR CONDITIONING

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions, Division 1 Specification Sections, and Section 15010, “Mechanical General Provisions,” apply to work of this Section.

1.2 SUBMITTALS

A. Submit manufacturer’s data on all products specified below or indicated on drawings. Include fan and pump curves with operating point plotted on curve. Include sound power data for eight octave bands and NC data, where specified, for HVAC equipment and system components. All sound power data shall be certified in accordance with AMCA-300.

1.3 PROTECTION OF EQUIPMENT, DUCTWORK, AND MATERIAL

A. All equipment, ductwork, and material not specifically designed for exterior installation shall not be delivered to the job site until an indoor, dry location is available for storage. All equipment, ductwork, and material shall be covered and protected from dirt, debris, moisture, paint, coatings, and damage of any kind. Store off of the floor on wood pallets.

B. All air-conveying equipment, ductwork, and material, including but not limited to air-handling units, fans, ductwork, plenums, and all coils, shall be kept clean as described above, and all airside surfaces shall be wiped clean (metal surfaces) or vacuumed clean prior to installation. Where air-handling equipment and ductwork surfaces are subject to additional accumulation of dirt and debris, interior and exterior cleaning shall be done prior to Substantial Completion.

C. Exterior surfaces of all equipment shall be cleaned at completion of construction in a manner that condition and appearance of equipment is the same as it left the factory.

1.4 WARRANTY-GUARANTEE

A. Contractor shall furnish written warranty, countersigned and guaranteed by the General Contractor, stating that work executed under this Section of the Specifications shall be free from defects of material and workmanship for a period of 12 months from date of Substantial Completion. Refer to Section 15010 for additional warranty period responsibilities.
PART 2 - PRODUCTS

2.1 HEAT GENERATION – Not Used

2.2 REFRIGERATION – Not Used

2.3 AIR HANDLING EQUIPMENT

A. Air Handling Unit (AHU-1):

1. General:
   a. Units shall be type, size, and have capacities as indicated on the drawings.
   b. Units shall be manufactured in modules of dimensions indicated on drawings. Units shall be shipped broken down into appropriately sized sections to allow passage through doorways and other obstructions. Dimensions of all components are critical and units with deviations from the specified dimensions will not be accepted.
   c. The basis of design manufacturer is TRANE. Alternative manufacturers that may be accepted upon review by the Engineer are MCQUAY and YORK if in full compliance with these specifications, drawings, and critical dimensions as determined by the Engineer.

2. Unit Construction:
   a. Casing Construction:
      (1) All unit panels shall be 2-inch solid, double-wall construction to facilitate cleaning of unit interior. Unit panels shall be provided with a mid-span, no through metal, internal thermal break. Casing thermal performance shall be such that under 55°F supply air temperature and design conditions on the exterior of the unit of 81°F dry bulb and 73°F wet bulb, condensation shall not form on the casing exterior.
      (2) All exterior and interior AHU panels will be made of galvanized steel.
      (3) The casing shall be able to withstand up to 8 inches of w.g. positive or negative static pressure. The casing shall not exceed 0.0042 inch deflection per inch of panel span at 1.5 times design static pressure up to a maximum of +8 inches w.g. in all positive pressure sections and -8 inches w.g. in all negative pressure sections.

   b. Drain Pans: All cooling coil sections shall be provided with an insulated,
double-wall stainless steel drain pan. To address indoor air quality (IAQ), the drain pan shall be designed in accordance with ASHRAE 62.1 being of sufficient size to collect all condensation produced from the coil and sloped in two planes promoting positive drainage to eliminate stagnant water conditions. The outlet shall be located at the lowest point of the pan and shall be sufficient diameter to preclude drain pan overflow under any normally expected operating condition. All drain pan threaded connections shall be visible external to the unit. Drain connections shall be of the same material as the primary drain pan and shall extend a minimum of 2-1/2 inches beyond the base to ensure adequate room for field piping of condensate drain traps. Coil support members inside the drain pan shall be of the same material as the drain pan and coil casing. Heating coil access and mixing sections will provide an IAQ drain pan.

c. Access Doors:

(1) Access doors shall be 2-inch double-wall construction. Interior and exterior door panels shall be of the same construction as the interior and exterior wall panels, respectively.

(2) All doors downstream of cooling coils shall be provided with a thermal break construction of door panel and door frame.

(3) Gasketing shall be provided around the full perimeter of the doors to prevent air leakage.

(4) Door hardware shall be designed to prevent unintended closure. Access doors shall be hinged and removable for quick, easy access. Hinges shall be interchangeable with the door handle hardware to allow for alternating door swing in the field to minimize access interference due to unforeseen job site obstructions. Door handle hardware shall be adjustable and visually indicate locking position of door latch external to the section.

(5) All doors shall be a minimum of 60 inches high when sufficient height is available, or the maximum height allowed by the unit height.

(6) Door handles will be provided for each latching point of the door necessary to maintain the specified air leakage integrity of the unit. Optionally, a single-handle door shall be provided for all outward swinging doors linked to multiple latching points necessary to maintain the specified air leakage integrity of the unit.

d. AF Fan: The fan shall be a double-width, double-inlet, multi-blade-type, airfoil (AF) fan. The fan shall be equipped with self-aligning, antifriction bearings. Fan performance shall be certified as complying with AHRI Standard 430.

e. Fan Isolation: All fans, including direct-drive plenum fans, shall be mounted on isolation bases and isolated from the unit casing by a flexible
connection.

f. Fan Motors: The motor shall be integrally mounted to an isolated fan assembly furnished by the unit manufacturer. The motor shall be mounted inside the unit casing on an adjustable base to permit adjustment of drive-belt tension.

g. Horizontal and Vertical Coil Sections: The coil section shall be provided complete with coil and coil holding frame. Coil section side panels shall be easily removable to allow for removal and replacement of coils without impacting the structural integrity of the unit. The coil shall be installed such that headers and return bends are enclosed by unit casings. If two or more cooling coils are stacked in the unit, an intermediate drain pan shall be installed between each coil. Like the primary drain pan, the intermediate drain pan shall be designed being of sufficient size to collect all condensation produced from the coil and sloped to promote positive drainage to eliminate stagnant water conditions. The intermediate pan shall begin at the leading face of the water-producing device and be of sufficient length extending downstream to prevent condensate from passing through the air stream of the lower coil. Intermediate drain pan shall include downspouts to direct condensate to the primary drain pan. The outlet shall be located at the lowest point of the pan and shall be sufficient diameter to preclude drain pan overflow under any normally expected operating condition.

h. Water Coils: The coils shall have aluminum fins and seamless copper tubes. Fins shall have collars drawn, belled, and firmly bonded to tubes by mechanical expansion of the tubes. The coil casing shall be stainless steel. The coils shall be proof-tested to 300 psig and leak-tested under water to 200 psig. Coil performance data and coils containing water shall be certified in accordance with AHRI Standard 410.

i. Base Rail: Unit base shall be constructed of all welded structural steel designed to protect the integrity of the case during lifting. Integral lifting lugs shall be provided. Base of unit shall be protected with corrosion-resistant coating.

j. Pleated Media Filters: The filters shall be 2-inch. Filters shall be capable of operating up to 625-fpm face velocity without loss of filter efficiency and holding capacity. The filters shall have a MERV 8 rating when tested in accordance with the ANSI/ASHRAE Standard 52.2.

k. Access/Inspection Sections: A section shall be provided to allow additional access/inspection of unit components and space for field-installed components as needed. The section length shall be variable to accommodate specific access, spacing, or dimensional requirements. An access door shall be provided for easy access. All access sections shall be complete with a double-wall, removable door downstream for inspection, cleaning, and maintenance. Interior and exterior door panels shall be of
the same construction as the interior and exterior wall panels, respectively. All doors downstream of cooling coils shall be provided with a thermal break construction of door panel and door frame.

2.4 UNITARY EQUIPMENT (Not Used)

2.5 TERMINAL EQUIPMENT (Not Used)

2.6 HVAC PIPING AND SPECIALTIES

A. Piping:

1. Chilled and hot water piping shall be Schedule 40 black steel. Piping 2-1/2" and over shall be fabricated by welding using Schedule 40 steel welding fittings.
2. Condensate drain piping within building shall be Type L copper tubing assembled with wrought-copper soldering fittings using 95—5 solder.
3. Pitch piping to vent at high points.
4. Provide accessible drains at low points.

B. Valves:

1. Valves 2-1/2" size and over shall be iron-body, bronze-mounted with flanged ends, except where specifically indicated. Catalog numbers indicated below are NIBCO. Valves with equivalent characteristics by MILWAUKEE, LUNKENHEIMER, or CRANE COMPANY are acceptable.

<table>
<thead>
<tr>
<th>Size</th>
<th>Pipe Material</th>
<th>Butterfly</th>
</tr>
</thead>
<tbody>
<tr>
<td>2-1/2&quot; and over</td>
<td>Copper/Steel</td>
<td>LD-2000-5</td>
</tr>
</tbody>
</table>

2. Balancing valves 2-1/2" and larger shall be butterfly valves as specified below. Valves shall be complete with memory stops and extended shafts.
3. Butterfly valves shall be lug type and suitable for dead-end service, 200 psig, bubble-tight shutoff, and 250°F service. Disc shall be nickel-coated iron with 416 stainless-steel extended shaft and bronze bearings. Seat shall be EPDM. Provide lever actuators with ten positions with memory stops. NIBCO, or approved equal. Valve sizes 6" and above shall be provided with gear operators.

D. Automatic Balancing Valves:

1. Provide NuTech Model AB, or approved equal, measuring and balancing valves where indicated for pipe sizes 1/2" to 12".
2. The GPM for the automatic flow control valves shall be factory set and shall automatically limit the rate of flow to within 5% of the specified amount.
3. For 1/2" - 2", the flow cartridge shall be removable from the Y-body housing without the use of special tools to provide access for cartridge change out, inspection, and cleaning without breaking the main piping. (Access shall be similar to that provided for removal of a Y-strainer screen).

4. True operating range of 2 - 32 psid required. The design flow should be achieved at the minimum psi differential. A 50% safety factor applied to the lower operating range is not acceptable.

5. Each valve shall have two P/T ports.

6. All automatic flow control devices shall be supplied by a single source.

7. Five-year product warranty and free first year cartridge exchange.

8. The internal wear surfaces of the valve cartridge must be Ultrason® composite or stainless steel.

9. The flow cartridge design shall incorporate a stainless steel spring which requires no adjustment screw or shims. A crimped sheet-metal design is not acceptable.

10. The internal flow cartridge shall be permanently marked with the GPM.

11. For 1/2" through 2" pipe sizes: The valve shall consist of a brass Y-type body, O-ring-type union, and integral brass body ball valve with memory stop. The ball valve ID shall be minimum standard port (one size smaller than valve connection size) Reduced port valves are not acceptable. NuTech Model AB, or approved equal.

12. For 2-1/2" and larger flanged connections: Ductile-iron body suitable for mounting wafer style between standard 150# or 300# flanges. The long flange bolts and nuts shall be provided with each automatic flow control valve. NuTech Model AW or approved equal.

13. All valves shall be factory leak tested at 100 psi air under water.

14. Ratings: 2-1/2" through 12" pipe size: 600 PSIG at 250°F

15. Where indicated on the plans, the differential pressure across the automatic flow control valve shall be measured for flow verification and to determine the amount of system over-heading or under-pumping. Where over-heading exist the ball valve shall be throttled to bring the flow cartridge back within the control range. The valve memory stop shall be set so the valve can be used for isolation and reopened to the balanced position.

16. The flow shall be verified by measuring the differential pressure across the coil served or the wide-open temperature control valve and calculating the flow using the coil or valve $C_v$.

17. A differential pressure test kit shall be supplied to verify flow and measure over-heading. The kit shall consist of a 4-1/2" diaphragm gauge equipped with 10-foot hoses and P/T adapters, all housed in a vinyl case. Calibration shall be 0-35 PSID for 2-32 PSI spring range or 0-65 PSID for 5-60 PSI range.

18. Install automatic flow control valves on the return lines of coils as indicated on the plans. Balancing valve on supply side is not acceptable. Submit proposed piping arrangement for approval by the Engineer.

19. The standard ports and handles shall clear 1" thick insulation. Handle and port extensions are required for over 1" thick insulation.
20. Install, on the supply side of coils, a Y-strainer with a brass blow-down valve with 3/4" hose end connection with cap and chain.

E. Test Stations – Pressure/Temperature (PT):

1. Install a 1/4" NPT fitting (Test Plug) of solid brass with brass chain at indicated locations. Test plug shall be capable of receiving either a pressure or temperature probe 1/8" o.d. Dual seal core shall be neoprene for temperature to 200°F and shall be rated zero leakage from vacuum to 1,000 psig. PETERSON EQUIPMENT COMPANY, SISCO, or approved equal.

F. Y-Strainers:

1. Strainers shall be self-cleaning “Y” type, of same size as pipe in which it is installed.
2. Provide valved blow-off outlet with hose connection and cap on each strainer. Blow of connections shall be at bottom of strainer and shall be of size equal to 1/2 the pipe up to a maximum of 2".
3. Screen perforations shall be suitable for intended service. Provide micron screen for flushing of system.

G. Air Vents:

1. Provide manual air vents where indicated, and where required to properly and adequately vent heating system of air. Vent shall utilize a ball valve with handle in lieu of key operated.
2. Provide automatic air vents where indicated. BELL & GOSSETT Model 107 or approved equal.

H. Thermometers:

1. Thermometers shall be provided as indicated. WEKSLER INSTRUMENT, Type “AF.”
2. Thermometers in pipelines shall be separable socket 5" dial bi-metal insertion type, with scale suitable for temperature range of medium being measured. Thermometers shall be located to facilitate reading from floor. Angle-type shall be used where necessary to facilitate reading. Install in thermal well in flow of fluid.
3. Thermometer range shall be 0-120°F for chilled water.

I. Pressure Gages:

1. Pressure gages shall be provided where indicated. WEKSLER INSTRUMENT, model AA-14-2.
2. Gages shall be bourdon spring type with 5" dial set in polypropylene case. Gages shall be equipped with brass tee-handle shut-off cocks. Gages shall have required range of 0-100 psig and not in more than 2 psi graduations.

J. Water Treatment:

1. Prior to initial start up of mechanical system, Contractor shall thoroughly flush and clean system to remove sediment and debris from system. Refer to Part 3 – EXECUTION of this Section for details.
2. Chemicals used shall comply with all of the Virginia Department of Environmental Quality regulations and requirements.
3. The chemical mixtures shall not exceed the Virginia Department of Environmental Quality or local effluent limits.
4. The Contractor shall notify the Owner approximately 30 days before the cleaning of the systems and application of the chemicals are started. The Owner’s Water Treatment Consultant shall observe and monitor the cleaning of the systems and the initial charge of chemicals required for placing the equipment in normal service.
5. The Contractor shall furnish the Owner in writing the date of the initial treatment, type of chemicals used for the treatment, and the estimated date that further treatment and testing will be required.

2.7 AIR DISTRIBUTION

A. Ductwork:

1. Provide all ducts, plenums, connections, dampers, and related items required to form a complete system as indicated on drawings and specified herein.
2. All ductwork shall be constructed of sheet metal.
3. Sheet-metal ducts shall be fabricated from G60 galvanized-steel sheets, and shall be of gages called for and as detailed in SMACNA Manual, HVAC Duct Construction Standards (Metal and Flexible).
4. Duct sealing requirements shall be Class A.
5. Provide flexible connections of fiberglass between ducts and air-handling unit connections, and return fans.
6. Details of construction and material shall be as per above-mentioned Manual, ASHRAE Handbooks, and as approved.
7. Support ductwork in accordance with the latest SMACNA standards.
8. Fabricate ductwork with airtight joints, presenting smooth surface on inside, neatly finished on outside; construct with curves and bends to aid in easy flow of air. Unless otherwise indicated, make inside radius of curves and bends at least width of ducts; where square elbows have to be used, provide fixed deflectors.
9. Construct, brace, and support ducts and air chambers in a manner that they will neither sag nor vibrate to any perceptible extent when fans are operating at maximum speed or capacity.

10. Install access doors as indicated, and where not indicated, in locations and of sizes which will afford easy access to multi-blade dampers, smoke detectors, fire dampers, other equipment, and devices requiring inspection and servicing. Access doors shall be installed to avoid lights, piping, conduit ceiling grid, etc., to provide unobstructed access. Access doors shall be installed on the underside of the ductwork. Access doors shall be a minimum of 18" x 18" where possible. Contractor shall ensure that a man’s head may be easily inserted through the access doors proposed in order to facilitate direct visual observation of the ductwork prior to placing the order and installation. In non-accessible ceilings, provide access doors in ceiling.

11. Make sheet-metal connections to masonry work airtight and watertight in approved manner.

12. Provide turning vanes in all low-velocity square elbows.

13. Duct sizes are inside free area. Increase duct sizes as required.

14. Ductwork and accessories shall not be delivered to the job site until just prior to erection and must be stored in an approved manner.

15. All ductwork shall be internally cleaned by vacuuming prior to installation.

16. All ductwork open ends shall be sealed with polyethylene and duct tape during construction after hanging.

2.8 MEASUREMENT AND CONTROL

A. Variable Speed (Frequency) Drive Units:

1. All variable speed drives shall contain a Siemens P1 chip for RS232 interface to the Siemens MEC Controller.

2. Provide variable speed frequency drive (VFD) units for the following equipment:

   a. Air-Handling Unit (AHU-1) for supply fan.

3. Manufacturers:

   ASEABROWNBOVERI
   DANFOSSGRAHAM
   TOSHIBA

4. This specification is to cover a complete Adjustable Frequency motor Drive (AFD) consisting of a pulse width modulated (PWM) inverter designed for use on a standard NEMA Design B induction motor.
5. The drive manufacturer shall supply the drive and all necessary controls as herein specified. The manufacturer shall have been engaged in the production of this type of equipment for a minimum of 20 years.

6. Referenced Standards:
   b. Underwriters Laboratories: UL 508C.
   c. National Electrical Manufacturer’s Association (NEMA): ICS 7.0, AC Adjustable Speed Drives.
   d. IEC 16800 Parts 1 and 2.

7. Qualifications:
   a. AFDs and options shall be UL listed as a complete assembly. AFDs that require the customer to supply external fuses for the AFD to be UL listed are not acceptable. The base AFD shall be UL listed for 100 KAIC without the need for input fuses.
   b. CE Mark – The AFD shall conform to the European Union ElectroMagnetic Compatibility directive, a requirement for CE marking. The AFD shall meet product standard EN 61800-3 for the First Environment restricted level.
   c. The AFD manufacturer shall have available a comprehensive, HVAC Drive Computer Based Training (CBT) product. The CBT product shall include detailed, interactive sections covering AFD unpacking, proper mechanical and electrical installation, and programming. The CBT product shall allow the user to provide just-in-time training to new personnel or refresher training for maintenance and repair personnel on the user’s site. The CBT product shall be repeatable, precise, and shall include record keeping capability. The CBT product shall record answers to simulations and tests by student ID. The CBT product must be professionally produced and have interactive sections, student tests, and include video clips of proper wiring and installation.

8. Submittals: Submittals shall include the following information:
   a. Outline dimensions, conduit entry locations and weight.
   b. Customer connection and power wiring diagrams.
   c. Complete technical product description include a complete list of options provided.
   d. Compliance to IEEE 519 – harmonic analysis for particular job site, including total harmonic voltage distortion and total harmonic current distortion (TDD).
e. The AFD manufacturer shall provide calculations; specific to this installation, showing total harmonic voltage distortion is less than 5%. Input line filters shall be sized and provided as required by the AFD manufacturer to ensure compliance with IEEE standard 519. All AFDs shall include a minimum of 5% impedance reactors, no exceptions.

9. Adjustable Frequency Drives:

a. The AFD package as specified herein shall be enclosed in a UL Listed Type 12 enclosure, completely assembled and tested by the manufacturer in an ISO9001 facility. The AFD tolerated voltage window shall allow the AFD to operate from a line of +30% nominal, and -35% nominal voltage as a minimum.

b. Environmental Operating Conditions: 0 to 40°C continuous. AFDs that can operate at 40°C intermittently (during a 24-hour period) are not acceptable and must be oversized. Altitude 0 to 3,300 feet above sea level, less than 95% humidity, non-condensing.

c. Enclosure shall be rated UL type 12 and shall be UL listed as a plenum-rated AFD. AFDs without these ratings are not acceptable.

d. All AFDs shall have the following standard features:

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

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

   (3) There shall be a built-in time clock in the AFD keypad. The clock shall have a battery backup with 10 years minimum life span. The clock shall be used to date and time stamp faults and record operating parameters at the time of fault. If the battery fails, the AFD shall automatically revert to hours of operation since initial power up. The clock shall also be programmable to control start/stop functions, constant speeds, PID parameter sets and output relays. The AFD shall have a digital input that allows an override to the time clock (when in the off mode) for a programmable time frame. There shall be four (4) separate, independent timer functions that have both weekday and weekend settings.

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

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

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

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

(8) The overload rating of the drive shall be 110% of its normal duty current rating for 1 minute every 10 minutes, 130% overload for 2 seconds. The minimum FLA rating shall meet or exceed the values in the NEC/UL table 430-150 for 4-pole motors.

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

(10) The input current rating of the AFD shall be no more than 3% greater than the output current rating. AFDs with higher input current ratings require the upstream wiring, protection devices and source transformers to be oversized per NEC 430-2.

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

(12) The AFD shall be capable of sensing a loss of load (broken belt / broken coupling) and signal the loss of load condition. The drive shall be programmable to signal this condition via a keypad warning, relay output and/or over the serial communications bus. Relay outputs shall include programmable time delays that will allow for drive acceleration from zero speed without signaling a false underload condition.

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

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

e. All AFDs to have the following adjustments:

(1) Three (3) programmable critical frequency lockout ranges to prevent the AFD from operating the load continuously at an unstable speed.

(2) Two (2) proportional/integral/derivative (PID) Setpoint controllers shall be standard in the drive, allowing pressure or flow signals to be connected to the AFD, using the microprocessor in the AFD for the closed loop control. The AFD shall have 250 ma of 24 VDC auxiliary power and be capable of loop powering a transmitter supplied by others. The PID setpoint shall be adjustable from the AFD keypad, analog inputs, or over the communications bus. There shall be two parameter sets for the first PID that allow the sets to be switched via a digital input, serial communications or from the keypad for night setback, summer/winter setpoints, etc. There shall be an independent, second PID loop that can utilize the second analog input and modulate one of the analog outputs to maintain setpoint of an independent process (i.e., valves, dampers, etc.). All setpoints, process variables, etc., to be accessible from the serial communication network. The setpoints shall be set in Engineering units and not require a percentage of the transducer input.

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

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

(5) Six (6) programmable digital inputs for maximum flexibility in interfacing with external devices, typically programmed as follows:

(a) There shall be a run permissive circuit for damper or valve control. Regardless of the source of a run command (keypad, input contact closure, time-clock control, or serial communications) the AFD shall provide a dry contact closure that will signal the damper to open (AFD motor does not operate).
When the damper is fully open, a normally open dry contact (end-switch) shall close. The closed end-switch is wired to an AFD digital input and allows AFD motor operation. Two separate safety interlock inputs shall be provided. When either safety is opened, the motor shall be commanded to coast to stop, and the damper shall be commanded to close. The keypad shall display “start enable 1 (or 2) missing”. The safety status shall also be transmitted over the serial communications bus. All digital inputs shall be programmable to initiate upon an application or removal of 24VDC.

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

(7) Seven (7) programmable preset speeds.

(8) Two independently adjustable accel and decel ramps with 1 – 1800 seconds adjustable time ramps.

(9) The AFD shall include a motor flux optimization circuit that will automatically reduce applied motor voltage to the motor to optimize energy consumption and audible motor noise.

(10) The AFD shall include a carrier frequency control circuit that reduces the carrier frequency based on actual AFD temperature that allows the highest carrier frequency without derating the AFD or operating at high carrier frequency only at low speeds.

(11) The AFD shall include password protection against parameter changes.

f. The Keypad shall include a backlit LCD display. The display shall be in complete English words for programming and fault diagnostics (alphanumeric codes are not acceptable). The keypad shall utilize the following assistants:

(1) Start-up assistants.
(2) Parameter assistants
(3) Maintenance assistant
(4) Troubleshooting assistant

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(3) Maintenance assistant
(4) Troubleshooting assistant

(11) The AFD shall include password protection against parameter changes.
list below shall be capable of being displayed at all times. The display shall be in complete English words (alphanumeric codes are not acceptable):

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

h. The AFD shall include a fireman’s override input. Upon receipt of a contact closure from the fireman’s control station, the AFD shall operate at an adjustable preset speed. The mode shall override all other inputs (analog/digital, serial communication, and all keypad commands) and force the motor to run at the adjustable, preset speed. “Override Mode” shall be displayed on the keypad. Upon removal of the override signal, the AFD shall resume normal operation.

i. Serial Communications:

(1) The AFD shall have an RS 485 port as standard. The standard protocols shall be Modbus, Johnson Controls N2 bus, and Siemens Building Technologies FLN. Optional protocols for LonWorks, BACnet, Profibus, Ethernet, and DeviceNet shall be available. Each individual drive shall have the protocol in the base AFD. The use of third party gateways and multiplexers is not acceptable. All protocols shall be “certified” by the governing authority. Use of non-certified protocols is not allowed.

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

- Data Sharing – Read Property
- Data Sharing – Write Property
- Device Management – Dynamic Device Binding
- Device Management – Dynamic Object Binding
- Device Management – Communication Control
If additional hardware is required to obtain the BACnet interface, the AFD manufacturer shall supply one BACnet gateway per drive. Multiple AFDs sharing one gateway shall not be acceptable.

(3) Serial communication capabilities shall include, but not be limited to; run-stop control, speed set adjustment, PID control adjustments, current limit, accel/decel time adjustments, and lock and unlock the keypad. The drive shall have the capability of allowing the DDC to monitor feedback such as process variable feedback, output speed / frequency, current (in amps), % torque, power (kW), kilowatt hours (resettable), operating hours (resettable), and drive temperature. The DDC shall also be capable of monitoring the AFD relay output status, digital input status, and all analog input and analog output values. All diagnostic warning and fault information shall be transmitted over the serial communications bus. Remote AFD fault reset shall be possible. The following additional status indications and settings shall be transmitted over the serial communications bus – keypad “Hand” or “Auto” selected, bypass selected, the ability to change the PID setpoint, and the ability to force the unit to bypass (if bypass is specified). The DDC system shall also be able to monitor if the motor is running in the AFD mode or bypass mode (if bypass is specified) over serial communications. A minimum of 15 field parameters shall be capable of being monitored.

(4) The AFD shall allow the DDC to control the drive’s digital and analog outputs via the serial interface. This control shall be independent of any AFD function. For example, the analog outputs may be used for modulating chilled water valves or cooling tower bypass valves. The drive’s digital (relay) outputs may be used to actuate a damper, open a valve or control any other device that requires a maintained contact for operation. In addition, all of the drive’s digital and analog inputs shall be capable of being monitored by the DDC system.

(5) The AFD shall include an independent PID loop for customer use. The independent PID loop may be used for cooling tower bypass valve control, chilled water valve control, etc. Both the AFD control PID loop and the independent PID loop shall continue functioning even if the serial communications connection is lost. The AFD shall keep the last good setpoint command and last good DO & AO commands in memory in the event the serial communications connection is lost.

j. EMI / RFI filters. All AFDs shall include EMI/RFI filters. The onboard filters shall allow the AFD assemble to be CE Marked and the AFD shall
meet product standard EN 61800-3 for the First Environment restricted level.

k. All AFDs through 60HP shall be protected from input and output power mis-wiring. The AFD shall sense this condition and display an alarm on the keypad.

l. The following shall be furnished and mounted by the drive manufacturer. All features shall be UL Listed by the drive manufacturer as a complete assembly and carry a UL 508 label.

   (1) A complete factory wired and tested bypass system consisting of an output contactor and bypass contactor. Overload protection and shall be provided in both drive and bypass modes.
   (2) Door interlocked, padlockable molded case switch that will disconnect all input power from the drive and all internally mounted options.
   (3) The drive / bypass shall provide single-phase motor protection in both the AFD and bypass modes.

   (4) The following operators shall be provided:
       Bypass Hand-Off-Auto
       Drive mode selector
       Bypass mode selector
       Bypass fault reset

   (5) The following indicating lights (LED type) shall be provided. A test mode or push to test feature shall be provided.
       Power-on (Ready)
       Run enable (safeties) open
       Drive mode select damper opening
       Bypass mode selected
       Drive running
       Bypass running
       Drive fault
       Bypass fault
       Bypass H-O-A mode
       Automatic transfer to bypass selected
       Safety open
       Damper opening
       Damper end-switch made

   (6) The following relay (form C) outputs from the bypass shall be provided:
System started
System running
Bypass override enabled
Drive fault
Bypass fault (motor overload or underload (broken belt))
Bypass H-O-A position

(7) The digital inputs for the system shall accept 24V or 115VAC (selectable). The bypass shall incorporate internally sourced power supply and not require an external control power source.

(8) Customer Interlock Terminal Strip – provide a separate terminal strip for connection of freeze, fire, smoke contacts, and external start command. All external safety interlocks shall remain fully functional whether the system is in Hand, Auto, or Bypass modes (not functional in Fireman’s Override 2). The remote start/stop contact shall operate in AFD and bypass modes.

(9) Class 20 or 30 (selectable) electronic motor overload protection shall be included.

B. Installation shall be the responsibility of the Mechanical Contractor. The Contractor shall install the drive in accordance with the recommendations of the AFD manufacturer as outlined in the installation manual.

C. Power wiring shall be completed by the Electrical Contractor unless otherwise noted as factory wired. The Contractor shall complete all wiring in accordance with the recommendations of the AFD manufacturer as outlined in the installation manual.

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

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

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

G. Warranty shall be 24 months from the date of certified start-up. The warranty shall include all parts, labor, travel time, and expenses. There shall be 365/24 support available via a toll free phone number.
PART 3 - EXECUTION

3.1 TESTS

A. Refer to Section 15990, “Testing, Adjusting, and Balancing,” for related requirements.

B. At their discretion, the Owner shall be represented at all tests. Contractor shall provide 48 hours notice to the Owner prior to the tests.

C. Before insulation is installed and before piping is concealed, test water piping hydrostatically and prove tight under 100 psig pressure. Test pressure shall be held for minimum of 8 hours. An air test in lieu of water may be used when danger of freezing is possible and when approved.

3.2 WATER TREATMENT

A. Prior to initial start up of mechanical system, Contractor shall thoroughly flush and clean system to remove sediment and debris from system.

1. Prior to connecting the new air handling unit to the building water loop, the existing piping shall be flushed with a detergent and hot water (110-130° F) mixture to remove previously accumulated dirt and other organic residue. In old piping systems with heavy encrustation of inorganic materials, consult a water treatment specialist for proper passivation and/or removal of these contaminants.

2. During the flushing, a 30 mesh (max.) strainer (or acceptable equivalent) shall be in place in the system piping and examined periodically as necessary to remove collected residue. The flushing process shall take no less than 6 hours or until the strainers, when examined after each flushing, are clean. Old systems with heavy encrustation shall be flushed for a minimum of 24 hours and may take longer before the filters run clean. Detergent and acid concentrations shall be used in strict accordance with the respective chemical manufacturer’s instructions. After flushing with the detergent and/or dilute acid concentrations, the system loop shall be purged with clean water for at least one hour to ensure that all residual cleaning chemicals have been flushed out.

3. Prior to supplying water to the air handling unit, the Water Treatment Specification shall be consulted for requirements regarding the water quality during air handling unit operation. The appropriate air handling unit manufacturer’s service literature shall be available to the operator and/or service contractor and consulted for guidelines concerning preventative maintenance and off-season shutdown procedures.

4. Water Treatment Requirements: Supply water for the chilled water circuits shall be analyzed and treated by a professional water treatment specialist who
is familiar with the operating conditions and materials of construction specified for the air handling unit and associated piping.

END OF SECTION 15800
SECTION 15900 – AUTOMATIC TEMPERATURE CONTROLS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including Special Conditions, Division 1 Specification Sections, and Section 15010, “Mechanical General Provisions,” apply to this Section.

1.2 SUMMARY

A. This Section includes the Building Management System (BMS) control equipment for HVAC systems and components, including open protocol control components for terminal heating and cooling units.

1.3 DEFINITIONS

ARP: Address Resolution Protocol
ASC: Application Specific Controller.
BMS: Building Management System
CAC: Custom Application Controller.
CSMA/CD: Carrier Sense Multiple Access/Collision Detect
DDC: Direct Digital Control
DDE: Dynamic Data Exchange
FTT: Free Topology Transceivers
GUI: Graphical User Interface
HVAC: Heating, Ventilation, and Air Conditioning
LAN: Local Area Network
MER: Mechanical Equipment Room
ODBC: Open Data DD Ce Connectivity
PID: Proportional, Integral, Derivative
PES: Portable Engineering Station
SNVT: Standard Network Variables Types
SQL: Structured Query Language
UDP: User Datagram Protocol
UNC: Universal Network Controller

1.4 SYSTEM DESCRIPTION

A. Furnish all labor, materials, equipment, and service necessary to replace the existing hybrid pneumatic-electric controls with complete Direct Digital Control System for a complete and operating temperature control system, utilizing a high speed peer-to-
peer network of interoperable Direct Digital Controls (DDC), Graphical User Interface (GUI) with color graphic displays available on at least 64 client computers, and electronic interfaces and actuation devices, as shown on the drawings and as described herein.

B. The Local Area Network (LAN) shall be either a 10 or 100 Mbps Ethernet network supporting BACnet, Java, XML, HTTP, and CORBA IIOP for maximum flexibility for integration of building data with enterprise information systems and providing support for multiple Universal Network Controllers (UNCs), user workstations and a local host computer system.

C. The Enterprise Ethernet (IEEE 802.3) LAN shall utilize Carrier Sense Multiple/Access/Collision Detect (CSMA/CD), Address Resolution Protocol (ARP) and User Datagram Protocol (UDP) operating at 10 or 100 Mbps.

D. The system will consist of an open architecture that utilizes EIA Standard 709.1, the LonTalk™ protocol, as the common communication protocol between all controllers and integral ANSI/ASHRAE™ Standard 135-1995, BACnet functionality to assure interoperability between all system components. Both the LonTalk™ protocol and the ANSI/ASHRAE™ Standard 135-1995, BACnet protocol are required to assure that the project is fully supported by the two leading HVAC open protocols to reduce future building maintenance, upgrade, and expansion costs.

E. Where necessary or desired, LonTalk™ packets may be encapsulated into TCP/IP messages to take advantage of existing infrastructure or to increase network bandwidth.

1. Any such encapsulation of the LonTalk™ protocol into IP datagrams shall conform to existing LonMark™ guide functionality lines for such encapsulation and shall be DDCed on industry standard protocols.
2. The products used in constructing the BMS shall be LonMark™ compliant.
3. In those instances in which Lon-Mark™ devices are not available, the BMS Contractor shall provide LonWorks™ devices with application source code, device resource files, and external interface definitions.

F. The software tools required to network manage both the LonTalk™ protocol and the ANSI/ASHRAE™ Standard 135-1995, BACnet protocol must be provided with the system. Drawings are diagrammatic only. Equipment and labor not specifically referred to herein or on the plans, that are required to meet the functional intent, shall be provided without additional cost to the Owner. Minimum BACnet compliance is Level 3; with the ability to support data read and write functionality. Physical connection of BACnet devices shall be via Ethernet/Ethernet IP.
G. Complete temperature control system to be DDC with electronic sensors and electronic/electric actuation of Mechanical Equipment Room (MER) and electronic actuation of new rooftop air-conditioning equipment valves and actuators as specified herein. The BMS is intended to seamlessly connect new devices throughout the building regardless of subsystem type. Existing connected equipment should easily co-exist on the same network channel.

1. The supplied system must incorporate the ability to access all data using Java enabled browsers without requiring proprietary operator interface and configuration programs.

2. An Open Data Connectivity (ODBC) or Structured Query Language (SQL) compliant server data is required for all system parameter storage.
   a. This data shall reside on a supplier-installed server for all data access.
   b. Systems requiring proprietary data and user interface programs shall not be acceptable.
   c. A hierarchical topology is required to assure reasonable system response times and to manage the flow and sharing of data without unduly burdening the customer’s internal Intranet network.
   d. Systems employing a “flat” single tiered architecture shall not be acceptable.

1.5 INSTALLATION OF PRODUCTS FURNISHED BUT NOT INSTALLED UNDER THIS SECTION

A. Section 15800 – Hydronic Piping:

   1. Control Valves.
   2. Temperature Sensor Wells and Sockets.

1.6 SUBMITTALS

A. Product Data: Include manufacturer’s technical literature for each control device. Indicate dimensions, capacities, performance characteristics, electrical characteristics, finishes for materials, and installation and startup instructions for each type of product indicated.

   1. Each control device labeled with setting or adjustable range of control.
B. Shop Drawings: Detail equipment assemblies and indicate dimensions, weights, loads, required clearances, method of field assembly, components, and location and size of each field connection.

1. Schematic flow diagrams showing fans, pumps, coils, dampers, valves, and control devices.
3. Details of control panel faces, including controls, instruments, and labeling.
4. Written description of sequence of operation.
5. Schedule of valves, including close-off and flow characteristics.
6. Trunk cable schematic showing programmable control unit locations and trunk data conductors.
7. Listing of connected data points, including connected control unit and input device.
8. System graphics indicating monitored systems, data (connected and calculated) point addresses, and operator notations.
9. System configuration showing peripheral devices, batteries, power supplies, diagrams, modems, and interconnections.

C. External Interface Files: XIF files or object diagrams for each DDC system component (Custom Application Controller and Application Specific Controller) proposed.

D. ANSI/ASHRAE™ Standard 135-1995, BACnet PIC Statement: Proof of Compliance Level 3 or higher is required to protect building owner by reducing future maintenance and expansion costs.

E. Software and Firmware Operational Documentation: Include the following:

1. Engineering, Installation, Operation and Maintenance manuals.
2. Program Software Backup: On a magnetic media or compact disc, complete with data files.
3. Device address list.
4. Printout of software application and graphic screens.
5. Licenses, guarantee, and warranty documents for all equipment and systems.

F. Field Test Reports: Indicate and interpret test results for compliance with performance requirements.

G. Maintenance Data: For systems to include in maintenance manuals specified in Division 1, include the following:
1. Maintenance instructions and lists of spare parts for each type of control device and compressed air station.
2. Interconnection wiring diagrams with identified and numbered system components and devices.
4. Inspection period, cleaning methods, cleaning materials recommended, and calibration tolerances.
5. Calibration records and list of set points.

H. Qualification Data: For firms and persons specified in “Quality Assurance” paragraph.

I. Project Record Documents: Record actual locations of control components, including control units, thermostats, and sensors. Revise Shop Drawings to reflect actual installation and operating sequences.

1.7 QUALITY ASSURANCE

A. Bids by wholesalers, distributors, mechanical contractors, and non-franchised contractors shall not be acceptable.

B. The system manufacturer shall, as a minimum, manufacture and supply the Custom Application Controller, Application Specific Controller, Graphical User Interface, damper actuators, and valve actuator assemblies.

C. All work described in this Section shall be installed, wired, circuit tested, and calibrated by factory certified technicians qualified for this work and in the regular employment of the temperature control system manufacturer’s local field office.

D. The Building Management System Contractor shall have a full service facility staffed with engineers trained in Integrating Interoperable Systems and technicians fully capable of providing LonWorks instructions and routine emergency maintenance service on all system components.

1.8 DELIVERY, STORAGE AND HANDLING

A. Factory-Mounted Components: Where control devices specified in this Section are indicated to be factory mounted on equipment, arrange for shipping of control devices to unit manufacturer.
1.9 COORDINATION

A. Coordinate location of thermostats, humidistats, and other exposed control sensors with plans and room details before installation.

B. Coordinate equipment from other sections, to achieve compatibility with equipment that interfaces with those systems.

C. Coordinate supply of conditioned electrical circuits for control units and operator workstation.

D. Coordinate with the Owner’s IT department on locations for UNCs, Ethernet communication cabling, and TCP/IP addresses.

1.10 WARRANTY AND MAINTENANCE

A. Warranty: The BAS/ATC Contractor shall provide a written warranty for the completed work whereby all defective materials and workmanship shall be repaired or replaced at no additional cost to the City for one year (12 months) from Final Acceptance date. This warranty also covers the work and materials on the building automation interface/programming for a fully compatible and functional system. All repairs or replacement of equipment/components other than those provided by the original equipment manufacturer (OEM) shall be approved by the City prior to commencement of repairs. All repairs and adjustments shall be made to the satisfaction of the Owner, City of Newport News.

1.11 OWNERSHIP OF PROPRIETARY MATERIAL

A. The Owner shall sign a copy of the manufacturer’s standard software and firmware licensing agreement as a condition of this Contract. Such license shall grant use of all programs and application software to Owner as defined by the manufacturer’s license agreement, but shall protect manufacturer’s rights to disclosure of trade secrets contained within such software. All project developed software and documentation shall become the property of the Owner. These include but are not limited to project graphic images, record drawings, project dataDDCe, project specific application programming code, and all other associated documentation.

PART 2 - PRODUCTS

2.1 APPROVED MANUFACTURERS

A. Manufacturers: Subject to compliance with requirements, provide products by one of the following pre-qualified manufacturers:
1. HONEYWELL, installed by Chesapeake Controls
2. CARRIER 1-VU
3. DELTA Controls, installed by Applied Control Specialists

2.2 DDC EQUIPMENT

A. GUI Server Application Software: Include the following:

1. Graphic screens shall be developed using any drawing package capable of generating a GIF, BMP, or JPG file format. Use of proprietary graphic file formats shall not be acceptable. In addition to, or in lieu of a graphic background, the GUI shall support the use of scanned pictures.

2. Graphic screens shall have the capability to contain objects for text, real-time values, animation, color spectrum objects, logs, graphs, HTML or XML document links, schedule objects, hyperlinks to other URL’s, and links to other graphic screens.

3. Graphics shall support layering and each graphic object shall be configurable for assignment to one a layer. A minimum of six layers shall be supported.

4. Modifying common application objects, such as schedules, calendars, and setpoints shall be accomplished in a graphical manner.
   a. Schedule times will be adjusted using a graphical slider, without requiring any keyboard entry from the operator.
   b. Holidays shall be set by using a graphical calendar, without requiring any keyboard entry from the operator.

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

6. Adjustments to analog objects, such as setpoints, shall be done by right-clicking the selected object and using a graphical slider to adjust the value. No entry of text shall be required.

7. System Configuration: At a minimum, the GUI shall permit the operator to perform the following tasks, with proper password access:
   a. Create, delete, or modify control strategies.
   b. Add/delete objects to the system.
   c. Tune control loops through the adjustment of control loop parameters.
   d. Enable or disable control strategies.
   e. Generate hard copy records or control strategies on a printer.
   f. Select points to be alarmable and define the alarm state.
g. Select points to be trended over a period of time and initiate the recording of values automatically.

8. On-line Help: Provide a context sensitive, on-line help system to assist the operator in operation and editing of the system. On-line help shall be available for all applications and shall provide the relevant data for that particular screen. Additional help information shall be available through the use of hypertext. All system documentation and help files shall be in HTML format.

9. Security: Each operator shall be required to log on to that system with a user name and password in order to view, edit, add, or delete data. System security shall be selectable for each operator. The system administrator shall have the ability to set passwords and security levels for all other operators. Each operator password shall be able to restrict the operators’ access for viewing and/or changing each system application, full screen editor, and object. Each operator shall automatically be logged off of the system if no keyboard or mouse activity is detected. This auto log-off time shall be set per operator password. All system security data shall be stored in an encrypted format.

10. System Diagnostics: The system shall automatically monitor the operation of all workstations, printers, modems, network connections, building management panels, and controllers. The failure of any device shall be annunciated to the operator.

11. Alarm Console:

   a. The system will be provided with a dedicated alarm window or console. This window will notify the operator of an alarm condition, and allow the operator to view details of the alarm and acknowledge the alarm. The use of the Alarm Console can be enabled or disabled by the system administrator.

   b. When the Alarm Console is enabled, a separate alarm notification window will supercede all other windows on the desktop and shall not be capable of being minimized or closed by the operator. This window will notify the operator of new alarms and un-acknowledged alarms. Alarm notification windows or banners that can be minimized or closed by the operator shall not be acceptable.

B. Web Browser Clients:

   1. The system shall be capable of supporting 64 clients using a standard Web browser, such as Internet Explorer™ or Netscape Navigator™. Systems requiring additional software (to enable a standard Web browser) to be resident on the client machine, are only acceptable if 64 licensed copies of the client machine software are provided, installed, and tested.
2. The Web browser software shall run on any operating system and system configuration that is supported by the Web browser. Systems that require specific machine requirements in terms of processor speed, memory, etc., in order to allow the Web browser to function with the FMCS, shall only be acceptable if 64 workstations or workstation hardware upgrades are provided.

3. The Web browser shall provide the same view of the system, in terms of graphics, schedules, calendars, logs, etc., and provide the same interface methodology as is provided by the Graphical User Interface. Systems that require different views or that require different means of interacting with objects, such as schedules or logs, shall not be permitted.

4. The Web browser client shall support at a minimum, the following functions:
   
a. User log-on identification and password shall be required. If an unauthorized user attempts access, a blank web page shall be displayed. Security using Java authentication and encryption techniques to prevent unauthorized access shall be implemented.
   
b. Graphical screens developed for the GUI shall be the same screens used for the Web browser client. Any animated graphical objects supported by the GUI shall be supported by the Web browser interface.
   
c. HTML programming shall not be required to display system graphics or data on a Web page. HTML editing of the Web page shall be allowed if the user desires a specific look or format.
   
d. Storage of the graphical screens shall be in the Building Control Units (BC), without requiring any graphics to be stored on the client machine. Systems that require graphics storage on each client are not acceptable.
   
e. Real-time values displayed on a Web page shall update automatically without requiring a manual “refresh” of the Web page.
   
f. User’s shall have administrator-defined access privileges. Depending on the access privileges assigned, the user shall be able to perform the following:
      
      (1) Modify common application objects, such as schedules, calendars, and setpoints in a graphical manner.
         
         (a) Schedule times will be adjusted using a graphical slider, without requiring any keyboard entry from the operator.
         (b) Holidays shall be set by using a graphical calendar, without requiring any keyboard entry from the operator.
      
      (2) Commands to start and stop binary objects shall be done by right-clicking the selected object and selecting the appropriate command from the pop-up menu. No entry of text shall be required.
      
      (3) View logs and charts.
(4) View and acknowledge alarms.

g. The system shall provide the capability to specify a user’s (as determined by the log-on user identification) home page. Provide the ability to limit a specific user to just their defined home page. From the home page, links to other views, or pages in the system shall be possible, if allowed by the system administrator.

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

C. Furnish one (1) laptop computer with the minimum requirements as follows. The Building Automation System supplier shall provide all cables, connectors, software, and hardware required to monitor, modify, upload, and download all DDC Controllers furnished on the project.

1. Base Unit: Dell Latitude E5510
2. Processor: Intel Core i5 540M, 2.53GHz, 1066MHz 3M L2 Cache
3. Memory: 3.0GB, DDR3-1333 SDRAM, 2 DIMM
4. Keyboard: Internal English Keyboard Dual Pointing
5. Video Card: Express Card without Modem
6. Hard Drive: 160GB Hard Drive 9.5MM, 7200RPM
7. Hard Drive Controller: Touchpad and Trackstick dual pointing
8. Floppy Disk Drive: 15.6" HD(1366x768) Anti-Glare LED
10. CD-ROM or DVD-ROM Drive: Cyberlink Power DVD 8.3, no Media
11. CD-ROM or DVD-ROM Drive: 8X DVD Bezel
12. Sound Card: Digital Microphone
13. Processor Cable: Dell WLAN 1501 (802.11b/g/n) 1/2 MiniCard
14. Feature 6-Cell/54-WHr Battery
15. Feature Nylon 15.6 Carry Case
16. Service: Dell Limited Hardware Warranty Plus Onsite Service Extended Year(s)
17. Web Server Operator Interface:

a. Must fully interface with the existing graphic driven enterprise web server at no additional cost to the Owner.

D. Universal Network Controllers (UNC):

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

a. Calendar functions
b. Scheduling
c. Trending
d. Alarm monitoring and routing
e. Time synchronization by means of an Atomic Clock Internet site, including automatic synchronization
f. Integration of LonWorks controller data and BACnet controller data
g. Network Management functions for all LonWorks DDCed devices

2. The Universal Network Controller UNC 600-2 must provide the following hardware features as a minimum:

a. One Ethernet Port – 10/100 Mbps
b. Two RS-232 ports
c. One LonWorks Interface Port – 78KB FTT-10A with Weidmuller connector
d. Power supply 120 VAC
e. Battery Backup
f. Real-time clock
g. Processor 550 MHz or greater
h. Java Virtual Machine
i. Minimum 3 GB IDE hard drive
j. 128 Mb Ram or greater
k. Operating system Windows NT 4.0 Embedded with Microsoft Java VM

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

4. The UNC shall support standard Web browser access via the Intranet/Internet. It shall support a minimum of 64 simultaneous users.

5. Event Alarm Notification and actions:

a. The UNC shall provide alarm recognition, storage; routing, management, and analysis to supplement distributed capabilities of equipment or application specific controllers.
b. The UNC shall be able to route any alarm condition to any defined user location whether connected to a local network or remote via dial-up telephone connection, or wide-area network.
c. Alarm generation shall be selectable for annunciation type and acknowledgement requirements, including but limited to:

(1) To alarm
(2) Return to normal
(3) To fault

d. Provide for the creation of a minimum of eight of alarm classes for the purpose of routing types and or classes of alarms, i.e., security, HVAC, Fire, etc.
e. Provide timed (schedule) routing of alarms by class, object, group, or node.
f. Provide alarm generation from binary object “runtime” and/or event counts for equipment maintenance. The user shall be able to reset runtime or event count values with appropriate password control.
g. Control equipment and network failures shall be treated as alarms and annunciated.
h. Alarms shall be annunciated in any of the following manners as defined by the user:

(1) Screen message text
(2) Email of the complete alarm message to multiple recipients. Provide the ability to route and email alarms DDCed on:

   (a) Day of week
   (b) Time of day
   (c) Recipient

(3) Pagers via paging services that initiate a page on receipt of email message
(4) Graphic with flashing alarm object(s)
(5) Printed message, routed directly to a dedicated alarm printer

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

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

j. Alarm actions may be initiated by user-defined programmable objects created for that purpose.
k. Defined users shall be given proper access to acknowledge any alarm, or specific types or classes of alarms defined by the user.
l. A log of all alarms shall be maintained by the UNC and/or a server (if configured in the system) and shall be available for review by the user.
m. Provide a “query” feature to allow review of specific alarms by user defined parameters.
n. A separate log for system alerts (controller failures, network failures, etc.) shall be provided and available for review by the user.
o. An Error Log to record invalid property changes or commands shall be provided and available for review by the user.

6. Data Collection and Storage:

a. The UNC shall have the ability to collect data for any property of any object and store this data for future use.

b. The data collection shall be performed by log objects, resident in the UNC that shall have, at a minimum, the following configurable properties:

   (1) Designating the log as interval or deviation.
   (2) For interval logs, the object shall be configured for time of day, day of week, and the sample collection interval.
   (3) For deviation logs, the object shall be configured for the deviation of a variable to a fixed value. This value, when reached, will initiate logging of the object.
   (4) For all logs, provide the ability to set the maximum number of data stores for the log and to set whether the log will stop collecting when full, or rollover the data on a first-in, first-out DDCed event.
   (5) Each log shall have the ability to have its data cleared on a time-DDCed event or by a user-defined event or action.

7. All log data shall be stored in a relational data in the UNC, and the data shall be accessed from a server (if the system is so configured) or a standard Web Browser.

8. All log data, when accessed from a server, shall be capable of being manipulated using standard SQL statements.

9. All log data shall be available to the user in the following data formats:

   a. HTML
   b. XML
   c. Plain Text
   d. Comma or tab separated values
10. Systems that do not provide log data in HTML and XML formats at a minimum shall provide as an alternative Microsoft SQL Server, Oracle 8i or Express, Hyperion Solutions SQL Server.

11. The UNC shall have the ability to archive its log data either locally (to itself), or remotely to a server or other UNC on the network. Provide the ability to configure the following archiving properties, at a minimum:
   a. Archive on time of day
   b. Archive on user-defined number of data stores in the log (buffer size)
   c. Archive when log has reached its user-defined capacity of data stores
   d. Provide ability to clear logs once archived

12. Audit Log: Provide and maintain an Audit Log that tracks all activities performed on the UNC. Provide the ability to specify a buffer size for the log and the ability to archive log DDCed on time or when the log has reached its user-defined buffer size. Provide the ability to archive the log locally (to the UNC), to another UNC on the network, or to a server. For each log entry, provide the following data:
   a. Time and date
   b. User ID
   c. Change or activity, i.e., Change setpoint, add or delete objects, commands, etc.

13. DataDDCe Backup and Storage:
   a. The UNC shall have the ability to automatically back up its dataDDCe. The dataDDCe shall be backed up DDCed on a user-defined time interval.
   b. Copies of the current dataDDCe and, at the most recently saved dataDDCe, shall be stored in the UNC. The age of the most recently saved dataDDCe is dependent on the user-defined dataDDCe save interval.
   c. The UNC dataDDCe shall be stored, at a minimum, in XML format to allow for user viewing and editing, if desired. Other formats are acceptable as well, as long as XML format is supported.

E. Custom Application Control Units: Modular, comprising processor board with programmable, nonvolatile, RAM/EEPROM memory for custom control applications. CACs shall be provided for Rooftop Units, Boiler Plant, and other applications as shown on drawings and shall have published Lon-Works™ application source code, device resource files, and external interface definitions.
1. Units monitor or control each input/output point; process information; and at least 50 expressions for customized HVAC control, including mathematical equations, Boolean logic, PID control loops with anti-windup, sequencers, timers, interlocks, thermostats, enthalpy calculation, counters, interlocks, ramps, drivers, schedules, calendars, OSS, compare, limit, curve fit, and alarms.

2. Stand-alone mode control functions operate regardless of network status. Functions include the following:
   a. Peer-to-peer primary network level communications supporting at least 200 LonMark™ Standard Network Variables (SNVTs) per CAC utilizing at least 100 different SNVT types as documented by the LonMark™ Interoperability Association to assure present and future compatibility with third party LonMark™ devices. The 200 LonMark™ SNVTs, minimum, must be configurable in any combination – all inputs or all outputs or any combination of input/outputs in any combination of the 100 different, minimum, SNVT types. The XIF SNVT order shall be definable, rather than random, to provide logical and effective LonMark™ network management. With the submittal package, Contractor shall provide CAC performance data that specifies the exact maximum number of SNVTs available in any combination and a list of all available SNVT types, including the LonMark™ Interoperability Association SNVT number.
   b. Automatic communications loss detection to maintain normal control functionality regardless of available network communications.
   c. Discrete/digital, analog, and pulse input/outputs.
   d. Monitoring, controlling, or addressing data points.
   e. Local energy management control strategies.
   f. Incorporate internal customizable safeties and limits to prevent third party LonMark™ tools from providing improper and unrealistic inputs to CACs.

3. Local operator interface port provides for download from and connection to portable workstation.

4. Communication: The Custom Application Controller shall communicate via the Primary Controller Network between BMS Controllers and other LonWorks™ devices. CACs shall communicate with the Building Controller and ASCs at a baud rate of not less than 78.8K baud using LonTalk™ communications protocol (EIA 709.1).

F. Application Specific Control Units: Single board construction comprising processor board with programmable, nonvolatile, RAM/EEPROM memory for custom control
and unitary applications. ASCs shall be provided for RTU, and other applications as shown on the drawings. To assure complete interoperability, all ASC’s firmware shall support all mandatory and all optional LonMark™ Standard Network Variables (SNVTs) for their LonMark™ profile as documented by the LonMark™ Interoperability Association. Bidder shall provide proof of ASC compliance for all the mandatory and all optional LonMark™ SNVTs. ASCs shall be DDCed on the Echelon Neuron 3150 microprocessor working with the ASCs stand-alone control program.

1. Units monitor or control each input/output point; process information; and download from the operator station.

2. Stand-alone mode control functions operate regardless of network status. Functions include the following:
   
a. Peer-to-peer primary network level communications with automatic communications loss detection to maintain normal control functionality regardless of available network communications.
   b. Discrete/digital, analog, and pulse input/output.
   c. Monitoring, controlling, or addressing data points.
   d. Appropriate LonMark™ profiles for specific unitary applications.
   e. Support for all mandatory and optional LonMark™ Standard Network Variable Types (SNVTs) for their LonMark™ profile as documented by the LonMark™ Interoperability Association
   f. Internal customizable safeties and limits to prevent third party LonMark™ tools from providing improper and unrealistic inputs to ASCs.

3. Local operator interface port located on ASC and ASC sensor provides for download from or upload to portable workstation. All Lon bus devices shall be accessible from either port.

4. Communication: ASCs shall communicate with the Building Controller and CACs at a baud rate of not less than 78.8K baud using LonTalk™ communications protocol (EIA 709.1).

5. ASC units monitor or control each input/output point; process information; and at least 50 expressions for customized HVAC control, including mathematical equations, Boolean logic, PID control loops with anti-windup, sequencers, timers, interlocks, thermostats, counters, interlocks, compare, limit, and alarms.

6. All ASC Controller setpoints shall be digital display setpoints with dual setpoint limits (integral hard limits which the user cannot exceed above and below and independent soft limits which are hidden from the user). All digital setpoints shall be network retentive after power outages and after replacement of sensor.
G. LANs: Capacity for a minimum of 64 client workstations connected to multi-user, multi-tasking environment with concurrent capability to access DDC network or control units.

1. Enterprise Network LAN Media: Ethernet (IEEE 802.3), peer-to-peer CSMA/CD, operating at 10 or 100 Mbps, cable 10 DDCe-T, UTP-8 wire, category 5.
2. Primary Controller Network LAN Media: LonTalk™ (EIA 709.1), peer-to-peer, FTT-10 operating at 78.8K.
3. Secondary Network LAN (If Required) Media: LonTalk™ (EIA 709.1), peer-to-peer, FTT-10 operating at 78.8K.
4. Remote Connection: ISDN, ADSL, T1 or dial-up connection, monthly charges paid by building owner.

H. Software:

1. Controller and System HVAC Applications: Update to latest version of software at Project completion. Include and implement the following capabilities from the control units if documented by the specified sequence of operations:
   a. Load Control Programs: Demand limiting, duty cycling, automatic time scheduling, start/stop time optimization, occupied/unoccupied setback/setup, DDC with PID, and trend logging.
   b. HVAC Control Programs: Optimal run time, supply-air reset, and enthalpy/economizer switchover.
   c. Boiler Control Programs: Boiler plant optimization with hot water supply reset, boiler and pump equipment selection and sequencing.
   d. Programming Application Features: Include trend point, alarm reporting, alarm lockout, weekly scheduling, staggered start, sequencing, anti-short cycling and calculated point.

2. Controller and Network Setup Software: Network management’s tools for LonTalk™ protocol and the ANSI/ASHRAE™ Standard 135-1995, BACnet protocol shall be provided, including a network learn function, LonMark bindings, service pins, winks, and diagnostics.

2.3 CONTROL PANELS

A. Local Control Panels: Unitized NEMA 1 cabinet with suitable brackets for wall or floor mounting, located adjacent to each system under automatic control. Provide common keying for all panels.
1. Fabricate panels of 0.06" thick, furniture-quality steel, or extruded-aluminum alloy, totally enclosed, with hinged doors and keyed lock and with manufacturer’s standard shop-painted finish.

2. Interconnections between internal and face-mounted devices pre-wired with color-coded stranded conductors neatly installed in plastic troughs and/or tie-wrapped. Terminals for field connections shall be UL Listed for 600-volt service, individually identified per control/interlock drawings, with adequate clearance for field wiring. Control terminations for field connection shall be individually identified per control drawings.

3. Door-mounted Equipment: Flush-mount (on hinged door) manual switches, including damper-positioning switches, changeover switches, thermometers, and gages.

4. Provide ON/OFF power switch with over-current protection for control power sources to each local panel

2.4 SENSORS

A. Electronic Temperature Sensors: Vibration and corrosion resistant; for wall, immersion, or duct mounting as required.

1. Resistance Temperature Detectors: Platinum, thermistor, or balco.
   a. Accuracy: ±0.2% at calibration point; thermistors shall have a maximum 5-year drift of no more than .225°F maximum error of no more than .36°F.
   b. Wire: Twisted, shielded-pair cable.
   c. Insertion Elements in Ducts: Single point, 6" long; use where not affected by temperature stratification or where ducts are smaller than 4 sq. ft.
   d. Averaging Elements in Ducts: 60" long, flexible for use where prone to temperature stratification or where ducts are larger than 4 sq. ft.; 264" long, flexible for use where prone to temperature stratification or where ducts are larger than 16 sq. ft; length as required.
   e. Insertion Elements for Liquids: Brass socket with minimum insertion length of 2-1/2".
   f. Outside-Air Sensors: Watertight inlet fitting, shielded from direct sunlight.
   g. Room Security Sensors: Stainless-steel cover plate with insulated back and security screws.

   a. Accuracy: 2% at 10-90% RH with linear output.
   b. Room Sensors: Range of 0 to 100% relative humidity.
c. Duct and Outside-Air Sensors: With element guard and mounting plate, range of 0 to 100% relative humidity.

3. Static-Pressure Transmitter: Nondirectional sensor with suitable range for expected input, and temperature compensated.
   
   a. Accuracy: $\pm 1\%$ of full scale with repeatability of 0.5%.
   b. Output: 4 to 20 mA, 0-5 VDC, 0-10 VDC.
   c. Building Static-Pressure Range: -.1" to .1", -.25" to .25", -.5" to .5", -1.0" to 1.0" w.c., jumper selectable.
   d. Duct Static-Pressure Range: 0" to 1", 0" to 2.5", 0" to 5", 0" to 10" w.c., jumper adjustable

4. Pressure Transmitters: Direct acting for gas, liquid, or steam service; range suitable for system; proportional output 4 to 20 mA.

B. Equipment Operation Sensors as Follows:

1. Status Inputs for Fans: Differential-pressure switch with adjustable range of 0" to 5" w.c.
2. Status Inputs for Pumps: Differential-pressure switch piped across pump with adjustable pressure-differential range of 8 to 60 psig.
3. Status Inputs for Electric Motors: Current-sensing relay with current transformers, adjustable and set to 175% of rated motor current.

C. Electronic Valve/Damper Position Indication: Visual scale indicating percent of travel and 2- to 10-VDC, feedback signal.

2.5 THERMOSTATS

A. Electric Low-limit Duct Thermostat: Snap-acting, single-pole, single-throw, manual- or automatic-reset switch that trips if temperature sensed across any 12 inches of bulb length is equal to or below setpoint.

1. Bulb Length: Minimum 20 feet
2. Quantity: One thermostat for every 20 sq. ft. of coil surface.

2.6 ACTUATORS

A. Electronic Valve Actuators: Direct-coupled type non-hydraulic designed for minimum 100,000 full-stroke cycles at rated torque. The actuator shall have rating of not less than twice the thrust needed for actual operation of the damper or valve.

2. Overload Protection: Electronic overload or digital rotation-sensing circuitry.
3. Fail-safe Operation: Mechanical, spring-return mechanism. Provide external, manual gear release on non-spring-return actuators.
4. Actuators shall have the ability to be tandem mounted.
5. All spring-return actuators shall have a manual override. Complete manual override shall take no more than 10 turns.
6. Power Requirements (Two-Position Spring Return): 24VAC or DC, Maximum 10VA.
7. Power Requirements (Modulating): Maximum 15 VA at 24VAC.
8. Proportional Signal: 2- to 10-VDC or 4 to 20 mA, and 2- to 10-VDC position feedback signal.
9. Temperature Rating: -22°F to 140°F.
10. Run Time: 200 seconds open, 40 seconds closed.
11. All actuators shall have a 5-year warranty.
12. Valves:
   a. Size for torque required for valve close-off at maximum pump differential pressure (regardless of water loop system pressures).
   b. Valve and Actuators shall come from the factory fully assembled.
   c. Spring Return Manual Override shall come with a 10 Degree Valve Preload to assure tight close off.

2.7 CONTROL VALVES

A. Valve bodies shall be 2-way normally open or closed, or 3-2 way mixing as specified. Valve bodies 2" or smaller shall be bronze, screwed type and shall be rated at 250 psig. Valve bodies 2-1/2" and larger shall be iron, flanged and rated at 125 psig except where otherwise noted.

B. Valves shall have stainless-steel stems and allow for servicing including packing, stem and disk replacement.

C. Ball Valves: 2-way or 3-way Ball valves shall meet the ANSI Class 125/150 rating. The disc shall be aluminum-bronze to provide bubble-tight close off in either direction. The seat shall be EPDM, Phenolic backed, non-collapsible, and easy to replace and withstand temperatures from -22°F to 212°F (-30°C to 100°C). The Shaft and Taper pin shall be corrosion-resistant stainless steel of the 300 or 400 series. The Shaft shall be supported at three locations with PTFE bushings for positive shaft alignment.

2.8 CONTROL CABLE

A. Electronic and Fiber-Optic Cable for Control Wiring.
B. LON communication cable shall be Category 4.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Verify that conditioned power supply is available to control units and operator workstation.

B. Verify that duct, pipe, and equipment mounted devices and wiring are installed before proceeding with installation.

3.2 INSTALLATION

A. Install equipment level and plumb.

B. Install software in control units and operator workstation. Implement all features of programs to specified requirements and as appropriate to sequence of operation.

C. Connect and configure equipment and software to achieve sequence of operation specified.

D. Verify location of thermostats, humidistsats, and other exposed control sensors with plans and room details before installation. Locate all 60" above the floor.
   1. Install averaging elements in ducts and plenums in crossing or zigzag pattern.

E. Locate ASCs in corridor above ceiling just outside the classroom. ASCs shall be installed in a covered NEMA 1 metallic enclosure marked to identify the ASC address and control application.

F. Each ASC shall be equipped with a single dedicated transformer.

G. Coordinate point names with Newport News Plant Services to be consistent with existing point names.

H. Clearly mark circuit breakers that provide primary power to ASCs.

I. Install labels and nameplates to identify control components according to Section 15010, “Mechanical General Provisions.”
J. Install hydronic instrument wells, valves, and other accessories according to Section 15010, “Mechanical General Provisions.”

3.3 ELECTRICAL WIRING AND CONNECTION INSTALLATION

A. Install raceways, boxes, and cabinets according to Section 16110, “Raceways.”

B. Install building wire and cable according to Section 16140, “Wiring Devices and Device Plates.”

C. The Control Contractor shall furnish and install all electrical control and interlock wiring required for the Automatic Temperature Control System furnished hereunder. All power wiring shall be furnished and installed under Division 16, except power to Direct Digital Control System field panels and controllers which shall be provided under this Section. Where electric power is supplied to a DDC Controller by this Contractor, a suitable circuit breaker will be furnished under this Section and installed under Division 16, ELECTRICAL of these Specifications.

D. Connect manual-reset limit controls independent of manual-control switch positions.

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

3.4 CONNECTIONS

A. Piping installation requirements are specified in other Division 15 Sections. Drawings indicate general arrangement of piping, fittings, and specialties.

B. Ground Equipment: Tighten electrical connectors and terminals according to manufacturer’s published torque-tightening values. If manufacturer’s torque values are not indicated, use those specified in UL 486A and UL 486B.

3.5 FIELD QUALITY CONTROL

A. Manufacturer’s Field Service: Engage a factory-authorized service representative to inspect field-assembled components and equipment installation, including piping and electrical connections. Report results in writing.

1. Operational Test: After electrical circuitry has been energized, start units to confirm proper unit operation. Remove malfunctioning units, replace with new units, and retest.

2. Test and adjust controls and safeties. Replace damaged and malfunctioning controls and equipment, and retest.
3. Calibration and test electric/electronic thermostats by disconnecting input sensors and stimulating operation with compatible signal generator.

B. Replace damaged or malfunctioning controls and equipment.

   1. Start, test, and adjust control systems.
   2. Demonstrate compliance with requirements, including calibration and testing, and control sequences.
   3. Adjust, calibrate, and fine tune circuits and equipment to achieve sequence of operation specified.

C. Verify DDC as follows:

   1. Verify software, including automatic restart, control sequences, scheduling, reset controls, and occupied/unoccupied cycles.
   2. Verify operation of operator workstation.
   3. Verify local control units including self-diagnostics.

3.6 DEMONSTRATION

A. Engage a factory-authorized service representative to train Owner’s maintenance personnel to adjust, operate, and maintain control systems and components.

   1. Train Owner’s maintenance personnel on procedures and schedules for starting and stopping, troubleshooting, servicing, and maintaining equipment and schedules.
   2. Provide operator training on data display, alarm and status descriptors, requesting data, executing commands, calibrating and adjusting devices, resetting default values, and requesting logs. Include a minimum of 40 hours dedicated instructor time on-site.
   3. Review data in maintenance manuals. Refer to Division 1, Section 01700, “Project Closeout.”
   4. Review data in maintenance manuals. Refer to Division 15, Section 15010, Paragraph 1.12, “Operation and Maintenance Data.”
   5. Schedule training with Owner, through Engineer, with at least 7 days’ advance notice.

3.7 ON-SITE ASSISTANCE

A. Occupancy Adjustments: Within one year of date of Substantial Completion, provide up to three Project site visits, when requested by Owner, to adjust and calibrate components and to assist Owner’s personnel in making program changes and in adjusting sensors and controls to suit actual conditions.
3.8 TRAINING

A. Provide a minimum of 16 hours of on-site or classroom training throughout the contract period for personnel designated by the Owner. Each session shall be a minimum of four hours in length and must be coordinated with the building Owner. Train the designated staff of Owner’s Representative and Owner to enable them to:

1. Proficiently operate the system
2. Understand control system architecture and configuration
3. Understand DDC system components
4. Understand system operation, including DDC system control and optimizing routines (algorithms)
5. Operate the workstation and peripherals
6. Log on and off the system
7. Access graphics, point reports, and logs
8. Adjust and change system setpoints, time schedules, and holiday schedules
9. Recognize malfunctions of the system by observation of the printed copy and graphical visual signals
10. Understand system drawings, and Operation and Maintenance Manual
11. Understand the job layout and location of control components
12. Access data from DDC controllers
13. Operate portable operators terminals

PART 4 - SEQUENCE OF OPERATION

A. The existing sequence of control for Air Handling Units 2, 3, 4, 5, 6, 1N and 2N are unchanged. The sequences are repeated here for application to the new controls equipment. The existing sequence of control for air handling unit 1 has been modified for the new equipment.

B. Heating hot water control: the main hot water pump (p-2) will be started if any of the following sets of conditions occur:

1. If outside air temperature sensor is p-2 outside air outside air freeze protection setpoint.
2. If air handling units ahu-2, 3, 4, 5 or 6 are in the occupied mode or the occupied override pushbutton is activated and its space temperature sensor is below its space temperature heating setpoint.
3. If any of the space temperature sensors for AHU-2, 3, 4, 5 or 6 are below their night setback temperature setpoints.

C. The hot water boiler (B-1) will be enabled when any of the following sets of conditions occur:
1. If the outside air temperature sensor is below the boiler night setback run temperature start setpoint.

2. If AHU-2, 3, 4, 5 or 6 are in the occupied mode or the occupied override pushbutton is activated and its space temperature sensor is below its space temperature heating setpoint.

3. If any of the space temperature sensors for AHU-2, 3, 4, 5 or 6 are below their night setback temperature setpoints.

4. If AHU-1 supply fan is operating.

5. If AHU-1 is in the occupied mode or the occupied override pushbutton is activated.

6. If air handling units 1N or 2N are in the occupied mode or the occupied override pushbutton is activated and its space temperature sensor is below its space temperature heating setpoint.

7. If any of the space temperature sensors for air handling units 1N or 2N are below their night setback temperature setpoints.

D. The system operator will select either manual or automatic hot water supply temperature setpoint. If manual is selected, the manual hot water temperature setpoint will be sent to the hot water boiler. If automatic is selected, the calculated hot water supply temperature setpoint will be sent to the hot water boiler. The calculated hot water setpoint will be reset inversely with changes in outside air temperature.

E. Boiler fail alarm and main hot water pump fail alarms will be initiated if status is not “on” when command is “on” after time delay. Boiler on alarm and main hot water pump on alarm will be initiated if status is “on” when command is “off” after time delay. Boiler fail alarm will be initiated after a time delay when the hot water boiler is enabled and the main hot water pump is enabled and the hot water supply temperature is below boiler hot water temperature setpoint. Internal boiler malfunction alarm will be provided.

F. Hot water supply temperature alarm will be provided and will be locked out when the boiler is not enabled or the main hot water pump is not running and for 20 minutes after the boiler is enabled or the main hot water pump is enabled.

G. HOA switch alarm and low ATC air pressure alarm will be provided.

H. Chilled Water Control:

1. The main chill water pump will be started when any of the following conditions occur:
a. If AHU-1chill water valve is more than 50 percent open and the main library space temperature is above its cooling setpoint and AHU-1 supply fan is running and the outside air temperature is above the cooling system “can run” setpoint.

b. If AHU-1chill water valve is more than 50 percent open and the main library space relative humidity is above its space relative humidity setpoint and AHU-1 supply fan is running and the outside air temperature is above the cooling system “can run” setpoint.

c. If air handling units 2, 3, 4, 5 or 6 are in the occupied mode or the occupied override pushbutton is activated and its space temperature sensor is above its space temperature cooling setpoint.

d. If air handling units 1n or 2n are in the occupied mode or the occupied override pushbutton is activated and its space temperature sensor is above its space temperature cooling setpoint and the outside air temperature is above the cooling system “can run” setpoint.

e. If air handling units 1N or 2N are in the occupied mode or the occupied override pushbutton is activated and its space relative humidity sensor is above its space relative humidity setpoint and the outside air temperature is above the cooling system “can run” setpoint.

f. If any of the space temperature sensors for air handling units 1n or 2n are above their night setup temperature setpoints and the outside air temperature is above the cooling system “can run” setpoint.

g. If the outside air temperature is below the outside air freeze protection setpoint.

h. If AHU-1 supply fan is running and the outside air temperature is above the cooling system “must run” setpoint.

2. The chiller will be enabled when the main chill water pump is commanded on and its on status is confirmed.

3. Chiller fail alarm and main chill water pump fail alarms will be initiated if status is not “on” when command is “on” after time delay. Chiller on alarm and main chill water pump on alarm will be initiated if status is “on” when command is “off” after time delay. Chiller fail alarm will be initiated after a time delay when the chiller is enabled and the chill water supply temperature is above the chiller chilled water temperature setpoint.

4. Chill water supply temperature alarm will be provided and will be locked out when the chiller is not enabled and for 30 minutes after the chiller is enabled.

I. Air Handling Unit Control (AHU-1): the summer/winter mode of AHU-1 will be switched to summer when the outside air temperature sensor is above the summer/winter changeover setpoint and switched to winter when the outside air temperature sensor is below the summer/winter changeover setpoint. The summer/winter mode is used to calculate seasonal optimum start space temperature comfort targets and to reverse the action of the optimum start algorithm. The
optimum start algorithm will calculate AHU-1 start time based upon occupancy time, space temperature, space temperature comfort target, outside air temperature, and previous start cycle success in achieving target.

1. AHU-1 will be started if any of the following sets of conditions occur:
   a. The optimum start command is on.
   b. The occupancy command is on.
   c. AHU-1 override through the DDC system is activated.
   d. The space temperature sensor exceeds the space temperature night setup temperature setpoint.
   e. The space temperature sensor falls below the space temperature night setback temperature setpoint.
   f. The space relative humidity exceeds the space relative humidity night setup relative humidity setpoint.

2. When AHU-1 status is off, the unit outside air damper and relief air damper will be closed, the return air damper will be opened, the cooling valve will be closed, and the heating valve will be closed. The cooling valve will be opened to the 10 percent open to the coil position when the outside air temperature is below 35 degrees for freeze protection.

3. The outside air enthalpy will be calculated from the outside air temperature and outside air relative humidity and return air enthalpy will be calculated from return air temperature and space relative humidity. If the outside air enthalpy is lower than the return air enthalpy and the lowest outside air temperature is below the outside air economizer setpoint, the economizer cycle will be enabled. If the return air enthalpy is lower than the outside air enthalpy or the lowest outside air temperature is above the outside air economizer setpoint, the economizer cycle will be disabled. The outside air damper and relief air damper will be closed when the mixed air temperature falls below 50 degrees.

4. When AHU-1 is started and the economizer is enabled, if the space temperature is below the space temperature setpoint, the outside damper will be commanded toward its minimum outside air position and the return air damper commanded toward its maximum return air position. The heating valve will be commanded to the full flow to the coil position. On a rise in space temperature, the heating valve will be modulated toward the closed to the coil position. On a further rise in space temperature and after the heating valve is fully closed to the coil, the outside air damper will be modulated toward its full outside air position and the return air damper toward its minimum outside air position. Space control damper signal will be overridden by the mixed air low limit control program if the mixed air temperature falls below the low limit setpoint. On a further rise in space temperature and after the outside air damper is in its full outside air position, the cooling valve will be modulated open to the full flow to the coil position. The reverse sequence will occur on a fall in
space temperature. If the economizer mode is disabled, the outside and return dampers will remain in their minimum outside air position. The cooling valve will be modulated to maintain the space temperature at the desired setpoint.

5. If the space relative humidity rises above the space relative humidity setpoint of 60% (adjustable), the dehumidification mode will be enabled. The supply fan will be reduced to 50% supply air volume and the space temperature control of the cooling valve will be overridden. The space relative humidity control will fully open the chilled water valve to the coil. If the space temperature falls below the space temperature setpoint, the heating valve will be modulated open to the coil to maintain the desired space temperature setpoint.

6. When AHU-1 supply fan status is on, the space static pressure sensor will modulate the relief air damper to maintain the space static pressure at the setpoint.

7. The air handling unit hot water pump (P-3) will be enabled if any of the following conditions occur:
   a. If AHU-1 supply fan is running and the heating valve is open to the coil either in heating mode or dehumidification mode for more than a specified time period.
   b. If the outside air temperature falls below AHU-1 freeze protection setpoint.

8. The exhaust air fans shall be started whenever AHU-1 or any other air handling unit is running in the scheduled occupied mode.

9. Main air handling unit, exhaust air fan, and air handling unit hot water pump “on” alarms will be initiated if their commands are off and their status is on after a time delay. Main air handling unit, exhaust air fan, and air handling unit hot water pump “fail” alarms will be initiated if their commands are on and their status is off after a time delay.

10. Space temperature, space relative humidity, mixed air temperature, and discharge air temperature alarms will be provided and will be locked out when AHU-1 supply fan is not enabled and for 20 minutes after AHU-1 supply fan is enabled.

J. Air handling unit 1N and 2N control (basement area): the summer/winter mode of the air handling unit will be switched to summer when the outside air temperature sensor is above the summer/winter changeover setpoint and switched to winter when the outside air temperature sensor is below the summer/winter changeover setpoint. The summer/winter mode is used to calculate seasonal optimum start space temperature comfort targets and to reverse the action of the optimum start algorithm. The optimum start algorithm will calculate the air handling unit start time based...
upon occupancy time, space temperature, space temperature comfort target, outside air temperature, and previous start cycle success in achieving target.

1. The air handling unit will be started if any of the following sets of conditions occur:
   a. The optimum start command is on.
   b. The occupancy command is on.
   c. The space temperature is below the space heating setpoint.
   d. The space temperature is above the space cooling setpoint and the outside air temperature is above the cooling system “can run” setpoint.
   e. The space relative humidity is above the space relative humidity setpoint and the outside air temperature is above the cooling system “can run” setpoint.
   f. The air handling unit override pushbutton is activated and the override timer function is active.
   g. The space temperature sensor exceeds the space temperature night setup temperature setpoint.
   h. The space temperature sensor falls below the space temperature night setback temperature setpoint.
   i. The space relative humidity exceeds the space relative humidity night setup relative humidity setpoint.

2. The basement heating pump will be started when either air handling unit 1N or 2N is commanded on and its space temperature falls below its space temperature heating setpoint or one of the space temperatures falls below its space night temperature setback setpoint.

3. The basement cooling pump will be started when either air handling unit 1N or 2N is commanded on and its space temperature rises above its space temperature cooling setpoint or its space relative humidity rises above its space relative humidity setpoint or one of the space temperatures rises above its space night temperature setup setpoint or its space relative humidity rises above its night space relative humidity setup setpoint. All basement cooling pump start conditions require the outside air temperature to be above the outside air “can run” setpoint.

4. The domestic hot water pump when any air handling unit is commanded on or the outside air temperature falls below the domestic hot water pump freeze protection setpoint.

5. Air handling unit 1N supply fan, air handling unit 2N supply fan, basement cooling pump, basement heating pump, and domestic hot water pump “on” alarms will be initiated if their commands are off and their status is on after a time delay. Air handling unit 1N supply fan, air handling unit 2N supply fan, basement cooling pump, basement heating pump, and domestic hot water pump
6. Air handling unit 1N space temperature, air handling unit 2N space temperature, and air handling unit 1N space relative humidity alarms will be provided and will be locked out when their respective air handling unit supply fans are not enabled and for 20 minutes after their respective air handling unit supply fan is enabled.

K. Air Handling Unit 2, 3, 4, 5 and 6 Control (support areas):

1. The summer/winter mode of the air handling units will be switched to summer when the outside air temperature sensor is above the summer/winter changeover setpoint and switched to winter when the outside air temperature sensor is below the summer/winter changeover setpoint. The summer/winter mode is used to calculate seasonal optimum start space temperature comfort targets and to reverse the action of the optimum start algorithm. The optimum start algorithm will calculate the air handling unit start time based upon occupancy time, space temperature, space temperature comfort target, outside air temperature, and previous start cycle success in achieving target.

2. The air handling unit will be started if any of the following sets of conditions occur:
   a. The optimum start command is on (not applicable to air handling unit 4).
   b. The occupancy command is on (except air handling unit 4 which will start whenever main air handling unit or air handling units 2, 3, 5 or 6 are commanded on).
   c. The space temperature is below the space heating setpoint.
   d. The space temperature is above the space cooling setpoint.
   e. The air handling unit override pushbutton is activated and the override timer function is active.
   f. The space temperature sensor falls below the space temperature night setback temperature setpoint.

3. Air handling unit 2 supply fan, air handling unit 3 supply fan, air handling unit 4 supply fan, and air handling unit 5 and 6 supply fan “on” alarms will be initiated if their commands are off and their status is on after a time delay. Air handling unit 2 supply fan, air handling unit 3 supply fan, air handling unit 4 supply fan, and air handling unit 5 and 6 supply fan “fail” alarms will be initiated if their commands are on and their status is off after a time delay.

4. Air handling unit 2 space temperature, air handling unit 3 space temperature, air handling unit 4 space temperature, and air handling unit 5 and 6 space temperature alarms will be provided and will be locked out when their...
respective air handling unit supply fans are not enabled and for 20 minutes after their respective air handling unit supply fan is enabled.
<table>
<thead>
<tr>
<th>System</th>
<th>Point Info</th>
<th>AI</th>
<th>AO</th>
<th>DI</th>
<th>DO</th>
<th>Device</th>
<th>Comments</th>
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<tr>
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<td>Existing 3-W Control Valve</td>
<td>Retrofit valve with new Electronic Actuator</td>
</tr>
<tr>
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<td>Cooling Coil</td>
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<tr>
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<td>Cooling Coil</td>
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<td></td>
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<td></td>
<td>Existing 3-W Control Valve</td>
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<tr>
<td></td>
<td>Space Temperature</td>
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<tr>
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<td><strong>AHU-5A</strong></td>
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<td>Existing 3-W Control Valve</td>
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<td>Cooling Coil</td>
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<td>Space Temperature</td>
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<td>Diff Press Switch</td>
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**AUTOMATIC TEMPERATURE CONTROLS**

15900 - 1
### Replace Main Air Handler and Temperature Controls
Grissom Library
Newport News, Virginia

<table>
<thead>
<tr>
<th>System</th>
<th>Point Info</th>
<th>AI</th>
<th>AO</th>
<th>DI</th>
<th>DO</th>
<th>Device</th>
<th>Comments</th>
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<td>Chilled Water System</td>
<td>Chiller (Enable/Disable)</td>
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END OF SECTION 15900
SECTION 15990 - TESTING, ADJUSTING, AND BALANCING (TAB)

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions, Division 1 Specification Sections, and Section 15010, “Mechanical General Provisions,” apply to this Section.

1.2 SCOPE OF WORK

A. The General Contractor shall obtain the services of an independent testing and balancing agency whose business is limited to testing, adjusting, and balancing and shall be certified by AABC (or NEBB). Agency shall have been in the TAB business for a minimum of 5 years. The TAB (Testing, Adjusting, and Balancing) Agency shall be a direct subcontractor of the General Contractor, and not affiliated in any way with the Mechanical Contractor.


C. All work shall be performed under the direct supervision of a certified TAB Engineer. All other personnel shall be regular full-time employees of the TAB Agency.

D. Test and Balance Agency shall submit within 30 days after receipt of construction contract two copies of qualifications, including current TAB Engineer’s certificate and National Project Certification Performance Guaranty.

E. TAB work shall not commence until all components of the HVAC system have been installed completely, including all power wiring and controls, and all equipment has been started and run tested in each mode of operation. Should any items be found incomplete at the time that TAB work is performed, the TAB Agency shall immediately notify the General Contractor and Owner’s Representative of any deficiencies found. The General Contractor shall be responsible for correcting reported deficiencies and verifying that the system is 100% complete, operable, and ready for TAB work to proceed.
PART 2 - PRODUCTS

2.1 MATERIAL AND EQUIPMENT

A. Provide all necessary instrumentation required to measure and adjust the HVAC air and water systems.

B. Equipment and instruments shall be of types approved by the Owner’s Representative, and/or manufacturers of devices installed.

C. Instruments used for testing and balancing of air and hydronic systems shall have calibration verified within a period of 12 months prior to balancing.

PART 3 - EXECUTION

3.1 GENERAL, MECHANICAL, AND ELECTRICAL CONTRACTOR’S RESPONSIBILITY

A. The General Contractor shall be responsible for directing the Mechanical and Electrical Contractors to fulfill the Contractors’ Responsibility for Testing, Adjusting, and Balancing as required in Section 15010. TAB work shall not commence until the conditions of paragraph 1.2.E of this Section and all requirements of Section 15010 for TAB have been completed.

3.2 TAB AGENCY’S RESPONSIBILITY

A. Carefully review the drawings and Specifications for the various systems noting all facilities incorporated in the design for purposes of adjusting and balancing. Should it be deemed necessary to provide additional dampers, baffles, valves, or other devices which would aid in the required adjusting and balancing, same shall be provided by the installing contractor.

B. The TAB Agency shall report any and all deficiencies that prohibit adjusting and balancing in accordance with the Contract Documents to the Contractor and the Owner’s Representative.

C. Adjust all water piping, duct, and equipment, including valves, controls, dampers, cocks, etc., to properly perform to ±10% of their respective design quantities of flow.

D. Determination of the air volumes shall be made by pitot tube and differential draft gauge for all supply, return, outdoor air, and exhaust air ducts. Openings for pitot traverses shall be provided as required and shall be fitted with neat removable plugs or covers. Air quantities at grilles, registers, diffusers, etc., shall be measured as recommended by the various manufacturers of the outlets.
E. The Test and Balance Agency shall perform the following:

1. Adjust fan RPM, tighten and align fan belts, measure operating amps.
2. Adjust volume dampers to obtain designed air volume.
3. Set balancing valves to obtain designed water flow at units, coils, and branches.
4. Adjust each air handler to obtain designed airflow.
5. Adjust dampers to provide design outside air quantities.
6. In cooperation with the ATC Contractor’s representative, setting adjustments of automatically controlled dampers to operate as specified. The TAB Agency shall inform ATC Contractor of all abnormalities in sequencing and/or calibration of components discovered during balancing.
7. Final settings of dampers and valves shall be permanently marked. Where provided, memory stops and locking devices shall be adjusted and locked to the final setting.

F. Before the work is offered for Final Acceptance, all equipment shall be run through a test to demonstrate that it has been adjusted to meet the requirements of the drawings and Specifications. Copies of the test and adjustment data shall be submitted in a report to the Owner’s Representative prior to final inspection.

G. The TAB Report shall include a General Comments section providing an overview of systems operation, observations of system installation abnormalities and deficiencies, problems encountered, etc. If required, provide explanation of methods of measurement and disparity between measured and design quantities.

H. Test and Balance Agency Report shall include the following data for each system. All sheets shall be neatly typed. Balancing Agency shall submit with his report a set of neatly marked plans identifying location of each piece of equipment, air terminal, flow measuring device, and points of traverse. Report all measured quantities and design quantities where applicable.

1. RPM and CFM of each fan.
2. Supply, return, and outdoor air CFM of each AHU and fan terminal unit where required.
3. Air pressure drop across A/C unit cooling coils.
4. Air pressure drop across each filter bank.
5. Discharge and suction static pressure of each fan.
6. Voltage rating and operating volts of each fan motor. For fan motors requiring three-phase power, record voltage of each individual phased leg and check for voltage imbalance.
7. Amp rating and operating amps of each fan motor. For fan motors requiring three-phase power, record amps of each individual phase.
8. Temperatures for each air handling unit at maximum capacity including the following measurements:
   a. Entering and Leaving air temperature at each coil.
   b. Entering and Leaving water temperature at each coil.
   c. Entering and Leaving air temperatures at each energy recovery wheel on supply and exhaust side of wheel.

9. Air handling unit is defined as any equipment that consists of a fan and coil, including air-handling units.

10. Temperatures for each heat exchanger device at maximum capacity, including the following:
   a. Entering and Leaving water temperature.
   b. Entering and Leaving air temperature.

11. Nameplate data of each piece of HVAC equipment installed.
12. GPM of each pump and corresponding suction and discharge pressure.
13. Voltage rating and operating volts of each pump motor. For pump motors requiring three-phase power, record voltage of each individual phased leg and check for voltage imbalance.
14. Amp rating and operating amps of each pump. For pump motors requiring three-phase power, record amps of each individual phase.
15. Differential pressure and corresponding GPM across each flow measuring device, including automatic flow control devices.
16. Final percent setting after adjustment of each balancing valve where applicable.

I. During the Final Inspection, the Agency shall have present all necessary instrumentation and an individual to make readings of select information which was submitted in the balance report. The select readings shall be made where directed by and in the presence of the Owner’s Representative and shall not deviate more than 5% from the values submitted in the report.

J. The Owner’s Representative may select no more than 20% of all reported data for rechecking. If more than 20% of data verified is not within ±5% of submitted data, the Owner’s Representative may void entire report and ask for complete rebalancing. The field check shall be made within 45 days of approved TAB submittal.

END OF SECTION 15990
SECTION 16010 - ELECTRICAL GENERAL PROVISIONS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SCOPE OF WORK

A. This Section of the Specifications describes the material and installation procedures to be followed for furnishing and installing the electrical equipment and material as outlined and described on the drawings listed in the schedule of drawings and as stated in this Division of the Specifications.

B. Where the word “Contractor” appears in this Division of the Specifications, it applies to the Contractor performing the electrical portion of the work, unless specifically indicated otherwise.

C. The Contractor shall install the systems as specified herein and indicated on the drawings and shall furnish all labor, material, tools, scaffolds, erection equipment, services and other items of expense as necessary as a part of this Contract. This Contract further includes placing the systems into operation and properly testing, adjusting, and balancing all items of equipment as specified and as approved by the Engineer.

1.3 SUPERVISION

A. The Electrical Contractor shall have a Supervisor on the job at all times that any electrical work is being installed. This shall include any and all work being accomplished by contractors who are subcontractors to the prime Electrical Contractor.

1.4 DRAWINGS

A. General arrangements of the necessary conduits, feeders, light fixtures, devices, panels, and equipment are indicated on the drawings in diagrammatic form only. Due to the scale of the drawings, offsets, fittings, and accessories may not be shown. Work indicated but having details omitted shall be provided complete to an operating condition with all fittings, wiring, and ancillary equipment and material as required. Where rearrangement is necessary, submit drawings of proposed changes for approval and coordinate and arrange work with consideration to the mechanical
drawings and to the work of the various building trades. Equipment provided under this Division of the Specifications shall be installed in accordance with the recommendations of the equipment or material manufacturer.

1.5 COORDINATION

A. Coordinate the electrical work with the mechanical drawings and work in order to avoid omissions and to eliminate any interference. Report any discrepancies found, as soon as possible, after discovery, to the Engineer.

1.6 CODES AND STANDARDS

A. Various recognized codes and standards form a part of these Specifications the same as if written fully herein and shall be followed as minimum requirements. The codes and standards will be referred to by their abbreviated names if appropriate and are listed below. Reference to these standards shall be understood to mean the latest edition and accumulative supplements which have been adopted by the “Authority Having Jurisdiction,” unless noted otherwise.

ADA       Americans with Disabilities Act (28 CFR PART 36)
ANSI      American National Standards Institute
ASTM      American Society for Testing and Materials
CBMA      Certified Ballast Manufacturers Association
IBC2006   International Building Code
ICC       International Code Council
ICEA      Insulated Cable Engineers Association
IECC      International Energy Conservation Code
IEEE      Institute of Electrical and Electronics Engineers
NEC       National Electrical Code
NEMA      National Electrical Manufacturers Association
NESC      National Electrical Safety Code
NFPA      National Fire Prevention Association
OSHA      The Occupational Safety and Health Act
UL        Underwriters Laboratories, Inc.

B. All equipment, material, apparatus, and work shall conform to the requirements of the NEC. If the Contractor observes that the drawings and specifications are at variance therewith, he shall notify the Engineer in writing. If the Contractor performs such work contrary to the above referenced rules and regulations and without written acknowledgment or notice thereto, he shall correct this work and bear all cost arising therefrom.

1.7 NOTICES AND FEES
A. Give all required notices, obtain all necessary permits, and pay all required fees, including any fees associated with temporary electrical power services during construction. Utility company fees, which are for the permanent installation of electrical power services, shall be paid for by the Owner.

PART 2 - PRODUCTS

2.1 EQUIPMENT AND MATERIALS

A. See Specification Section 01300, “Submittals,” for shop drawing submittal procedures. Submit shop drawings for all materials required for this project. Obtain approval from the Engineer before manufacture is started on any of same. The shop drawings shall show complete details of the various items, wiring diagrams, etc., and shall be submitted in a sufficient number of copies to allow the Engineer to retain one copy. Approved copies of all shop drawings shall be kept on the job site at all times accessible to the Engineer.

2.2 ACCEPTABLE MANUFACTURERS

A. The following list states specific names of acceptable manufacturers of particular equipment and indicates the types of material on which submittals shall be made:

<table>
<thead>
<tr>
<th>Submittal Information Required:</th>
</tr>
</thead>
<tbody>
<tr>
<td>Disconnect Switches: General Electric Company</td>
</tr>
<tr>
<td>Square D Company</td>
</tr>
<tr>
<td>Eaton/Cutler-Hammer</td>
</tr>
<tr>
<td>Siemens</td>
</tr>
</tbody>
</table>

B. The following list states other materials for which product data submittals shall be made:

Fire Alarm System Components

C. Catalog numbers and manufacturers are listed as a guide for minimum requirements to be met. Material and equipment of manufacturers other than those listed will be given consideration by the Engineer providing the material meets the minimum requirements set forth in these Specifications and providing the material or equipment will provide satisfactory performance for the intended installation and meet the aesthetic performance of the specified item. Submittals of other than
specified equipment shall have indicated on the specification sheets in the shop drawing submittals each item called for in these Specifications by paragraph and subparagraph numbers and/or letters.

D. See Specification Section 01300 for substitution requirements.

E. Any deviation from the manufacturers listed in the preceding list and of those stated in the Contract Documents shall be submitted to the Engineer for approval in accordance with Specification Section 16100, “Materials and Equipment.” Facsimile or email transmission of data for review will not be accepted.

F. The Engineer will review for approval, only one substitute for each type of material specified in the Division 16 Contract Documents. If the substitute material is not approved, the Contractor shall provide the material by one of the specified manufacturers. Approval of substitute material is at the sole discretion of the Engineer, and Owner, and the Contractor shall bear all costs arising therefrom, including any design fees if additional design effort is prudent or required.

PART 3 - EXECUTION

3.1 INSTALLATION

A. “Provide,” as used on the drawings and in these Specifications, shall mean furnish, install, connect, adjust, test, and place into operation, except where otherwise specifically provided in this Contract.

B. Provide coordinated electrical systems, equipment, and material complete with auxiliaries and accessories.

C. Run all conduit concealed except where specifically indicated otherwise. Exposed conduit installation other than where indicated shall be approved by the Owner and Engineer prior to installation.

3.2 CLEANING AND PAINTING

A. Remove all dirt, trash, and oil from all raceways, boxes, fittings, cabinets, panelboards, and switchgear.

B. Protect, to the satisfaction of the Engineer, all equipment provided against damage during construction. If damage does occur to any materials, refinish, repair, or replace the equipment or material as directed by the Engineer.

3.3 REPAIR OF EXISTING WORK
A. Repair of existing work, demolition, and modification of existing electrical distribution systems shall be performed as follows:

1. Workmanship: Lay out work in advance. Exercise care when cutting, channeling, chasing, or drilling of walls, ceilings, or other surfaces as necessary for proper installation, support, or anchorage of conduit, raceways, or other electrical work. Repair damage to buildings, piping, and equipment using skilled craftsmen of trades involved.

2. Existing Concealed Wiring to be Removed: Existing concealed wiring to be removed shall be disconnected from its source. Remove conductors; cut conduits flush with floor, underside of floor, and through walls; and seal openings.

3. Continuation of Service: Maintain continuity of existing circuits to remain. Existing circuits shall remain energized. Circuits which are to remain but were disturbed during demolition shall have circuits wiring and power restored back to original condition as approved by the Architect. Only materials specified for this project may be used.

3.4 RECORD DRAWINGS

A. Refer to Specification Section 01720 “Project Record Documents”.

3.5 MAINTENANCE MANUALS

A. Refer to Specification Section 01730 “Operation and Maintenance Data”.

END OF SECTION 16010
SECTION 16100 - MATERIALS AND METHODS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions, Division 1 Specification Sections, and Section 16010, “Electrical General Provisions,” apply to this Section.

1.2 SCOPE OF WORK

A. Provide all labor, material, equipment, and supplies to fabricate, install, test, and place in operation the electrical and other systems as called for in these Specifications and as indicated on the Contract Drawings.

B. Properly store and protect all material and equipment until installed.

C. All material and equipment shall be new and of the quality noted or specified. All material, equipment, and work of inferior quality will be rejected. Remove rejected material and equipment from the job site immediately and replace, and correct unaccepted work, all by the Contractor at his own expense. The Engineer will decide upon the quality of material and equipment furnished and of the work performed.

1.3 WARRANTIES

A. The Contractor shall provide the Owner with a one-year, unlimited warranty (material and labor) on all work accomplished and materials provided under Division 16, including all components thereof. The warranty start date is the date of project “Substantial Completion” as determined by the Architect.

PART 2 - PRODUCTS

2.1 MATERIAL

A. Electrical material furnished under these Specifications shall be new and listed by UL and shall bear the UL label where labeling service is available for the type of material specified for this project.
2.2 RACEWAYS

A. Raceways shall be of the size indicated or as required by the NEC, whichever is the larger except where larger conduits are specified on the Contract Drawings. Raceways shall be 1/2" minimum.

B. Raceways shall be provided for all electrical systems indicated on the drawings unless specifically indicated otherwise. Raceways shall be hot-dip galvanized rigid steel conduit (GRS), electrical metallic tubing (EMT), flexible metal conduit, or intermediate metallic conduit (IMC). Flexible metal conduit in mechanical room shall be liquidtight.

2.3 CONDUCTORS

A. Conductors shall be of the American Wire Gauge size indicated, specified herein, and shall be so sized to equal or exceed the minimum requirement of the NEC.

B. All conductors shall be copper, except as otherwise indicated.

2.4 OUTLETS

A. Outlet and junction boxes shall be of one-piece galvanized construction of a type and size applicable for use in location indicated on the drawings and as required by the NEC.

B. Location of outlets for equipment is indicated on the drawings. Due to the small scale of the drawings, it is not possible to indicate the exact location. Examine the mechanical drawings and finish conditions and arrange work as required to meet such conditions.

2.5 LABELING

A. Label all disconnect switches provided under Division 16 of these Specifications.

B. Labels shall be machine engraved, laminated, Bakelite, nameplate type. Labels shall have black faces with white letters.

C. Size of labels shall be based on the required lettering and lettering size. The following are the minimum requirements for each type of label:

1. Disconnect Switches: Disconnect switches shall be labeled in 1/4" high letters. First line shall state what the switch is feeding. Second line shall state from which circuit and panel the switch is fed.
D. Attach labels with a minimum of two rivets or sheet metal screws. Adhesive-backed labeling will not be accepted.

2.6 PULL BOXES

A. Install pull boxes at all necessary points, whether indicated on the drawings or not, to prevent injury to conductor insulation or other damage that might result from pulling resistance or for other reasons necessary for proper installation. Minimum dimensions shall not be less than the NEC requirements and shall be increased if necessary for practical reasons or where required to fit the job condition.

B. Above grade pull boxes shall be constructed of galvanized sheet steel, code gauge, except that not less than 12 gauge shall be used for any box. Where boxes are used in connection with exposed conduit, plain covers attached to the box with a suitable number of countersunk flathead machine screws may be used.

C. All junction and pull box covers shall be labeled indicating the circuits contained therein in a manner that will prevent unintentional interference with circuits during testing and servicing. For example: “HE1-13.” See Specification Section 16135 for labeling requirements.

2.7 DISCONNECT SWITCHES

A. Disconnect switches shall conform to governing industry NEMA standards. They shall be listed by UL. Disconnect switches shall be NEMA standard HD, quick-make, quick-break type. Provide disconnect switches where required by the NEC whether indicated or not.

B. Where disconnect switches are indicated or required by the NEC to be weatherproof, furnish NEMA 3R enclosures.

2.8 BRANCH CIRCUITS

A. The branch circuit wiring has been designed to utilize the advantages of multi-wire distribution and shall be installed substantially as indicated on the drawings. Major changes in the grouping or general routing of the branch circuits require prior approval in writing from the Engineer.

B. Where individual 120V or 277V homerun circuits are shown on the drawings, they may be combined as follows:

1. No more than three phase conductors plus three neutrals and one ground per conduit.

2. No two of the same phase conductor per conduit.
3. Provide 120V circuits with individual neutrals per circuit. **Neutrals may not be shared.**
4. Neutral sharing by 277V circuits is acceptable.

C. The number of conductors in each run of conduit is indicated on the drawings, but where there is a conflict between the number of wires indicated and the actual number required as determined by the functional requirements of the connected load, or where the number of wires was inadvertently omitted from the drawings, the correct number and size of wires as determined by the functional requirements of the connected load shall govern and be provided at no additional cost.

### 2.9 MOTOR DISCONNECTING MEANS

A. Provide a disconnecting means for each motor when required by the NEC even if not indicated on the drawings. If required disconnects are not shown on the drawings, a circuit breaker in a panelboard or horsepower rated switch will be acceptable as a disconnecting means, if readily accessible and if located within sight of the motor and in compliance with all codes. A quick-make and quick-break general use tumbler or snap switch will be acceptable for capacities of 20 amperes or less and 300 volts and less, provided the ampere rating of the switch is at least double the rating of the equipment controlled. Switches of 30- to 400-ampere capacity shall be of the enclosed, quick-make and quick-break type, heavy duty, horsepower rated. Switches shall disconnect all ungrounded conductors and shall disconnect grounded conductors if required by the NEC to do so. Switches shall be fused when required by the NEC, the manufacturer of the equipment served, UL, or the local authority having jurisdiction whether indicated or not.

### PART 3 - EXECUTION

### 3.1 INSTALLATION

A. Install material in a first-class and workmanlike manner to the satisfaction of the Engineer.

END OF SECTION 16100
SECTION 16110 - RACEWAYS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions, Division 1 Specification Sections, and Section 16010, “Electrical General Provisions,” apply to this Section.

1.2 SCOPE OF WORK

A. Conduit may be run exposed in mechanical rooms, locations where specifically indicated, and spaces with exposed construction as approved by the Engineer.

B. Provide a conduit system complete with fittings and hangers as specified herein and as required by the NEC. Run all electrical wiring systems above 24 Volts in conduit unless specifically indicated otherwise.

C. Install conduit as a complete system without wiring and continuous from outlet to outlet and from fitting to fitting, mechanically and electrically connected to all boxes, fittings, and wireways, and grounded in accordance with the NEC.

D. Size conduit to equal or exceed the minimum requirements of the NEC (except where sizes are specifically indicated on the drawings).

E. Coordinate the routing of conduit with other trades to avoid conflicts with structural members, piping, ductwork, and other job site conditions.

PART 2 - PRODUCTS

2.1 CONDUIT

A. Minimum size conduit shall be 1/2" unless noted or indicated otherwise on drawings. Use larger sizes as required by the NEC to accommodate the number and sizes of wires contained therein.

B. Conduit concealed in walls or above ceilings shall be rigid steel, electrical metallic tubing (EMT), or intermediate metallic conduit (IMC).

C. EMT and IMC shall be UL approved, hot-dip, high-strength, galvanized steel.
D. Flexible metal conduit shall be galvanized, continuous spiral, single strip type. In areas subject to moisture and where specifically indicated, flexible metal conduit shall have a plastic covering in accordance with NEC Article 350. Fittings shall be standard UL approved with ground connector. Watertight connectors shall be used with plastic-covered conduit. All flexible metal conduit installed in mechanical room shall be plastic covered. The maximum length for flexible metal conduit is 72" unless as otherwise noted.

E. Conduit may not be run in the flutes of metal roof decking, and may not be attached to any part of metal roof decking.

2.2 FITTINGS

A. All conduit entering or leaving panelboards, cabinets, outlet boxes, pull boxes, or junction boxes shall have lock nuts and bushings, except provide insulated throat connectors on EMT conduit 3/4" and 1". Rigid steel conduit shall have a lock nut both inside and outside of the enclosure entered. Install bushings on the ends of IMC conduit and EMT conduit larger than 1". Insulating bushings shall be OZ Type A for rigid and IMC, and Type B for EMT. Conduit entering enclosures through concentric knockouts shall have grounding-type bushings with copper bond wire to enclosure.

B. Fittings for rigid conduit shall be threaded type, except where IMC changes to EMT above floor slab, fittings shall be threadless type.

C. Fittings for EMT shall be UL-approved, steel, concrete-tight, compression type.

2.3 JUNCTION BOXES

A. Use junction boxes on exposed conduit work for changes in direction of conduit runs and breaking around beams and columns.

B. Furnish covers and gaskets with the junction boxes where installed in damp or wet locations.

C. Label all junction and pull box covers indicating the circuits contained therein in a manner that will prevent unintentional interference with circuits during testing and servicing. For example: “HE1-13.” See Specification Section 16135 for labeling requirements.

PART 3 - EXECUTION
3.1 INSTALLATION

A. Conduit may be run exposed in mechanical and electrical equipment rooms. Maintain a minimum clear distance of 6" from parallel runs of flues, steam, or hot water pipes. Do not run conduit horizontally in concrete slabs.

B. Use flexible metal conduit (minimum 18" in length, maximum 72" in length) for connections to all motors and any equipment subject to vibration.

C. Group conduit so it is uniformly spaced, where straight and at turns. Make bends and offsets (where unavoidable) with a hickey or bending machine.

D. Ream conduit after threading to remove all burrs.

E. Securely fasten conduit to outlets, junction boxes, and pull boxes to effect firm electrical contact. Join conduit with approved couplings. Running threads are not allowed.

F. Exercise care to avoid condensation pockets in the installations. Keep conduit, fittings, and boxes free from foreign matter of any kind, before, during, and after installation.

G. Do not use EMT below grade, outdoors, in wet locations, or in first floor mechanical/electrical equipment rooms below 48" above finished floor level. EMT is acceptable for use on mechanical mezzanines and in mechanical rooms above the first floor.

H. Support exposed runs of conduit a maximum of every 8 feet apart and parallel or perpendicular to walls, structural members, or intersections of vertical planes and ceilings with right angle turns consisting of fittings or symmetrical bends. Support conduit within one foot of all changes in direction and on each side of the change.

I. Supports shall be wall brackets, trapeze, strap hanger, or pipe straps, secured to hollow masonry with toggle bolts; to brick and concrete with expansion bolts; to metal surfaces with machine screws; and to wood with wood screws.

J. Use explosive drive equipment to make connections where the use of this equipment is beneficial, and is subject to strict compliance with safety regulations and approved by the Owner.

K. Wooden plugs inserted in masonry and the use of nails as fastening media are prohibited.
L. Install and support conduit from the underside of the upper chord in bar joist construction.

M. Do not support conduit from metal roof decks.

N. Do not attach outlet or junction boxes to metal decking.

END OF SECTION 16110
SECTION 16122 - METAL CLAD CABLES

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions, Division 1 Specifications Sections, and Section 16010, “Electrical General Provisions,” apply to this Section.

1.2 DESCRIPTION

A. Metal clad cables may be utilized for branch circuit wiring in walls and above lay-in-tile ceilings only and installed in accordance with NEC 330.

1.3 REFERENCES

A. Metal clad cable shall be constructed in strict accordance with Underwriters Laboratories, Inc. Standard for Metal Clad Cables, UL 1569. The cable shall bear the UL label and the manufacturer’s “E” number.

B. Further, the product shall have passed UL Test Procedure 1479, Through Penetration Fire Rating, and meet NEC 300.22 Wiring in Ducts, Plenums and Other Air-Handling Spaces.

PART 2 - PRODUCTS

2.1 CONDUCTORS

A. Provide electrical wires, cables, and connectors of manufacturer’s standard materials, as indicated by published product information; designed and constructed as recommended by manufacturer for a complete installation and for application indicated. Except as otherwise indicated, provide copper conductors with conductivity of not less than 98% at 20°C (75°F).

B. Wiring sizes #12 and #10 AWG shall be solid. Larger sizes may be stranded.

PART 3 - EXECUTION
3.1 SPLICES

A. Splicing connectors must have a metal spring that is free to expand. The spring must be suitably coated to resist corrosion. Each connector size must be listed by UL for the intended purpose. The connectors must be suitably color coded to assure that the proper size is used on the wire combinations to be spliced. Each connector must be capable of withstanding 105°C ambient temperatures. The connectors must be compatible with all common rubber and thermoplastic wire insulations. They must also be capable of making copper-to-copper, copper-to-aluminum, and aluminum-to-aluminum splices. At the Contractor’s option, self-strapping electrical tap connectors may be used in wire size and voltage range of the connector. When tape is required for splices, SCOTCHBRAND No. 33, or approved equal, shall be used. Use plastic tape on PVC and its copolymers and rubber-based pressure-sensitive adhesive. The tape must be applicable at temperatures ranging from 0°F through 100°F without loss of physical or electrical properties. The tape must not crack, slip, or flag when exposed to various environments indoor or outdoor. The tape must also be compatible with all synthetic cable insulations as well as cable splicing compounds.

B. Make splices in conductors #8 AWG and larger with solderless connectors, with molded composition covers.

C. Connect conductors #12 and #10 AWG with pre-insulated spring connectors rated at not less than 105°C. Connectors shall be UL approved for fixture and pressure work. Connectors shall be 3M CO. SCOTCHLOK, Type Y, R, and B, or approved equal.

D. Join or terminate conductors #8 AWG and larger with pressure-type copper connectors and properly tape.

E. All branch circuit and control wiring shall be color coded. The color shall be integral with sheath for sizes #12, #10, and #8 AWG. Larger size wire and cable shall be color coded with a minimum 1/2" wide, colored, plastic tape strip. Place strips a minimum of 6" on center anywhere the conductors are accessible and visible. Wire and cable shall be color coded as follows:

<table>
<thead>
<tr>
<th>120/208-Volt System</th>
<th>277/480-Volt System</th>
</tr>
</thead>
<tbody>
<tr>
<td>Phase A - black</td>
<td>Phase A - brown</td>
</tr>
<tr>
<td>Phase B - red</td>
<td>Phase B - orange</td>
</tr>
<tr>
<td>Phase C - blue</td>
<td>Phase C - yellow</td>
</tr>
<tr>
<td>Neutral - white</td>
<td>Neutral - grey</td>
</tr>
<tr>
<td>Ground - green</td>
<td>Ground - green</td>
</tr>
</tbody>
</table>

F. Advise the Engineer if the color coding provided by the utility company differs from that indicated above.
3.2 SUPPORT OF CABLE

A. Cable shall be supported at intervals as required by the NEC. Contractor shall supply the necessary additional bracing of an approved material to support the cable. Where long runs of cable need to be supported, the Contractor shall install a trapeze to support the cable.

B. MC cable shall be located same as required for installation of conduit unless otherwise noted elsewhere in the Contract Documents.

END OF SECTION 16122
SECTION 16125 - CONDUCTORS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions, Division 1 Specification Sections, and Section 16010, “Electrical General Provisions,” apply to this Section.

1.2 SCOPE OF WORK

A. Feeder and branch circuit wiring shall conform to the requirements of the NEC, and shall meet all relevant ASTM specifications.

PART 2 - PRODUCTS

2.1 CONDUCTORS

A. Provide electrical wires, cables, and connectors of manufacturer’s standard materials, as indicated by published product information; designed and constructed as recommended by manufacturer for a complete installation and for application indicated. Except as otherwise indicated, provide copper conductors with conductivity of not less than 98% at 20°C (75°F).

B. Provide factory-fabricated wires of sizes, ampacity ratings, and materials for applications and services indicated. Where not indicated, provide proper wire selection as determined by Installer to comply with project’s installation requirements, the NEC, and NEMA standards. Select from the following UL types those wires with construction features which fulfill project requirements:

1. Type THWN or THHN: Max operating temperature not to exceed 90°C (194°F) (THHN) in dry locations, or 75°C (167°F) (THWN) in wet or dry locations. Insulation, flame-retardant, moisture- and heat-resistant, thermoplastic; outer covering, nylon jacket; conductor, annealed copper.

2. Type XHHW: For dry and wet locations; max operating temperature 90°C (194°F) for dry locations, and 75°C (167°F) for wet locations. Insulation, flame-retardant, cross-linked synthetic polymer; conductor, annealed copper.
C. Unless specified otherwise, power and lighting conductors shall be 600 volt, Type THWN/THHN, or XHHW.

D. Conductors shall be continuous from outlet to outlet with splices made only in pull boxes, junction boxes, and outlet boxes.

E. Do not use wire smaller than #12 AWG for power wiring.

F. Wiring sizes #12 and #10 AWG shall be solid. Larger sizes may be stranded.

PART 3 - EXECUTION

3.1 SPLICES

A. Splicing connectors must have a metal spring that is free to expand. The spring must be suitably coated to resist corrosion. Each connector size must be listed by UL for the intended purpose. The connectors must be suitably color coded to assure that the proper size is used on the wire combinations to be spliced. Each connector must be capable of withstanding 105°C ambient temperatures. The connectors must be compatible with all common rubber and thermoplastic wire insulations. They must also be capable of making copper-to-copper, copper-to-aluminum, and aluminum-to-aluminum splices. At the Contractor’s option, self-strapping electrical tap connectors may be used in wire size and voltage range of the connector. When tape is required for splices, SCOTCHBRAND No. 33, or approved equal, shall be used. Use the plastic tape on PVC and its copolymers and rubber-based pressure-sensitive adhesive. The tape must be applicable at temperatures ranging from 0°F through 100°F without loss of physical or electrical properties. The tape must not crack, slip, or flag when exposed to various environments indoor or outdoor. The tape must also be compatible with all synthetic cable insulations as well as cable splicing compounds.

B. Make splices in conductors #8 AWG and larger with solderless connectors, with molded composition covers.

C. Connect conductors #12 and #10 AWG with pre-insulated spring connectors rated at not less than 105°C. Connectors shall be UL approved for fixture and pressure work. Connectors shall be 3M CO. SCOTCHLOK, Type Y, R, and B, or approved equal.

D. Join or terminate conductors #8 AWG and larger with pressure-type copper connectors and properly tape.
E. All branch circuit, feeder, and control wiring shall be color coded. The color shall be integral with sheath for sizes #12, #10, and #8 AWG. Larger size wire and cable shall be color coded with a minimum 1/2” wide, colored, plastic tape strip. Place strips a minimum of 6” on center anywhere the conductors are accessible and visible. Wire and cable shall be color coded as follows:

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</tr>
<tr>
<td>Neutral - white</td>
<td>Neutral - grey</td>
</tr>
<tr>
<td>Ground - green</td>
<td>Ground - green</td>
</tr>
</tbody>
</table>

F. Advise the Engineer if the color-coding provided by the utility company differs from that indicated above.

END OF SECTION 16125
SECTION 16135 - ELECTRICAL BOXES AND FITTINGS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions, Division 1 Specification Sections, and Section 16010, “Electrical General Provisions,” apply to this Section.

1.2 SCOPE OF WORK

A. Furnish and install all junction boxes of a type and size applicable for use in the location indicated on the drawings and as required by the NEC.

B. Exercise special care in the location of outlet and junction boxes in order that the hanging or recessing of light fixtures will not be obstructed by piping or ductwork installed by other trades. To this end, coordinate the work with representatives of the other trades involved and by reference to the mechanical drawings.

PART 2 - PRODUCTS

2.1 OUTLET BOXES

A. Outlet boxes shall be sheet steel, zinc coated, or cadmium plated.

B. Provide outlet boxes installed but not used, including data outlets, with blank coverplates matching those provided on adjacent outlets.

C. Size boxes as follows:

1. Switch and Receptacle Outlet Boxes: Provide single gang outlet boxes 1-1/2" deep unless required to be larger. Provide extra deep boxes where required.

2. Where larger size boxes are required or called for, they shall be similar in all other respects to the types specified above.

2.2 PULL BOXES AND JUNCTION BOXES

A. Install pull boxes and junction boxes where required for changes in direction, at junction points, and where needed to facilitate wire pulling.

B. Size boxes in accordance with the requirements of the NEC.
C. Boxes shall be constructed of 12-gauge minimum hot-rolled sheet steel and shall be hot-dip galvanized inside and outside to match the conduit. Boxes shall have removable covers.

D. Label the front face of the cover on each box with indelible black marker indicating the number of each circuit contained in or running through the box. In areas where exposed construction is the final finished condition and conduit and junction boxes are called out to be painted, label the inside face of the covers.

PART 3 - EXECUTION

3.1 INSTALLATION

A. Make necessary adjustments in the location of junction boxes to avoid conflicts as approved by the Engineer and at no additional cost to the Owner.

B. Prior to roughing-in conduit, coordinate with other trades and the Owner regarding all equipment requiring electrical connections. Required adjustments to the conduit and wire sizes shall be made at no additional cost.

C. Conduit installation shall be rigid and secure, and, where necessary, angle iron (1" by 1" by 1/4" or larger) shall be used to facilitate adequate mounting.

D. Install electrical boxes and fittings in accordance with manufacturer’s published instructions, applicable requirements of the NEC and NECA “Standard of Installation,” and in accordance with recognized industry practices to fulfill project requirements.

E. Coordinate installation of electrical boxes and fittings with wire/cable, wiring devices, and raceway installation work.

F. Provide knockout closures to cap unused knockout holes where blanks have been removed in panel cans, terminal cabinet backboxes, junction boxes, and pull boxes.

G. Install electrical boxes in those locations which ensure ready accessibility to enclosed electrical wiring.

H. Fasten electrical boxes firmly and rigidly to substrates or structural surfaces to which attached.

I. Subsequent to installation of boxes, protect boxes from construction debris and damage.
J. Upon completion of installation work, properly ground all electrical boxes.

K. Do not mount boxes to metal roof decking.

END OF SECTION 16135
SECTION 16155 - MOTORS AND CONTROLS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions, Division 1 Specification Sections, and Section 16010, “Electrical General Provisions,” apply to this Section.

1.2 SCOPE OF WORK

A. Furnish and install disconnect switches as indicated on the drawings and specified herein.

B. Provide all wiring, disconnect switches, and electrical connections to all equipment provided and requiring electrical connections. Starters and/or contactors, including Variable Frequency Drives (“VFD”) for HVAC equipment that is not integral with the HVAC equipment shall be furnished by the Mechanical Contractor and mounted and provided with power wiring by the Electrical Contractor unless otherwise indicated. Power wiring between starters and/or contactors and the final connection point to the HVAC equipment shall be provided under Division 16. The Mechanical Contractor shall provide the proper number and size of auxiliary contacts required by the HVAC equipment.

C. All control wiring and conduits between control instruments and the motor starter serving a piece of HVAC equipment shall be provided by the Mechanical Contractor under Division 15, unless indicated otherwise on electrical drawings.

PART 2 - PRODUCTS

2.1 DISCONNECT SWITCHES

A. Disconnect switches shall be rated 240 or 600 Volts as required with number of poles and current rating as indicated. Disconnect switches shall be fusible type where indicated, or not indicated but required by the NEC, manufacturer of the equipment served, or the local authority having jurisdiction.

B. If a piece of mechanical equipment is provided on the project which carries a nameplate indicating a fuse size, either “maximum,” “minimum,” or “recommended,” a fused disconnect switch shall be provided whether indicated or not, and it shall be fused equal to the nameplate recommendations or nameplate
C. minimum, whichever is the larger. If the disconnect switch is not indicated on the contract drawings, report this condition to the Architect/Engineer as soon as this condition is found.

D. Switches shall be NEMA standard HD type.

PART 3 - EXECUTION

3.1 INSPECTION

A. Inspect area and conditions under which electrical connections for equipment are to be installed, and notify the General Contractor, in writing, of conditions detrimental to proper completion of the work. Do not proceed with the work until unsatisfactory conditions have been corrected.

3.2 INSTALLATION OF DISCONNECT SWITCHES

A. Coordinate locations of disconnect switches (and magnetic starters furnished under Division 15) with the locations of mechanical equipment, piping, electrical equipment, and any and all other building elements such that all NEC requirements, including working clearances, are met. Adjust locations from those shown on the drawings as required to comply with NEC working clearance requirements at no additional cost to the project.

3.3 ELECTRICAL CONNECTIONS TO EQUIPMENT

A. Provide electrical connections to equipment indicated in accordance with equipment manufacturer's published instructions and with recognized industry practices and complying with applicable requirements of UL, the NEC, and NECA “Standard of Installation,” to ensure that products fulfill requirements.

B. Coordinate with other work, including wires/cables, raceway, and equipment installation, as necessary to properly interface installation of electrical connections for equipment with other work.

C. Connect electrical power supply conductors to equipment in accordance with equipment manufacturer's published instructions and wiring diagrams. Mate and match conductors of electrical connections for proper interface between electrical power supplies and installed equipment.

D. Cover splices with electrical insulating material equivalent to or greater than the electrical insulation rating of the conductors being spliced.
E. Prepare cables and wires by cutting and stripping covering, armor, jacket, and insulation properly to ensure uniform and neat appearance where cables and wires are terminated. Exercise care to avoid cutting through tapes which will remain on conductors. Also avoid “ringing” conductors while skinning wire.

F. Trim cables and wires as short as practicable and arrange routing to facilitate inspection, testing, and maintenance.

G. Tighten connectors and terminals, including screws and bolts, in accordance with equipment manufacturer’s published torque tightening values for equipment connectors. Accomplish tightening by utilizing proper torquing tools, including torque screwdriver, beam-type torque wrench, and ratchet wrench with adjustable torque settings. Where manufacturer’s torquing requirements are not available, tighten connectors and terminals to comply with torquing values contained in UL 486A.

H. Provide flexible metal conduit for motor connections and other electrical equipment connections where subject to movement and vibration.

I. Provide liquid-tight flexible metal conduit for connection of motors and other electrical equipment where subject to movement and vibration and where connections are located where subject to any of the following conditions:
   1. Mechanical Rooms

3.4 FIELD QUALITY CONTROL

A. Upon completion of installation of electrical connections and after circuitry has been energized with rated power source, test connections to demonstrate capability and compliance with requirements. Ensure that direction of rotation of each motor fulfills requirement. Correct malfunctioning units at site, then retest to demonstrate compliance.

END OF SECTION 16155
SECTION 16190 - SUPPORTING DEVICES

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions, Division 1 Specification Sections, and Section 16010, “Electrical General Provisions,” apply to this Section.

1.2 SCOPE OF WORK

A. Extent of supports, anchors, sleeves, and seals is indicated in other Division 16 Sections.

B. Types of supports, anchors, sleeves, and seals specified in this Section include the following:

   C-clamps
   I-beam clamps
   One-hole conduit straps
   Two-hole conduit straps
   Round steel rods
   Expansion anchors
   Toggle bolts
   Wall and floor seals

C. Supports, anchors, sleeves, and seals furnished as part of factory-fabricated equipment are specified as part of equipment assembly in other Division 16 Sections.

1.3 QUALITY ASSURANCE

A. Furnish supporting devices manufactured by firms regularly engaged in manufacture of supporting devices of types, sizes, and ratings required.

B. Comply with the requirements of the NEC, as applicable to construction and installation of electrical supporting devices.

C. Comply with applicable requirements of ANSI/NEMA FB1, “Fittings and Supports for Conduit and Cable Assemblies.”

D. Comply with NECA “Standard of Installation” pertaining to anchors, fasteners, hangers, supports, and equipment mounting.
E. Provide electrical components which are UL-Listed and labeled.

PART 2 - PRODUCTS

2.1 MANUFACTURED SUPPORTING DEVICES

A. Provide supporting devices complying with manufacturer’s standard materials, design, and construction in accordance with published product information and as required for a complete installation, and as herein specified. Where more than one type of device meets indicated requirements, selection is Installer’s option.

B. Provide supporting devices of types, sizes, and materials required, and having the following construction features:

1. Reducing Couplings: Steel rod reducing coupling, 1/2" by 5/8"; galvanized steel; approx. 16 pounds per 100 units.
2. C-Clamps: Galvanized steel; 1/2" rod size; approx. 70 pounds per 100 units.
3. I-Beam Clamps: Galvanized steel, 1-1/4" by 3/16" stock; 3/8" cross bolt; flange width 2"; approx. 52 pounds per 100 units.
4. One-hole Conduit Straps: For supporting metal conduit through 3/4" galvanized steel; approx. 7 pounds per 100 units.
5. Two-hole Conduit Straps: For supporting metal conduit above 3/4" galvanized steel; 3/4" strap width; and 2-1/8" between center of screw holes.
6. Hexagon Nuts: For 1/2" rod size; galvanized steel; approx. 4 pounds per 100 units.
7. Round Steel Rod: Galvanized steel; 1/2" dia.; approx. 67 pounds per 100 feet.
8. Offset Conduit Clamps: For supporting 2" rigid metal conduit; galvanized steel; approx. 200 pounds per 100 units.

C. Provide anchors of types, sizes, and materials required and having the following construction features:

1. Expansion Anchors: 1/2"; approx. 38 pounds per 100 units.
2. Toggle Bolts: Springhead; 3/16" by 4"; approx. 5 pounds per 100 units.

D. Provide sleeves and seals of types, sizes, and materials required, and having the following construction features:

1. Provide factory-assembled, watertight wall and floor seals suitable for sealing around conduit, pipe or tubing passing through concrete floors and concrete block walls. Construct with steel sleeves, malleable-iron body, neoprene sealing grommets and rings, metal pressure rings, pressure clamps and cap screws.
E. Provide U-channel strut system for supporting electrical equipment, 16-gauge hot-dip galvanized steel of sizes required; construct with 9/16" dia. holes, 8" o.c. on top surface, and with the following fittings which mate and match with U-channel:

- Fixture hangers
- Channel hangers
- End caps
- Beam clamps
- Wiring stud
- Rigid conduit clamps
- Conduit hangers
- U-bolts

PART 3 - EXECUTION

3.1 INSTALLATION OF SUPPORTING DEVICES

A. Install hangers, anchors, sleeves, and seals as indicated in accordance with manufacturer’s published instructions and with recognized industry practices to ensure supporting devices comply with the requirements of the NEC, NECA, and ANSI/NEMA for installation of supporting devices.

B. Coordinate with other electrical work, including outlet box, raceway and wiring work, as necessary to interface installation of supporting devices with other work.

C. Install hangers, supports, clamps, and attachments to support conduit and outlet boxes properly from building structure. Arrange for grouping of parallel runs of horizontal conduits to be supported together on trapeze-type hangers where possible. Install supports with maximum spacings indicated.

D. Tighten sleeve seal nuts until sealing grommets have expanded to form watertight seal.

END OF SECTION 16190
SECTION 16450 - GROUNDING

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions, Division 1 Specification Sections, and Section 16010, “Electrical General Provisions,” apply to this Section.

1.2 SCOPE OF WORK

A. Provide grounding for service, conduits, motor frames, metal casings, receptacles, and solid neutral, and as required by NEC Article 250.56 as a minimum. Resistance to ground shall not exceed 25 ohms.

PART 2 - PRODUCTS

2.1 GROUND WIRE

A. Provide a green insulated ground wire, sized per the NEC, in all conduits, junction boxes, and pull boxes.

PART 3 - EXECUTION

3.1 INSTALLATION

A. Connect grounding conductors to the panelboard equipment ground bus and not to the panelboard neutral bus. Also connect grounding bushings to the ground bus. Connect the neutral bus only to the system neutral wire. Provide a bonding wire between the equipment ground bus and the neutral bus in the main distribution equipment only. The grounding system (conduit, cabinets, enclosures, and grounding conductors) and the grounded system (neutral conductors and service equipment ground) shall be separate and independent systems, except at the main distribution equipment.

B. Test resistance to ground and submit readings to the Engineer for approval. Include the date and time of the test and the name of the individual performing the test.

END OF SECTION 16450