



Specifications

Fayetteville State University

McLeod Hall

HVAC Replacement

November 22, 2022

SCO ID #: 21-24131-01A

Code: 42134 Item: 301

M&C Project #: 05815-0044

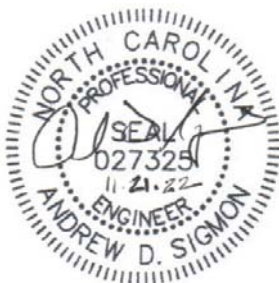


MCKIM & CREED

1730 Varsity Drive, Suite 500

Raleigh, NC 27606

License # F-1222



Advertisement For Bids

Sealed proposals will be received until 1:30pm on December 14, 2022, in the Fayetteville-Cumberland Regional Entrepreneur and Business HUB, 1073 Murchison Road, Fayetteville, NC 28301 and immediately thereafter publicly opened and read for the furnishing of labor, material and equipment for the construction of:

**Fayetteville State University
McLeod Hall, HVAC Replacement
Fayetteville, NC
SCO ID No.: 21-24131-01A Code: 42134 Item: 301**

Bids will be received for **single prime bid** contracts. All Proposals will be lump sum.

Complete plans and specifications for this project can be obtained from McKim & Creed beginning on November 22, 2022. Electronic copies are available to Prime Bidders only by contacting McKim & Creed using contact information via e-mail to Allison Jurgens at ajurgens@mckimcreed.com.

Bid documents will also be available for examination in the plan rooms of iSqFt, CMD Group, Construct Connect, Dodge Data and Analytics, NC Institute of Minority Economic Development (114 W. Parrish St., 4th Floor, Durham, NC), and Hispanic Contractors Association of the Carolinas (877-227-1680).

The State reserves the unqualified right to reject any and all proposals.

Fayetteville State University has an affirmative policy of fostering, promoting and conducting business with minority owned enterprises. Minority contractors are encouraged to participate in the bidding process.

The bidder must include completed minority business subcontractor documentation form(s) with their proposal or the bid may be considered non-responsive and invalid.

Pre-Bid Meeting

A public meeting will be held for all interested bidders at 1:30pm on November 30, 2022 in the Fayetteville-Cumberland Regional Entrepreneur and Business HUB, 1073 Murchison Road, Fayetteville, NC 28301. The meeting will also address project specific questions.

A copy of pertinent sections of the performance standards may be obtained by contacting the designer at the address or phone number noted above.

Jon Parsons
Fayetteville State University
Physical Plant Building
Facilities Management
1200 Murchison Road
Fayetteville, NC 28301

NOTICE TO BIDDERS

Sealed proposals will be received until 1:30 pm on December 14, 2022 in the Fayetteville-Cumberland Regional Entrepreneur and Business HUB, 1073 Murchison Road, Fayetteville, NC 28301 and immediately thereafter publicly opened and read for the furnishing of labor, material and equipment for the construction of:

**Fayetteville State University
McLeod Hall, HVAC Replacement
SCO ID No.: 21-24131-01A Code: 42134 Item: 301**

The Work consists of the following: conversion of 2-pipe system to 4-pipe CHW/HW systems, addition of chilled water piping, replacement of 2-pipe fan coil units and AHUs with 4-pipe units, replacement of exhaust fans, replacement of CHW/HW pumps, lower first floor corridor ceiling, and replace first floor corridor lighting. Additional work to be included as alternates includes chiller replacement, chiller relocation, and HW pipe insulation replacement.

Bids will be received for single prime contract. All proposals shall be lump sum.

Pre-Bid Meeting

A open pre-bid meeting will be held for all interested bidders at 1:30pm on November 30, 2022 in the Fayetteville-Cumberland Regional Entrepreneur and Business HUB, 1073 Murchison Road, Fayetteville, NC 28301. The meeting will also address project specific questions and issues for preferred brand products.

Complete plans, specifications and contract documents will be available the NC Institute of Minority Economic Development, Inc.(114 W. Parrish St., 4th Floor, Durham, NC), the Hispanic Contractors Association of the Carolinas (HCAC) in Winston-Salem, Charlotte and Raleigh areas (877-227-1680), Construct Connect, and Dodge Data and Analytics. Electronic copies can be made available to Prime Bidders only by contacting McKim & Creed via e-mail to Allison Jurgens (ajurgens@mckimcreed.com).

The bidder shall include with the bid proposal the form *Identification of Minority Business Participation* identifying the minority business participation it will use on the project and shall include either *Affidavit A* or *Affidavit B* as applicable. Forms and instructions are included within the Proposal Form in the bid documents. Failure to complete these forms is grounds for rejection of the bid. (GS143-128.2c Effective 1/1/2002)

All contractors are hereby notified that they must have proper license as required under the state laws governing their respective trades. Contractors for this project have been pre-qualified, and a list of pre-qualified contractors is located advertisement for bid section of the project specifications.

General contractors are notified that Chapter 87, Article 1, General Statutes of North Carolina, will be observed in receiving and awarding general contracts. General contractors submitting bids on this project must have license classification for General Contractor (Unlimited).

Under GS 87-1, a contractor that superintends or manages construction of any building, highway, public utility, grading, structure, or improvement shall be deemed a "general contractor" and shall be so licensed. Therefore, a single prime project that involves other trades will require the single prime contractor to hold a proper General Contractors license. On public buildings being bid single prime, where the total value of the general construction does not exceed 25% of the total construction value, contractors under GS87- Arts 2 and 4 (Plumbing,

Mechanical & Electrical) may bid and contract directly with the Owner as the SINGLE PRIME CONTRACTOR and may subcontract to other properly licensed trades. [GS87-1.1- Rules .0210](#)

Each proposal shall be accompanied by a cash deposit or a certified check drawn on some bank or trust company, insured by the Federal Deposit Insurance Corporation, of an amount equal to not less than five percent (5%) of the proposal, or in lieu thereof a bidder may offer a bid bond of five percent (5%) of the bid executed by a surety company licensed under the laws of North Carolina to execute the contract in accordance with the bid bond. Said deposit shall be retained by the owner as liquidated damages in event of failure of the successful bidder to execute the contract within ten days after the award or to give satisfactory surety as required by law.

A performance bond and a payment bond will be required for one hundred percent (100%) of the contract price.

Payment will be made based on ninety-five percent (95%) of monthly estimates and final payment made upon completion and acceptance of work.

No bid may be withdrawn after the scheduled closing time for the receipt of bids for a period of 30 days.

The owner reserves the right to reject any or all bids and to waive informalities.

Designer:

McKim & Creed
1730 Varsity Drive, Suite 500
Raleigh, NC 27606
919-233-8091

Owner:

Fayetteville State University

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STANDARD FORM FOR CONSTRUCTION PROJECTS

**STATE CONSTRUCTION OFFICE
NORTH CAROLINA
DEPARTMENT OF ADMINISTRATION**

Form OC-15

This document is intended for use on State capital construction projects and shall not be used on any project that is not reviewed and approved by the State Construction Office. Extensive modification to the General Conditions by means of “Supplementary General Conditions” is strongly discouraged. State agencies and institutions may include special requirements in “Division 1 – General Requirements” of the specifications, where they do not conflict with the General Conditions.

Twenty Fourth Edition January 2013

INSTRUCTIONS TO BIDDERS

For a proposal to be considered it must be in accordance with the following instructions:

1. PROPOSALS

Proposals must be made in strict accordance with the Form of Proposal provided therefor, and all blank spaces for bids, alternates, and unit prices applicable to bidder's work shall be properly filled in. When requested alternates are not bid, the proposer shall so indicate by the words "No Bid". Any blanks shall also be interpreted as "No Bid". The bidder agrees that bid on Form of Proposal detached from specifications will be considered and will have the same force and effect as if attached thereto. Photocopied or faxed proposals will not be considered. Numbers shall be stated both in writing and in figures for the base bids and alternates. If figures and writing differ, the written number will supersede the figures.

Any modifications to the Form of Proposal (including alternates and/or unit prices) will disqualify the bid and may cause the bid to be rejected.

The bidder shall fill in the Form of Proposal as follows:

- a. If the documents are executed by a sole owner, that fact shall be evidenced by the word "Owner" appearing after the name of the person executing them.
- b. If the documents are executed by a partnership, that fact shall be evidenced by the word "Co-Partner" appearing after the name of the partner executing them.
- c. If the documents are executed on the part of a corporation, they shall be executed by either the president or the vice president and attested by the secretary or assistant secretary in either case, and the title of the office of such persons shall appear after their signatures. The seal of the corporation shall be impressed on each signature page of the documents.
- d. If the proposal is made by a joint venture, it shall be executed by each member of the joint venture in the above form for sole owner, partnership or corporation, whichever form is applicable.
- e. All signatures shall be properly witnessed.
- f. If the contractor's license of a bidder is held by a person other than an owner, partner or officer of a firm, then the licensee shall also sign and be a party to the proposal. The title "Licensee" shall appear under his/her signature.

Proposals should be addressed as indicated in the Advertisement for Bids and be delivered, enclosed in an opaque sealed envelope, marked "Proposal" and bearing the title of the work, name of the bidder, and the contractor's license number of the bidder. Bidders should clearly mark on the outside of the bid envelope which contract(s) they are bidding.

Bidder shall identify on the bid, the minority businesses that will be utilized on the project with corresponding total dollar value of the bid and affidavit listing good faith efforts or an affidavit indicating work under contract will be self-performed, as required by G.S. 143-128.2(c) and G.S. 143-128.2(f). Failure to comply with these requirements is grounds for rejection of the bid.

For projects bid in the single-prime alternative, the names and license numbers of major subcontractors shall be listed on the proposal form.

It shall be the specific responsibility of the bidder to deliver his bid to the proper official at the selected place and prior to the announced time for the opening of bids. Later delivery of a bid for any reason, including delivery by any delivery service, shall disqualify the bid.

Unit prices quoted in the proposal shall include overhead and profit and shall be the full compensation for the contractor's cost involved in the work. See General Conditions, Article 19c-1.

2. EXAMINATION OF CONDITIONS

It is understood and mutually agreed that by submitting a bid the bidder acknowledges that he has carefully examined all documents pertaining to the work, the location, accessibility and general character of the site of the work and all existing buildings and structures within and adjacent to the site, and has satisfied himself as to the nature of the work, the condition of existing buildings and structures, the conformation of the ground, the character, quality and quantity of the material to be encountered, the character of the equipment, machinery, plant and any other facilities needed preliminary to and during prosecution of the work, the general and local conditions, the construction hazards, and all other matters, including, but not limited to, the labor situation which can in any way affect the work under the contract, and including all safety measures required by the Occupational Safety and Health Act of 1970 and all rules and regulations issued pursuant thereto. It is further mutually agreed that by submitting a proposal the bidder acknowledges that he has satisfied himself as to the feasibility and meaning of the plans, drawings, specifications and other contract documents for the construction of the work and that he accepts all the terms, conditions and stipulations contained therein; and that he is prepared to work in cooperation with other contractors performing work on the site.

Reference is made to contract documents for the identification of those surveys and investigation reports of subsurface or latent physical conditions at the site or otherwise affecting performance of the work which have been relied upon by the designer in preparing the documents. The owner will make copies of all such surveys and reports available to the bidder upon request.

Each bidder may, at his own expense, make such additional surveys and investigations as he may deem necessary to determine his bid price for the performance of the work. Any on-site investigation shall be done at the convenience of the owner. Any reasonable request for access to the site will be honored by the owner.

3. BULLETINS AND ADDENDA

Any addenda to specifications issued during the time of bidding are to be considered covered in the proposal and in closing a contract they will become a part thereof. It shall be the bidder's responsibility to ascertain prior to bid time the addenda issued and to see that his bid includes any changes thereby required.

Should the bidder find discrepancies in, or omission from, the drawings or documents or should he be in doubt as to their meaning, he shall at once notify the designer who will send written instructions in the form of addenda to all bidders. Notification should be no later than seven (7) days prior to the date set for receipt of bids. Neither the owner nor the designer will be responsible for any oral instructions.

All addenda should be acknowledged by the bidder(s) on the Form of Proposal. However, even if not acknowledged, by submitting a bid, the bidder has certified that he has reviewed all issued addenda and has included all costs associated within his bid.

4. BID SECURITY

Each proposal shall be accompanied by a cash deposit or a certified check drawn on some bank or trust company insured by the Federal Deposit Insurance Corporation, or a bid bond in an amount equal to not less than five percent (5%) of the proposal, said deposit to be retained by the owner as liquidated damages in event of failure of the successful bidder to execute the contract within ten (10) days after the award or to give satisfactory surety as required by law (G.S. 143-129).

Bid bond shall be conditioned that the surety will, upon demand, forthwith make payment to the obligee upon said bond if the bidder fails to execute the contract. The owner may retain bid securities of any bidder(s) who may have a reasonable chance of award of contract for the full duration of time stated in the Notice to Bidders. Other bid securities may be released sooner, at the discretion of the owner. All bid securities (cash or certified checks) shall be returned to the bidders promptly after award of contracts, and no later than seven (7) days after expiration of the holding period stated in the Notice to Bidders. Standard Form of Bid Bond is included in these specifications and shall be used.

5. RECEIPT OF BIDS

Bids shall be received in strict accordance with requirements of the General Statutes of North Carolina. Bid security shall be required as prescribed by statute. Prior to the closing of the bid, the bidder will be permitted to change or withdraw his bid. Guidelines for opening of public construction bids are available from the State Construction Office.

6. OPENING OF BIDS

Upon opening, all bids shall be read aloud. Once bidding is closed, there shall not be any withdrawal of bids by any bidder and no bids may be returned by the designer to any bidder. After the opening of bids, no bid may be withdrawn, except under the provisions of General Statute 143-129.1, for a period of thirty days unless otherwise specified. Should the successful bidder default and fail to execute a contract, the contract may be awarded to the next lowest and responsible bidder. The owner reserves the unqualified right to reject any and all bids. Reasons for rejection may include, but shall not be limited to, the following:

- a. If the Form of Proposal furnished to the bidder is not used or is altered.
- b. If the bidder fails to insert a price for all bid items, alternate and unit prices requested.
- c. If the bidder adds any provisions reserving the right to accept or reject any award.
- d. If there are unauthorized additions or conditional bids, or irregularities of any kind which tend to make the proposal incomplete, indefinite or ambiguous as to its meaning.
- e. If the bidder fails to complete the proposal form where information is requested so the bid may be properly evaluated by the owner.
- f. If the unit prices contained in the bid schedule are unacceptable to the owner and the State Construction Office.
- g. If the bidder fails to comply with other instructions stated herein.

7. BID EVALUATION

The award of the contract will be made to the lowest responsible bidder as soon as practical. The owner may award on the basis of the base bid and any alternates the owner chooses.

Before awarding a contract, the owner may require the apparent low bidder to qualify himself to be a responsible bidder by furnishing any or all of the following data:

- a. The latest financial statement showing assets and liabilities of the company or other information satisfactory to the owner.
- b. A listing of completed projects of similar size.
- c. Permanent name and address of place of business.
- d. The number of regular employees of the organization and length of time the organization has been in business under present name.
- e. The name and home office address of the surety proposed and the name and address of the responsible local claim agent.
- f. The names of members of the firms who hold appropriate trade licenses, together with license numbers.
- g. If prequalified, contractor info will be reviewed and evaluated comparatively to submitted prequalification package.

Failure or refusal to furnish any of the above information, if requested, shall constitute a basis for disqualification of any bidder.

In determining the lowest responsible, responsive bidder, the owner shall take into consideration the bidder's compliance with the requirements of G.S. 143-128.2(c), the past performance of the bidder on construction contracts for the State with particular concern given to completion times, quality of work, cooperation with other contractors, and cooperation with the designer and owner. Failure of the low bidder to furnish affidavit and/or documentation as required by G.S. 143-128.2(c) shall constitute a basis for disqualification of the bid.

Should the owner adjudge that the apparent low bidder is not the lowest responsible, responsive bidder by virtue of the above information, said apparent low bidder will be so notified and his bid security shall be returned to him.

8. PERFORMANCE BOND

The successful bidder, upon award of contract, shall furnish a performance bond in an amount equal to 100 percent of the contract price. See Article 35, General Conditions.

9. PAYMENT BOND

The successful bidder, upon award of contract, shall furnish a payment bond in an amount equal to 100 percent of the contract price. See Article 35, General Conditions.

10. PAYMENTS

Payments to the successful bidders (contractors) will be made on the basis of monthly estimates. See Article 31, General Conditions.

11. PRE-BID CONFERENCE

Prior to the date set for receiving bids, the Designer may arrange and conduct a Pre-Bid Conference for all prospective bidders. The purpose of this conference is to review project requirements and to respond to questions from prospective bidders and their subcontractors or material suppliers related to the intent of bid documents. Attendance by prospective bidders shall be as required by the "Notice to Bidders".

12. SUBSTITUTIONS

In accordance with the provisions of G.S. 133-3, material, product, or equipment substitutions proposed by the bidders to those specified herein can only be considered during the bidding phase until ten (10) days prior to the receipt of bids when submitted to the Designer with sufficient data to confirm material, product, or equipment equality. Proposed substitutions submitted after this time will be considered only as potential change order.

Submittals for proposed substitutions shall include the following information:

- a. Name, address, and telephone number of manufacturer and supplier as appropriate.
- b. Trade name, model or catalog designation.
- c. Product data including performance and test data, reference standards, and technical descriptions of material, product, or equipment. Include color samples and samples of available finishes as appropriate.
- d. Detailed comparison with specified products including performance capabilities, warranties, and test results.
- e. Other pertinent data including data requested by the Designer to confirm product equality.

If a proposed material, product, or equipment substitution is deemed equal by the Designer to those specified, all bidders of record will be notified by Addendum.

GENERAL CONDITIONS OF THE CONTRACT

The use or reproduction of this document or any part thereof is authorized for and limited to use on projects of the State of North Carolina, and is distributed by, through and at the discretion of the State Construction Office, Raleigh, North Carolina, for that distinct and sole purpose.

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ARTICLE 1 - DEFINITIONS

- a. The **contract documents** consist of the Notice to Bidders; Instructions to Bidders; General Conditions of the Contract; special conditions if applicable; Supplementary General Conditions; the drawing and specifications, including all bulletins, addenda or other modifications of the drawings and specifications incorporated into the documents prior to their execution; the proposal; the contract; the performance bond; the payment bond; insurance certificates; the approval of the attorney general; and the certificate of the Office of State Budget and Management. All of these items together form the contract.
- b. The **owner** is the State of North Carolina through the agency named in the contract.
- c. The **designer(s)** are those referred to within this contract, or their authorized representatives. The Designer(s), as referred to herein, shall mean architect and/or engineer. They will be referred to hereinafter as if each were of the singular number, masculine gender.
- d. The **contractor**, as referred to hereinafter, shall be deemed to be either of the several contracting parties called the "Party of the First Part" in either of the several contracts in connection with the total project. Where, in special instances hereinafter, a particular contractor is intended, an adjective precedes the word "contractor," as "general," "heating," etc. For the purposes of a single prime contract, the term Contractor shall be deemed to be the single contracting entity identified as the "Party of the First Part" in the single Construction Contract. Any references or adjectives that name or infer multiple prime contractors shall be interpreted to mean the single prime Contractor.
- e. A **subcontractor**, as the term is used herein, shall be understood to be one who has entered into a direct contract with a contractor, and includes one who furnishes materials worked to a special design in accordance with plans and specifications covered by the contract, but does not include one who only sells or furnishes materials not requiring work so described or detailed.
- f. **Written notice** shall be defined as notice in writing delivered in person to the contractor, or to a partner of the firm in the case of a partnership, or to a member of the contracting organization, or to an officer of the organization in the case of a corporation, or sent to the last known business address of the contracting organization by registered mail.
- g. **Work**, as used herein as a noun, is intended to include materials, labor, and workmanship of the appropriate contractor.
- h. The **project** is the total construction work to be performed under the contract documents by the several contractors.
- i. **Project Expediter**, as used herein, is an entity stated in the contract documents, designated to effectively facilitate scheduling and coordination of work activities. See Article 14(f) for responsibilities of a Project Expediter. **For the purposes of a single prime contract, the single prime contractor shall be designated as the Project Expediter.**
- j. **Change order**, as used herein, shall mean a written order to the contractor subsequent to the signing of the contract authorizing a change in the contract. The change order shall be signed by the contractor, designer and the owner, and approved by the State Construction Office, in that order (Article 19).

- k. **Field Order**, as used herein, shall mean a written approval for the contractor to proceed with the work requested by owner prior to issuance of a formal Change Order. The field order shall be signed by the contractor, designer, owner, and State Construction Office.
- l. **Time of completion**, as stated in the contract documents, is to be interpreted as consecutive calendar days measured from the date established in the written Notice to Proceed, or such other date as may be established herein (Article 23).
- m. **Liquidated damages**, as stated in the contract documents [, is an amount reasonably estimated in advance to cover the consequential damages associated with the Owner's economic loss in not being able to use the Project for its intended purposes at the end of the contract's completion date as amended by change order, if any, by reason of failure of the contractor(s) to complete the work within the time specified. Liquidated damages does not include the Owner's extended contract administration costs (including but not limited to additional fees for architectural and engineering services, testing services, inspection services, commissioning services, etc.), such other damages directly resulting from delays caused solely by the contractor, or consequential damages that the Owner identified in the bid documents that may be impacted by any delay caused solely by the Contractor (e.g., if a multi-phased project-subsequent phases, delays in start other projects that are dependent on the completion of this Project, extension of leases and/or maintenance agreements for other facilities).
- n. **Surety**, as used herein, shall mean the bonding company or corporate body which is bound with and for the contractor, and which engages to be responsible for the contractor and his acceptable performance of the work.
- o. **Routine written communications between the Designer and the Contractor** are any communication other than a "request for information" provided in letter, memo, or transmittal format, sent by mail, courier, electronic mail, or facsimile. Such communications can not be identified as "request for information".
- p. **Clarification or Request for information (RFI)** is a request from the Contractor seeking an interpretation or clarification by the Designer relative to the contract documents. The RFI, which shall be labeled (RFI), shall clearly and concisely set forth the issue or item requiring clarification or interpretation and why the response is needed. The RFI must set forth the Contractor's interpretation or understanding of the contract documents requirements in question, along with reasons for such an understanding.
- q. **Approval** means written or imprinted acknowledgement that materials, equipment or methods of construction are acceptable for use in the work.
- r. **Inspection** shall mean examination or observation of work completed or in progress to determine its compliance with contract documents.
- s. **"Equal to" or "approved equal"** shall mean materials, products, equipment, assemblies, or installation methods considered equal by the bidder in all characteristics (physical, functional, and aesthetic) to those specified in the contract documents. Acceptance of equal is subject to approval of Designer and owner.
- t. **"Substitution" or "substitute"** shall mean materials, products, equipment, assemblies, or installation methods deviating in at least one characteristic (physical, functional, or aesthetic) from those specified, but which in the opinion of the bidder would improve competition and/or enhance the finished installation. Acceptance of substitution is subject to the approval of the Designer and owner.

- u. **Provide** shall mean furnish and install complete in place, new, clean, operational, and ready for use.
- v. **Indicated and shown** shall mean provide as detailed, or called for, and reasonably implied in the contract documents.
- w. **Special inspector** is one who inspects materials, installation, fabrication, erection or placement of components and connections requiring special expertise to ensure compliance with the approved construction documents and referenced standards.
- x. **Commissioning** is a quality assurance process that verifies and documents that building components and systems operate in accordance to the owner's project requirements and the project design documents.
- y. **Designer Final Inspection** is the inspection performed by the design team to determine the completeness of the project in accordance with approved plans and specifications. This inspection occurs prior to SCO final inspection.
- z. **SCO Final Inspection** is the inspection performed by the State Construction Office to determine the completeness of the project in accordance with NC Building Codes and approved plans and specifications.
- aa. **Beneficial Occupancy** is requested by the owner and is occupancy or partial occupancy of the building after all life safety items have been completed as determined by the State Construction Office. Life safety items include but not limited to fire alarm, sprinkler, egress and exit lighting, fire rated walls, egress paths and security.
- bb. Final Acceptance is the date in which the State Construction Office accepts the construction as totally complete. This includes the SCO Final Inspection and certification by the designer that all punch lists are completed.

ARTICLE 2 - INTENT AND EXECUTION OF DOCUMENTS

- a. The drawings and specifications are complementary, one to the other, and that which is shown on the drawings or called for in the specifications shall be as binding as if it were both called for and shown. The intent of the drawings and specifications is to establish the scope of all labor, materials, transportation, equipment, and any and all other things necessary to provide a bid for a complete job. In case of discrepancy or disagreement in the contract documents, the order of precedence shall be: Form of Contract, specifications, large-scale detail drawings, small-scale drawings.
- b. The wording of the specifications shall be interpreted in accordance with common usage of the language except that words having a commonly used technical or trade meaning shall be so interpreted in preference to other meanings.
- c. The contractor shall execute each copy of the proposal, contract, performance bond and payment bond as follows:
 - 1. If the documents are executed by a sole owner, that fact shall be evidenced by the word "Owner" appearing after the name of the person executing them.
 - 2. If the documents are executed by a partnership, that fact shall be evidenced by the word "Co-Partner" appearing after the name of the partner executing them.

3. If the documents are executed on the part of a corporation, they shall be executed by either the president or the vice president and attested by the secretary or assistant secretary in either case, and the title of the office of such persons shall appear after their signatures. The seal of the corporation shall be impressed on each signature page of the documents.
4. If the documents are made by a joint venture, they shall be executed by each member of the joint venture in the above form for sole owner, partnership or corporation, whichever form is applicable to each particular member.
5. All signatures shall be properly witnessed.
6. If the contractor's license is held by a person other than an owner, partner or officer of a firm, then the licensee shall also sign and be a party to the contract. The title "Licensee" shall appear under his/her signature.
7. The bonds shall be executed by an attorney-in-fact. There shall be attached to each copy of the bond a certified copy of power of attorney properly executed and dated.
8. Each copy of the bonds shall be countersigned by an authorized individual agent of the bonding company licensed to do business in North Carolina. The title "Licensed Resident Agent" shall appear after the signature.
9. The seal of the bonding company shall be impressed on each signature page of the bonds.
10. The contractor's signature on the performance bond and the payment bond shall correspond with that on the contract. The date of performance and payment bond shall not be prior to the date of the contract.

ARTICLE 3 - CLARIFICATIONS AND DETAIL DRAWINGS

- a. In such cases where the nature of the work requires clarification by the designer, such clarification shall be furnished by the designer with reasonable promptness by means of written instructions or detail drawings, or both. Clarifications and drawings shall be consistent with the intent of contract documents, and shall become a part thereof.
- b. The contractor(s) and the designer shall prepare, if deemed necessary, a schedule fixing dates upon which foreseeable clarifications will be required. The schedule will be subject to addition or change in accordance with progress of the work. The designer shall furnish drawings or clarifications in accordance with that schedule. The contractor shall not proceed with the work without such detail drawings and/or written clarifications.

ARTICLE 4 - COPIES OF DRAWINGS AND SPECIFICATIONS

The designer or Owner shall furnish free of charge to the contractors electronic copies of plans and specifications. If requested by the contractor, paper copies of plans and specifications shall be furnished free of charge as follows:

- a. General contractor - Up to twelve (12) sets of general contractor drawings and specifications, up to six (6) sets of which shall include drawings and specifications of all other contracts, plus a clean set of black line prints on white paper of all appropriate drawings, upon which the contractor shall clearly and legibly record all work-in-place that is at variance with the contract documents.

- b. Each other contractor - Up to six (6) sets of the appropriate drawings and specifications, up to three (3) sets of which shall include drawings and specifications of all other contracts, plus a clean set of black line prints on white paper of all appropriate drawings, upon which the contractor shall clearly and legibly record all work-in-place that is at variance with the contract documents.
- c. Additional sets shall be furnished at cost, including mailing, to the contractor upon request by the contractor. This cost shall be stated in the bidding documents.
- d. For the purposes of a single-prime contract, the contractor shall receive up to 30 sets of drawings and specifications, plus a clean set of black line prints on white paper of all appropriate drawings, upon which the contractor shall clearly and legibly record all work-in-place that is at variance with the contract documents.

ARTICLE 5 - SHOP DRAWINGS, SUBMITTALS, SAMPLES, DATA

- a. Within 15 consecutive calendar days after the notice to proceed, each prime contractor shall submit a schedule for submission of all shop drawings, product data, samples, and similar submittals through the Project Expediter to the Designer. This schedule shall indicate the items, relevant specification sections, other related submittal, data, and the date when these items will be furnished to the designer.
- b. The Contractor(s) shall review, approve and submit to the Designer all Shop Drawings, Coordination Drawings, Product Data, Samples, Color Charts, and similar submittal data required or reasonably implied by the Contract Documents. Required Submittals shall bear the Contractor's stamp of approval, any exceptions to the Contract Documents shall be noted on the submittals, and copies of all submittals shall be of sufficient quantity for the Designer to retain up to three (3) copies of each submittal for his own use plus additional copies as may be required by the Contractor. Submittals shall be presented to the Designer in accordance with the schedule submitted in paragraph (a). so as to cause no delay in the activities of the Owner or of separate Contractors.
- c. The Designer shall review required submittals promptly, noting desired corrections if any, and retaining three (3) copies (1 for the Designer, 1 for the owner and 1 for SCO) for his use. The remaining copies of each submittal shall be returned to the Contractor not later than twenty (20) days from the date of receipt by the Designer, for the Contractor's use or for corrections and resubmittal as noted by the Designer. When resubmittals are required, the submittal procedure shall be the same as for the original submittals.
- d. Approval of shop drawings/submittals by the Designer shall not be construed as relieving the Contractor from responsibility for compliance with the design or terms of the contract documents nor from responsibility of errors of any sort in the shop drawings, unless such lack of compliance or errors first have been called in writing to the attention of the Designer by the Contractor.

ARTICLE 6 - WORKING DRAWINGS AND SPECIFICATIONS AT THE JOB SITE

- a. The contractor shall maintain, in readable condition at his job office, one complete set of working drawings and specifications for his work including all shop drawings. Such drawings and specifications shall be available for use by the designer, his authorized representative, owner or State Construction Office.

- b. The contractor shall maintain at the job office, a day-to-day record of work-in-place that is at variance with the contract documents. Such variations shall be fully noted on project drawings by the contractor and submitted to the designer upon project completion and no later than 30 days after final acceptance of the project.
- c. The contractor shall maintain at the job office a record of all required tests that have been performed, clearly indicating the scope of work inspected and the date of approval or rejection.

ARTICLE 7 - OWNERSHIP OF DRAWINGS AND SPECIFICATIONS

All drawings and specifications are instruments of service and remain the property of the owner. The use of these instruments on work other than this contract without permission of the owner is prohibited. All copies of drawings and specifications other than contract copies shall be returned to the owner upon request after completion of the work.

ARTICLE 8 - MATERIALS, EQUIPMENT, EMPLOYEES

- a. The contractor shall, unless otherwise specified, supply and pay for all labor, transportation, materials, tools, apparatus, lights, power, heat, sanitary facilities, water, scaffolding and incidentals necessary for the completion of his work, and shall install, maintain and remove all equipment of the construction, other utensils or things, and be responsible for the safe, proper and lawful construction, maintenance and use of same, and shall construct in the best and most workmanlike manner, a complete job and everything incidental thereto, as shown on the plans, stated in the specifications, or reasonably implied therefrom, all in accordance with the contract documents.
- b. All materials shall be new and of quality specified, except where reclaimed material is authorized herein and approved for use. Workmanship shall at all times be of a grade accepted as the best practice of the particular trade involved, and as stipulated in written standards of recognized organizations or institutes of the respective trades except as exceeded or qualified by the specifications.
- c. Upon notice, the contractor shall furnish evidence as to quality of materials.
- d. Products are generally specified by ASTM or other reference standard and/or by manufacturer's name and model number or trade name. When specified only by reference standard, the Contractor may select any product meeting this standard, by any manufacturer. When several products or manufacturers are specified as being equally acceptable, the Contractor has the option of using any product and manufacturer combination listed. However, the contractor shall be aware that the cited examples are used only to denote the quality standard of product desired and that they do not restrict bidders to a specific brand, make, manufacturer or specific name; that they are used only to set forth and convey to bidders the general style, type, character and quality of product desired; and that equivalent products will be acceptable. Request for substitution of materials, items, or equipment shall be submitted to the designer for approval or disapproval; such approval or disapproval shall be made by the designer prior to the opening of bids. Alternate materials may be requested after the award if it can clearly be demonstrated that it is an added benefit to the owner and the designer and owner approves.
- e. The designer is the judge of equality for proposed substitution of products, materials or equipment.

- g. If at any time during the construction and completion of the work covered by these contract documents, the language, conduct, or attire of any workman of the various crafts be adjudged a nuisance to the owner or designer, or if any workman be considered detrimental to the work, the contractor shall order such parties removed immediately from grounds.

ARTICLE 9 - ROYALTIES, LICENSES AND PATENTS

It is the intention of the contract documents that the work covered herein will not constitute in any way infringement of any patent whatsoever unless the fact of such patent is clearly evidenced herein. The contractor shall protect and save harmless the owner against suit on account of alleged or actual infringement. The contractor shall pay all royalties and/or license fees required on account of patented articles or processes, whether the patent rights are evidenced hereinafter.

ARTICLE 10 - PERMITS, INSPECTIONS, FEES, REGULATIONS

- a. The contractor shall give all notices and comply with all laws, ordinances, codes, rules and regulations bearing on the conduct of the work under this contract. If the contractor observes that the drawings and specifications are at variance therewith, he shall promptly notify the designer in writing. See Instructions to Bidders, Paragraph 3, Bulletins and Addenda. Any necessary changes required after contract award shall be made by change order in accordance with Article 19. If the contractor performs any work knowing it to be contrary to such laws, ordinances, codes, rules and regulations, and without such notice to the designer, he shall bear all cost arising therefrom. Additional requirements implemented after bidding will be subject to equitable negotiations.
- b. All work under this contract shall conform to the North Carolina State Building Code and other State, local and national codes as are applicable. The cost of all required inspections and permits shall be the responsibility of the contractor and included within the bid proposal. All water taps, meter barrels, vaults and impact fees shall be paid by the contractor unless otherwise noted.
- d. Projects constructed by the State of North Carolina or by any agency or institution of the State are not subject to inspection by any county or municipal authorities and are not subject to county or municipal building codes. The contractor shall, however, cooperate with the county or municipal authorities by obtaining building permits. Permits shall be obtained at no cost.
- e. Projects involving local funding (community colleges) are subject also to county and municipal building codes and inspection by local authorities. The contractor shall pay the cost of these permits and inspections.

ARTICLE 11 - PROTECTION OF WORK, PROPERTY AND THE PUBLIC

- a. The contractors shall be jointly responsible for the entire site and the building or construction of the same and provide all the necessary protections, as required by the owner or designer, and by laws or ordinances governing such conditions. They shall be responsible for any damage to the owner's property, or of that of others on the job, by them, their personnel, or their subcontractors, and shall make good such damages. They shall be responsible for and pay for any damages caused to the owner. All contractors shall have access to the project at all times.
- b. The contractor shall provide cover and protect all portions of the structure when the work is not in progress, provide and set all temporary roofs, covers for doorways, sash and windows, and all other materials necessary to protect all the work on the building, whether set by him, or any of the subcontractors. Any work damaged through the lack of proper protection or from any other cause, shall be repaired or replaced without extra cost to the owner.
- c. No fires of any kind will be allowed inside or around the operations during the course of construction without special permission from the designer and owner.
- d. The contractor shall protect all trees and shrubs designated to remain in the vicinity of the operations by building substantial boxes around same. He shall barricade all walks, roads, etc., as directed by the designer to keep the public away from the construction. All trenches, excavations or other hazards in the vicinity of the work shall be well barricaded and properly lighted at night.
- e. The contractor shall provide all necessary safety measures for the protection of all persons on the job, including the requirements of the A.G.C. *Accident Prevention Manual in Construction*, as amended, and shall fully comply with all state laws or regulations and North Carolina State Building Code requirements to prevent accident or injury to persons on or about the location of the work. He shall clearly mark or post signs warning of hazards existing, and shall barricade excavations, elevator shafts, stairwells and similar hazards. He shall protect against damage or injury resulting from falling materials and he shall maintain all protective devices and signs throughout the progress of the work.
- f. The contractor shall adhere to the rules, regulations and interpretations of the North Carolina Department of Labor relating to Occupational Safety and Health Standards for the Construction Industry (Title 29, Code of Federal Regulations, Part 1926, published in Volume 39, Number 122, Part II, June 24, 1974, *Federal Register*), and revisions thereto as adopted by General Statutes of North Carolina 95-126 through 155.
- g. The contractor shall designate a responsible person of his organization as safety officer/inspector to inspect the project site for unsafe health and safety hazards, to report these hazards to the contractor for correction, and whose duties also include accident prevention on the project, and to provide other safety and health measures on the project site as required by the terms and conditions of the contract. The name of the safety inspector shall be made known to the designer and owner at the time of the preconstruction conference and in all cases prior to any work starting on the project.
- h. In the event of emergency affecting the safety of life, the protection of work, or the safety of adjoining properties, the contractor is hereby authorized to act at his own discretion, without further authorization from anyone, to prevent such threatened injury or damage.

Any compensation claimed by the contractor on account of such action shall be determined as provided for under Article 19(b).

- i. Any and all costs associated with correcting damage caused to adjacent properties of the construction site or staging area shall be borne by the contractor. These costs shall include but not be limited to flooding, mud, sand, stone, debris, and discharging of waste products.

ARTICLE 12 - SEDIMENTATION POLLUTION CONTROL ACT OF 1973

- a. Any land-disturbing activity performed by the contractor(s) in connection with the project shall comply with all erosion control measures set forth in the contract documents and any additional measures which may be required in order to ensure that the project is in full compliance with the Sedimentation Pollution Control Act of 1973, as implemented by Title 15, North Carolina Administrative Code, Chapter 4, Sedimentation Control, Subchapters 4A, 4B and 4C, as amended (15 N.C.A.C. 4A, 4B and 4C).
- b. Upon receipt of notice that a land-disturbing activity is in violation of said act, the contractor(s) shall be responsible for ensuring that all steps or actions necessary to bring the project in compliance with said act are promptly taken.
- c. The contractor(s) shall be responsible for defending any legal actions instituted pursuant to N.C.G.S. 113A-64 against any party or persons described in this article.
- d. To the fullest extent permitted by law, the contractor(s) shall indemnify and hold harmless the owner, the designer and the agents, consultants and employees of the owner and designer, from and against all claims, damages, civil penalties, losses and expenses, including, but not limited to, attorneys' fees, arising out of or resulting from the performance of work or failure of performance of work, provided that any such claim, damage, civil penalty, loss or expense is attributable to a violation of the Sedimentation Pollution Control Act. Such obligation shall not be construed to negate, abridge or otherwise reduced any other right or obligation of indemnity which would otherwise exist as to any party or persons described in this article.

ARTICLE 13 - INSPECTION OF THE WORK

- a. It is a condition of this contract that the work shall be subject to inspection during normal working hours and during any time work is in preparation and progress by the designer, designated official representatives of the owner, State Construction Office and those persons required by state law to test special work for official approval. The contractor shall therefore provide safe access to the work at all times for such inspections.
- b. All instructions to the contractor will be made only by or through the designer or his designated project representative. Observations made by official representatives of the owner shall be conveyed to the designer for review and coordination prior to issuance to the contractor.
- c. All work shall be inspected by designer, special inspector and/or State Construction Office prior to being covered by the contractor. Contractor shall give a minimum two weeks notice unless otherwise agreed to by all parties. If inspection fails, after the first reinspection all costs associated with additional reinspections shall be borne by the contractor.

- d. Where special inspection or testing is required by virtue of any state laws, instructions of the designer, specifications or codes, the contractor shall give adequate notice to the designer of the time set for such inspection or test, if the inspection or test will be conducted by a party other than the designer. Such special tests or inspections will be made in the presence of the designer, or his authorized representative, and it shall be the contractor's responsibility to serve ample notice of such tests.
- e. All laboratory tests shall be paid by the owner unless provided otherwise in the contract documents except the general contractor shall pay for laboratory tests to establish design mix for concrete, and for additional tests to prove compliance with contract documents where materials have tested deficient except when the testing laboratory did not follow the appropriate ASTM testing procedures.
- f. Should any work be covered up or concealed prior to inspection and approval by the designer, special inspector, and/or State Construction Office such work shall be uncovered or exposed for inspection, if so requested by the designer in writing. Inspection of the work will be made upon notice from the contractor. All cost involved in uncovering, repairing, replacing, recovering and restoring to design condition, the work that has been covered or concealed will be paid by the contractor involved.

ARTICLE 14 - CONSTRUCTION SUPERVISION AND SCHEDULE

- a. Throughout the progress of the work, each contractor shall keep at the job site, a competent superintendent and supervisory staff satisfactory to the designer and the owner. The superintendent and supervisory staff shall not be changed without the consent of the designer and owner unless said superintendent ceases to be employed by the contractor or ceases to be competent as determined by the contractor, designer or owner. The superintendent and other staff designated by the contractor in writing shall have authority to act on behalf of the contractor, and instructions, directions or notices given to him shall be as binding as if given to the contractor. However, directions, instructions, and notices shall be confirmed in writing.
- b. The contractor shall examine and study the drawings and specifications and fully understand the project design, and shall provide constant and efficient supervision to the work. Should he discover any discrepancies of any sort in the drawings or specifications, he shall report them to the designer without delay. He will not be held responsible for discrepancies in the drawings and/or specifications, but shall be held responsible to report them should they become known to him.
- c. All contractors shall be required to cooperate and consult with each other during the construction of this project. Prior to installation of work, all contractors shall jointly prepare coordination drawings, showing locations of various ductworks, piping, motors, pumps, and other mechanical or electrical equipment, in relation to the structure, walls and ceilings. These drawings shall be submitted to the designer through the Project Expediter for information only. Each contractor shall lay out and execute his work to cause the least delay to other contractors. Each contractor shall be financially responsible for any damage to other contractor's work and for undue delay caused to other contractors on the project.
- d. The contractor is required to attend job site progress conferences as called by the designer. The contractor shall be represented at these job progress conferences by both home office and project personnel. These representatives shall have authority to act on behalf of the contractor. These meetings shall be open to subcontractors, material

suppliers and any others who can contribute toward maintaining required job progress. It shall be the principal purpose of these meetings, or conferences, to effect coordination, cooperation and assistance in every practical way toward the end of maintaining progress of the project on schedule and to complete the project within the specified contract time. Each contractor shall be prepared to assess progress of the work as required in his particular contract and to recommend remedial measures for correction of progress as may be appropriate. The designer or his authorized representative shall be the coordinator of the conferences and shall preside as chairman. The contractor shall turn over a copy of his daily reports to the Designer and Owner at the job site progress conference. Owner will determine daily report format.

- e. The contractor(s) shall, employ an engineer or a land surveyor licensed in the State of North Carolina to lay out the work and to establish a bench mark in a location where same will not be disturbed and where direct instruments sights may be taken.
- f. The designer shall designate a Project Expediter on projects involving two or more prime contracts. The Project Expediter shall be designated in the Supplementary General Conditions. The Project Expediter shall have at a minimum the following responsibilities.
 - 1. Prepare the project construction schedule and shall allow all prime contractors (multi-prime contract) and subcontractors (single-prime contract) performing general, plumbing, HVAC, and electrical work equal input into the preparation of the initial construction schedule.
 - 2. Maintain a project progress schedule for all contractors.
 - 3. Give adequate notice to all contractors to ensure efficient continuity of all phases of the work.
 - 4. Notify the designer of any changes in the project schedule.
 - 5. Recommend to the owner whether payment to a contractor shall be approved.
- g. It shall be the responsibility of the Project Expediter to cooperate with and obtain from several prime contractors and subcontractors on the job, their respective work activities and integrate these activities into a project construction schedule in form of a detailed bar chart or Critical Path Method (CPM), schedule. Each prime contractor shall provide work activities within fourteen (14) days of request by the Project Expediter. A “work activity”, for scheduling purposes, shall be any component or contractual requirement of the project requiring at least one (1) day, but not more than fourteen (14) days, to complete or fulfill. The project construction schedule shall graphically show all salient features of the work required to construct the project from start to finish and within the allotted time established in the contract. The time (in days) between the contractor’s early completion and contractual completion dates is part of the project total float time; and shall be used as such, unless amended by a change order. On a multi-prime project, each prime contractor shall review the proposed construction schedule and approve same in writing. The Project Expediter shall submit the proposed construction schedule to the designer for comments. The complete Project construction schedule shall be of the type set forth in the Supplementary General Condition or subparagraph (1) or (2) below, as appropriate:

1. For a project with total contracts of \$500,000 or less, a bar chart schedule will satisfy the above requirement. The schedule shall indicate the estimated starting and completion dates for each major element of the work.
2. For a project with total contracts over \$500,000, a Critical Path Method (CPM) schedule shall be utilized to control the planning and scheduling of the Work. The CPM schedule shall be the responsibility of the Project Expediter and shall be paid for by the Project Expediter.

Bar Chart Schedule: Where a bar chart schedule is required, it shall be time-scaled in weekly increments, shall indicate the estimated starting and completion dates for each major element of the work by trade and by area, level, or zone, and shall schedule dates for all salient features, including but not limited to the placing of orders for materials, submission of shop drawings and other Submittals for approval, approval of shop drawings by designers, the manufacture and delivery of material, the testing and the installation of materials, supplies and equipment, and all Work activities to be performed by the Contractor. The Contractor shall allow sufficient time in his schedule for all commissioning, required inspections and completion of final punchlist(s). Each Work activity will be assigned a time estimate by the Contractor. One day shall be the smallest time unit used.

CPM Schedule: Where a CPM schedule is required, it shall be in time-scaled precedence format using the Project Expediter's logic and time estimates. The CPM schedule shall be drawn or plotted with activities grouped or zoned by Work area or subcontract as opposed to a random (or scattered) format. The CPM schedule shall be time-scaled on a weekly basis and shall be drawn or plotted at a level of detail and logic which will schedule all salient features of the work to be performed by the Contractor. The Contractor shall allow sufficient time in his schedule for all commissioning, required inspections and completion of final punchlist(s).. Each Work activity will be assigned a time estimate by the Contractor. One day shall be the smallest time unit used.

The CPM schedule will identify and describe each activity, state the duration of each activity, the calendar dates for the early and late start and the early and late finish of each activity, and clearly highlight all activities on the critical path. "Total float" and "free float" shall be indicated for all activities. Float time shall not be considered for the exclusive use or benefit of either the Owner or the Contractor, but must be allocated in the best interest of completing the Work within the Contract time. Extensions to the Contract time, when granted by Change Order, will be granted only when equitable time adjustment exceeds the Total Float in the activity or path of activities affected by the change. On contracts with a price over \$2,500,000, the CPM schedule shall also show what part of the Contract Price is attributable to each activity on the schedule, the sum of which for all activities shall equal the total Contract Price.

Early Completion of Project: The Contractor may attempt to complete the project prior to the Contract Completion Date. However, such planned early completion shall be for the Contractor's convenience only and shall not create any additional rights of the Contractor or obligations of the Owner under this Contract, nor shall it change the Time

for Completion or the Contract Completion Date. The Contractor shall not be required to pay liquidated damages to the Owner because of its failure to complete by its planned earlier date. Likewise, the Owner shall not pay the Contractor any additional compensation for early completion nor will the Owner owe the Contractor any compensation should the Owner, its officers, employees, or agents cause the Contractor not to complete earlier than the date required by the Contract Documents.

- h. The proposed project construction schedule shall be presented to the designer no later than fifteen (15) days after written notice to proceed. No application for payment will be processed until this schedule is accepted by the designer and owner.
- i. The approved project construction schedule shall be distributed to all contractors and displayed at the job site by the Project Expediter.
- j. The several contractors shall be responsible for their work activities and shall notify the Project Expediter of any necessary changes or adjustments to their work. The Project Expediter shall maintain the project construction schedule, making biweekly adjustments, updates, corrections, etc., that are necessary to finish the project within the Contract time, keeping all contractors and the designer fully informed. Copy of a bar chart schedule annotated to show the current progress shall be submitted by the Contractor(s) to the designer, along with monthly request for payment. For project requiring CPM schedule, the Contractor shall submit a biweekly report of the status of all activities. The bar chart schedule or status report shall show the actual Work completed to date in comparison with the original Work scheduled for all activities. If any activities of the work of several contractors are behind schedule, the contractor must indicate in writing, what measures will be taken to bring each such activity back on schedule and to ensure that the Contract Completion Date is not exceeded. A plan of action and recovery schedule shall be developed and submitted to the designer by the Project Expediter, when (1) the contractor's report indicates delays, that are in the opinion of the designer or the owner, of sufficient magnitude that the contractor's ability to complete the work by the scheduled completion is brought into question; (2) the updated construction schedule is thirty (30) days behind the planned or baseline schedule and no legitimate time extensions, as determined by the Designer, are in process; and (3) the contractor desires to make changes in the logic (sequencing of work) or the planned duration of future activities of the CPM schedule which, in the opinion of the designer or the owner, are of a major nature. The plan of action, when required shall be submitted to the Owner for review within two (2) business days of the Contractor receiving the Owner's written demand. The recovery schedule, when required, shall be submitted to the Owner within five (5) calendar days of the Contractor's receiving the Owner's written demand. Failure to provide an updated construction schedule or a recovery schedule may be grounds for rejection of payment applications or withholding of funds as set forth in Article 33.
- k. The Project Expediter shall notify each contractor of such events or time frames that are critical to the progress of the job. Such notice shall be timely and reasonable. Should the progress be delayed due to the work of any of the several contractors, it shall be the duty of the Project Expediter to immediately notify the contractor(s) responsible for such delay, the designer, the State Construction Office and other prime contractors. The designer shall determine the contractor(s) who caused the delays and notify the bonding company of the responsible contractor(s) of the delays; and shall make a recommendation to the owner regarding further action.
- l. Designation as Project Expediter entails an additional project control responsibility and does not alter in any way the responsibility of the contractor so designated, nor the

responsibility of the other contractors involved in the project. The project expeditor's Superintendent(s) shall be in attendance at the Project site at all times when work is in progress unless conditions are beyond the control of the Contractor or until termination of the Contract in accordance with the Contract Documents. It is understood that such Superintendent shall be acceptable to the Owner and Designer and shall be the one who will be continued in that capacity for the duration of the project unless he ceases to be on the Contractor's payroll or the Owner otherwise agrees. The Superintendent shall not be employed on any other project for or by the Contractor or by any other entity during the course of the Work. If the Superintendent is employed by the Contractor on another project without the Owner's approval, then the Owner may deduct from the Contractor's monthly general condition costs and amount representing the Superintendent's cost and shall deduct that amount for each month thereafter until the Contractor has the Superintendent back on the Owner's Project full-time.

ARTICLE 15 - SEPARATE CONTRACTS AND CONTRACTOR RELATIONSHIPS

- a. Effective from January 1, 2002, Chapter 143, Article 8, was amended, to allow public contracts to be delivered by the following delivery methods: single-prime, dual (single-prime and separate-prime), construction manager at risk, and alternative contracting method as approved by the State Building Commission. The owner reserves the right to prepare separate specifications, receive separate bids, and award separate contracts for such other major items of work as may be in the best interest of the State. For the purposes of a single prime contract, refer to Article 1 – Definitions.
- b. All contractors shall cooperate with each other in the execution of their work, and shall plan their work in such manner as to avoid conflicting schedules or delay of the work. See Article 14, Construction Supervision.
- c. If any part of contractor's work depends upon the work of another contractor, defects which may affect that work shall be reported to the designer in order that prompt inspection may be made and the defects corrected. Commencement of work by a contractor where such condition exists will constitute acceptance of the other contractor's work as being satisfactory in all respects to receive the work commenced, except as to defects which may later develop. The designer shall be the judge as to the quality of work and shall settle all disputes on the matter between contractors.
- d. Any mechanical or electrical work such as sleeves, inserts, chases, openings, penetrations, etc., which is located in the work of the general contractor shall be built in by the general contractor. The respective mechanical and electrical contractors shall set all sleeves, inserts and other devices that are to be incorporated into the structure in cooperation and under the supervision of the general contractor. The responsibility for the exact location of such items shall be that of the mechanical and/or electrical contractor.
- e. The designer and the owner shall have access to the work whenever it is in preparation and progress and during normal working hours. The contractor shall provide facilities for such access so the designer may perform his functions under the contract documents.
- f. Should a contractor cause damage to the work or property of another contractor, he shall be directly responsible, and upon notice, shall promptly settle the claim or otherwise resolve the dispute.

ARTICLE 16 - SUBCONTRACTS AND SUBCONTRACTORS

- a. Within thirty (30) days after award of the contract, the contractor shall submit to the designer, owner and to the State Construction Office a list giving the names and addresses of subcontractors and equipment and material suppliers he proposes to use, together with the scope of their respective parts of the work. Should any subcontractor be disapproved by the designer or owner, the designer or owner shall submit his reasons for disapproval in writing to the State Construction Office for its consideration with a copy to the contractor. If the State Construction Office concurs with the designer's or owner's recommendation, the contractor shall submit a substitute for approval. The designer and owner shall act promptly in the approval of subcontractors, and when approval of the list is given, no changes of subcontractors will be permitted except for cause or reason considered justifiable by the designer or owner.
- b. The designer will furnish to any subcontractor, upon request, evidence regarding amounts of money paid to the contractor on account of the subcontractor's work.
- c. The contractor is and remains fully responsible for his own acts or omissions as well as those of any subcontractor or of any employee of either. The contractor agrees that no contractual relationship exists between the subcontractor and the owner in regard to the contract, and that the subcontractor acts on this work as an agent or employee of the contractor.
- d. The owner reserves the right to limit the amount of portions of work to be subcontracted as hereinafter specified.

ARTICLE 17 - CONTRACTOR AND SUBCONTRACTOR RELATIONSHIPS

The contractor agrees that the terms of these contract documents shall apply equally to each subcontractor as to the contractor, and the contractor agrees to take such action as may be necessary to bind each subcontractor to these terms. The contractor further agrees to conform to the Code of Ethical Conduct as adopted by the Associated General Contractors of America, Inc., with respect to contractor-subcontractor relationships, and that payments to subcontractors shall be made in accordance with the provisions of G.S. 143-134.1 titled Interest on final payments due to prime contractors: payments to subcontractors.

- a. On all public construction contracts which are let by a board or governing body of the state government or any political subdivision thereof, except contracts let by the Department of Transportation pursuant to G.S. 136-28.1, the balance due prime contractors shall be paid in full within 45 days after respective prime contracts of the project have been accepted by the owner, certified by the architect, engineer or designer to be completed in accordance with terms of the plans and specifications, or occupied by the owner and used for the purpose for which the project was constructed, whichever occurs first. Provided, however, that whenever the architect or consulting engineer in charge of the project determines that delay in completion of the project in accordance with terms of the plans and specifications is the fault of the contractor, the project may be occupied and used for the purposes for which it was constructed without payment of any interest on amounts withheld past the 45 day limit. No payment shall be delayed because of the failure of another prime contractor on such project to complete his contract. Should final payment to any prime contractor beyond the date such contracts have been certified to be completed by the designer or architect, accepted by the owner, or occupied by the owner and used for the purposes for which the project was constructed, be delayed by more than 45 days, said prime contractor shall be paid interest, beginning on the 46th day, at the rate of one percent (1%) per month or fraction thereof unless a lower rate is

agreed upon on such unpaid balance as may be due. In addition to the above final payment provisions, periodic payments due a prime contractor during construction shall be paid in accordance with the payment provisions of the contract documents or said prime contractor shall be paid interest on any such unpaid amount at the rate stipulated above for delayed final payments. Such interest shall begin on the date the payment is due and continue until the date on which payment is made. Such due date may be established by the terms of the contract. Funds for payment of such interest on state-owned projects shall be obtained from the current budget of the owning department, institution or agency. Where a conditional acceptance of a contract exists, and where the owner is retaining a reasonable sum pending correction of such conditions, interest on such reasonable sum shall not apply.

- b. Within seven days of receipt by the prime contractor of each periodic or final payment, the prime contractor shall pay the subcontractor based on work completed or service provided under the subcontract. Should any periodic or final payment to the subcontractor be delayed by more than seven days after receipt of periodic or final payment by the prime contractor, the prime contractor shall pay the subcontractor interest, beginning on the eighth day, at the rate of one percent (1%) per month or fraction thereof on such unpaid balance as may be due.
- c. The percentage of retainage on payments made by the prime contractor to the subcontractor shall not exceed the percentage of retainage on payments made by the owner to the prime contractor. Any percentage of retainage on payments made by the prime contractor to the subcontractor that exceeds the percentage of retainage on payments made by the owner to the prime contractor shall be subject to interest to be paid by the prime contractor to the subcontractor at the rate of one percent (1%) per month or fraction thereof.
- d. Nothing in this section shall prevent the prime contractor at the time of application and certification to the owner from withholding application and certification to the owner for payment to the subcontractor for unsatisfactory job progress; defective construction not remedied; disputed work; third-party claims filed or reasonable evidence that claim will be filed; failure of subcontractor to make timely payments for labor, equipment and materials; damage to prime contractor or another subcontractor; reasonable evidence that subcontract cannot be completed for the unpaid balance of the subcontract sum; or a reasonable amount for retainage not to exceed the initial percentage retained by owner.

ARTICLE 18 - DESIGNER'S STATUS

- a. The designer shall provide general administration of the performance of construction contracts, including liaison and necessary inspection of the work to ensure compliance with plans and specifications. He is the agent of the owner only for the purpose of constructing this work and to the extent stipulated in the contract documents. He has authority to direct work to be performed, to stop work, to order work removed, or to order corrections of faulty work, where any such action by the designer may be necessary to assure successful completion of the work.
- b. The designer is the impartial interpreter of the contract documents, and, as such, he shall exercise his powers under the contract to enforce faithful performance by both the owner and the contractor, taking sides with neither.
- c. Should the designer cease to be employed on the work for any reason whatsoever, then the owner shall employ a competent replacement who shall assume the status of the former designer.

- d. The designer and his consultants will make inspections of the project. He will inspect the progress, the quality and the quantity of the work.
- e. The designer and the owner shall have access to the work whenever it is in preparation and progress during normal working hours. The contractor shall provide facilities for such access so the designer and owner may perform their functions under the contract documents.
- f. Based on the designer's inspections and evaluations of the project, the designer shall issue interpretations, directives and decisions as may be necessary to administer the project. His decisions relating to artistic effect and technical matters shall be final, provided such decisions are within the limitations of the contract.

ARTICLE 19 - CHANGES IN THE WORK

- a. The owner may have changes made in the work covered by the contract. These changes will not invalidate and will not relieve or release the contractor from any guarantee given by him pertinent to the contract provisions. These changes will not affect the validity of the guarantee bond and will not relieve the surety or sureties of said bond. All extra work shall be executed under conditions of the original contract.
- b. Except in an emergency endangering life or property, no change shall be made by the contractor except upon receipt of approved change order or written field order from the designer, countersigned by the owner and the state construction office authorizing such change. No claim for adjustments of the contract price shall be valid unless this procedure is followed.

A field order, transmitted by fax, electronically, or hand delivered, may be used where the change involved impacts the critical path of the work. A formal change order shall be issued as expeditiously as possible.

In the event of emergency endangering life or property, the contractor may be directed to proceed on a time and material basis whereupon the contractor shall proceed and keep accurately on such form as specified by the designer or owner, a correct account of costs together with all proper invoices, payrolls and supporting data. Upon completion of the work the change order will be prepared as outlined under either Method "c(1)" or Method "c(2)" or both.

- c. In determining the values of changes, either additive or deductive, contractors are restricted to the use of the following methods:
 - 1. Where the extra work involved is covered by unit prices quoted in the proposal, or subsequently agreed to by the Contractor, Designer, Owner and State Construction Office the value of the change shall be computed by application of unit prices based on quantities, estimated or actual as agreed of the items involved, except in such cases where a quantity exceeds the estimated quantity allowance in the contract by one hundred percent (100%) or more. In such cases, either party may elect to proceed under subparagraph c2 herein. If neither party elects to proceed under c2, then unit prices shall apply.
 - 2. The contracting parties shall negotiate and agree upon the equitable value of the change prior to issuance of the change order, and the change order shall stipulate the corresponding lump sum adjustment to the contract price.

- d. Under Paragraph "b" and Methods "c(2)" above, the allowances for overhead and profit combined shall be as follows: all contractors (the single contracting entity (prime), his subcontractors (1st tier subs), or their sub-subcontractors (2nd tier subs, 3rd tier subs, etc)) shall be allowed a maximum of 10% on work they each self-perform; the prime contractor shall be allowed a maximum of 5% on contracted work of his 1st tier sub; 1st tier, 2nd tier, 3rd tier, etc contractors shall be allowed a maximum of 2.5% on the contracted work of their subs. ; Under Method "c(1)", no additional allowances shall be made for overhead and profit. In the case of deductible change orders, under Method "c(2)" and Paragraph (b) above, the contractor shall include no less than five percent (5%) profit, but no allowances for overhead.
- e. The term "net cost" as used herein shall mean the difference between all proper cost additions and deductions. The "cost" as used herein shall be limited to the following:
1. The actual costs of materials and supplies incorporated or consumed as part of the work;
 2. The actual costs of labor expended on the project site; labor expended in coordination, change order negotiation, record document maintenance, shop drawing revision or other tasks necessary to the administration of the project are considered overhead whether they take place in an office or on the project site.
 3. The actual costs of labor burden, limited to the costs of social security (FICA) and Medicare/Medicaid taxes; unemployment insurance costs; health/dental/vision insurance premiums; paid employee leave for holidays, vacation, sick leave, and/or petty leave, not to exceed a total of 30 days per year; retirement contributions; worker's compensation insurance premiums; and the costs of general liability insurance when premiums are computed based on payroll amounts; the total of which shall not exceed thirty percent (30%) of the actual costs of labor;
 4. The actual costs of rental for tools, excluding hand tools; equipment; machinery; and temporary facilities required for the work;
 5. The actual costs of premiums for bonds, insurance, permit fees, and sales or use taxes related to the work.
- Overtime and extra pay for holidays and weekends may be a cost item only to the extent approved by the owner.
- f. Should concealed conditions be encountered in the performance of the work below grade, or should concealed or unknown conditions in an existing structure be at variance with the conditions indicated by the contract documents, the contract sum and time for completion may be equitably adjusted by change order upon claim by either party made within thirty (30) days after the condition has been identified. The cost of such change shall be arrived at by one of the foregoing methods. All change orders shall be supported by a unit cost breakdown showing method of arriving at net cost as defined above.
- g. In all change orders, the procedure will be for the designer to request proposals for the change order work in writing. The contractor will provide such proposal and supporting data in suitable format. The designer shall verify correctness. Delay in the processing of the change order due to lack of proper submittal by the contractor of all required supporting data shall not constitute grounds for a time extension or basis of a claim. Within fourteen (14) days after receipt of the contractor's accepted proposal including all supporting documentation required by the designer, the designer shall prepare the change order and forward to the contractor for his signature or otherwise respond, in writing, to

the contractor's proposal. Within seven (7) days after receipt of the change order executed by the contractor, the designer shall, certify the change order by his signature, and forward the change order and all supporting data to the owner for the owner's signature. The owner shall execute the change order and forward to the State Construction Office for final approval, within seven (7) days of receipt. The State Construction Office shall act on the change order within seven (7) days. In case of emergency or extenuating circumstances, approval of changes may be obtained verbally by telephone or field orders approved by all parties, then shall be substantiated in writing as outlined under normal procedure.

- h. At the time of signing a change order, the contractor shall be required to certify as follows:

"I certify that my bonding company will be notified forthwith that my contract has been changed by the amount of this change order, and that a copy of the approved change order will be mailed upon receipt by me to my surety."

- i. A change order, when issued, shall be full compensation, or credit, for the work included, omitted or substituted. It shall show on its face the adjustment in time for completion of the project as a result of the change in the work.
- j. If, during the progress of the work, the owner requests a change order and the contractor's terms are unacceptable, the owner, with the approval of the State Construction Office, may require the contractor to perform such work on a time and material basis whereupon the contractor shall proceed and keep accurately on such form as specified by the Designer or owner, a correct account of cost together with all proper invoices, payrolls and supporting data. Upon completion of the work a change order will be prepared with allowances for overhead and profit per paragraph d. above and "net cost" and "cost" per paragraph e. above. Without prejudice, nothing in this paragraph shall preclude the owner from performing or to have performed that portion of the work requested in the change order.

ARTICLE 20 - CLAIMS FOR EXTRA COST

- a. Should the contractor consider that as a result of instructions given by the designer, he is entitled to extra cost above that stated in the contract, he shall give written notice thereof to the designer within seven (7) days without delay. The written notice shall clearly state that a claim for extra cost is being made and shall provide a detailed justification for the extra cost. The contractor shall not proceed with the work affected until further advised, except in emergency involving the safety of life or property, which condition is covered in Article 19(b) and Article 11(h). No claims for extra compensation shall be considered unless the claim is so made. The designer shall render a written decision within seven (7) days of receipt of claim.
- b. The contractor shall not act on instructions received by him from persons other than the designer, and any claims for extra compensation or extension of time on account of such instruction will not be honored. The designer shall not be responsible for misunderstandings claimed by the contractor of verbal instructions which have not been confirmed in writing, and in no case shall instructions be interpreted as permitting a departure from the contract documents unless such instruction is confirmed in writing and supported by a properly authorized change order.
- c. Should a claim for extra compensation that complies with the requirements of (a) above by the contractor and is denied by the designer or owner, and cannot be resolved by a

representative of the State Construction Office, the contractor may request a mediation in connection with GS 143-128(f1) in the dispute resolution rules adopted by the State Building Commission (1 N.C.A.C. 30H .0101 through .1001). If the contractor is unable to resolve its claim as a result of mediation, the contractor may pursue the claim in accordance with the provisions of G.S. 143-135.3, or G.S. 143-135.6 where Community Colleges are the owner, and the following:

1. A contractor who has not completed a contract with a board for construction or repair work and who has not received the amount he claims is due under the contract may submit a verified written claim to the director of the State Construction Office of the Department of Administration for the amount the contractor claims is due. The director may deny, allow or compromise the claim, in whole or in part. A claim under this subsection is not a contested case under Chapter 150B of the General Statutes.
2.
 - (a) A contractor who has completed a contract with a board for construction or repair work and who has not received the amount he claims is due under the contract may submit a verified written claim to the director of the State Construction Office of the Department of Administration for the amount the contractor claims is due. The claim shall be submitted within sixty (60) days after the contractor receives a final statement of the board's disposition of his claim and shall state the factual basis for the claim.
 - (b) The director shall investigate a submitted claim within ninety (90) days of receiving the claim, or within any longer time period upon which the director and the contractor agree. The contractor may appear before the director, either in person or through counsel, to present facts and arguments in support of his claim. The director may allow, deny or compromise the claim, in whole or in part. The director shall give the contractor a written statement of the director's decision on the contractor's claim.
 - (c) A contractor who is dissatisfied with the director's decision on a claim submitted under this subsection may commence a contested case on the claim under Chapter 150B of the General Statutes. The contested case shall be commenced within sixty (60) days of receiving the director's written statement of the decision.
 - (d) As to any portion of a claim that is denied by the director, the contractor may, in lieu of the procedures set forth in the preceding subsection of this section, within six (6) months of receipt of the director's final decision, institute a civil action for the sum he claims to be entitled to under the contract by filing a verified complaint and the issuance of a summons in the Superior Court of Wake County or in the superior court of any county where the work under the contract was performed. The procedure shall be the same as in all civil actions except that all issues shall be tried by the judge, without a jury.

ARTICLE 21 - MINOR CHANGES IN THE WORK

The designer will have the authority to order minor changes in the work not involving an adjustment in the contract sum or time for completion, and not inconsistent with the intent of the contract documents. Such changes shall be effected by written order, copied to the State Construction Office, and shall be binding on the owner and the contractor.

ARTICLE 22 - UNCORRECTED FAULTY WORK

Should the correction of faulty or damaged work be considered inadvisable or inexpedient by the owner and the designer, the owner shall be reimbursed by the contractor. A change order will be issued to reflect a reduction in the contract sum.

ARTICLE 23 - TIME OF COMPLETION, DELAYS, EXTENSION OF TIME

- a. The time of completion is stated in the Supplementary General Conditions and in the Form of Construction Contract. The Project Expediter, upon notice of award of contract, shall prepare a construction schedule to complete the project within the time of completion as required by Article 14.
- b. The contractors shall commence work to be performed under this agreement on a date to be specified in a written Notice to Proceed from the designer and shall fully complete all work hereunder within the time of completion stated. Time is of the essence and the contractor acknowledges the Owner will likely suffer financial damage for failure to complete the work within the time of completion. For each day in excess of the above number of days, the contractor(s) shall pay the owner the sum stated as liquidated damages reasonably estimated in advance to cover the losses to be incurred by the owner by reason of failure of said contractor(s) to complete the work within the time specified, such time being in the essence of this contract and a material consideration thereof.
- c. In the event of multiple prime contractors, the designer shall be the judge as to the division of responsibility between the contractor(s), based on the construction schedule, weekly reports and job records, and shall apportion the amount of liquidated damages to be paid by each of them, according to delay caused by any or all of them.
- d. If the contractor is delayed at any time in the progress of his work solely by any act or negligence of the owner, the designer, or by any employee of either; by any separate contractor employed by the owner; by changes ordered in the work; by labor disputes at the project site; by abnormal weather conditions not reasonably anticipated for the locality where the work is performed; by unavoidable casualties; by any causes beyond the contractor's control; or by any other causes which the designer and owner determine may justify the delay, then the contract time may be extended by change order only for the time which the designer and owner may determine is reasonable.

Time extensions will not be granted for rain, wind, snow or other natural phenomena of normal intensity for the locality where work is performed. For purpose of determining extent of delay attributable to unusual weather phenomena, a determination shall be made by comparing the weather for the contract period involved with the average of the preceding five (5) year climatic range during the same time interval based on the National Oceanic and Atmospheric Administration National Weather Service statistics for the locality where work is performed and on daily weather logs kept on the job site by the contractor reflecting the effect of the weather on progress of the work and initialed by the designer's representative. No weather delays shall be considered after the building is dried in unless work claimed to be delayed is on the critical path of the baseline schedule or approved updated schedule. Time extensions for weather delays, acts of God, labor disputes, fire, delays in transportation, unavoidable casualties or other delays which are beyond the control of the Owner do not entitle the Contractor to compensable damages for delays. Any contractor claim for compensable damages for delays is limited to delays caused solely by the owner or its agents. Contractor caused delays shall be accounted for before owner or designer caused delays in the case of concurrent delays.

- e. Request for extension of time shall be made in writing to the designer, copies to the owner and SCO, within twenty (20) days following cause of delay. In case of continuing cause for delay, the Contractor shall notify the Designer to the designer, copies to the owner and SCO, of the delay within 20 days of the beginning of the delay and only one claim is necessary.
- f. The contractor shall notify his surety in writing of extension of time granted.
- g. No claim for time extension shall be allowed on account of failure of the designer to furnish drawings or instructions until twenty (20) days after demand for such drawings and/or instructions. See Article 5c. Demand must be in written form clearly stating the potential for delay unless the drawings or instructions are provided. Any delay granted will begin after the twenty (20) day demand period is concluded.

ARTICLE 24 - PARTIAL UTILIZATION/BENEFICIAL OCCUPANCY

- a. The owner may desire to occupy or utilize all or a portion of the project prior to the completion of the project.
- b. Should the owner request a utilization of a building or portion thereof, the designer shall perform a designer final inspection of area after being notified by the contractor that the area is ready for such. After the contractor has completed designer final inspection punch list and the designer has verified, then the designer shall schedule a beneficial occupancy inspection at a time and date acceptable to the owner, contractor(s) and State Construction Office. If beneficial occupancy is granted by the State Construction Office, in such areas the following will be established:
 - 1. The beginning of guarantees and warranties period for the equipment necessary to support. in the area.
 - 2. The owner assumes all responsibilities for utility costs for entire building.
 - 2. Contractor will obtain consent of surety.
 - 3. Contractor will obtain endorsement from insurance company permitting beneficial occupancy.
- c. The owner shall have the right to exclude the contractor from any part of the project which the designer has so certified to be substantially complete, but the owner will allow the contractor reasonable access to complete or correct work to bring it into compliance with the contract.
- d. Occupancy by the owner under this article will in no way relieve the contractor from his contractual requirement to complete the project within the specified time. The contractor will not be relieved of liquidated damages because of beneficial occupancy. The designer may prorate liquidated damages based on the percentage of project occupied.

ARTICLE 25 - FINAL INSPECTION, ACCEPTANCE, AND PROJECT CLOSEOUT

- a. Upon notification from the contractor(s) that the project is complete and ready for inspection, the designer shall make a Designer final inspection to verify that the project is complete and ready for SCO final inspection. Prior to SCO final inspection, the contractor(s) shall complete all items requiring corrective measures noted at the Designer

final inspection. The designer shall schedule a SCO final inspection at a time and date acceptable to the owner, contractor(s) and State Construction Office.

- b. At the SCO final inspection, the designer and his consultants shall, if job conditions warrant, record a list of items that are found to be incomplete or not in accordance with the contract documents. At the conclusion of the SCO final inspection, the designer and State Construction Office representative shall make one of the following determinations:
 - 1. That the project is completed and accepted.
 - 2. That the project will be accepted subject to the correction of the list of discrepancies (punch list). All punch list items must be completed within thirty (30) days of SCO final inspection or the owner may invoke Article 28, Owner's Right to Do Work.
 - 4. That the project is not complete and another date for a SCO final inspection will be established.
- c. Within fourteen (14) days of final acceptance per Paragraph b1 or within fourteen (14) days after completion of punch list per Paragraph b2 above, the designer shall certify the work and issue applicable certificate(s) of compliance.
- d. Any discrepancies listed or discovered after the date of SCO final inspection and acceptance under Paragraphs b1 or b2 above shall be handled in accordance with Article 42, Guarantee.
- f. The final acceptance date will establish the following:
 - 1. The beginning of guarantees and warranties period.
 - 2. The date on which the contractor's insurance coverage for public liability, property damage and builder's risk may be terminated.
 - 3. That no liquidated damages (if applicable) shall be assessed after this date.
 - 4. The termination date of utility cost to the contractor.
- g. **Prior to issuance of final acceptance date, the contractor shall have his authorized representatives visit the project and give full instructions to the designated personnel regarding operating, maintenance, care, and adjustment of all equipment and special construction elements. In addition, the contractor shall provide to the owner a complete instructional video (media format acceptable to the owner) on the operation, maintenance, care and adjustment of all equipment and special construction elements.**

ARTICLE 26 - CORRECTION OF WORK BEFORE FINAL PAYMENT

- a. Any work, materials, fabricated items or other parts of the work which have been condemned or declared not in accordance with the contract by the designer shall be promptly removed from the work site by the contractor, and shall be immediately replaced by new work in accordance with the contract at no additional cost to the owner. Work or property of other contractors or the owner, damaged or destroyed by virtue of such faulty work, shall be made good at the expense of the contractor whose work is faulty.

- b. Correction of condemned work described above shall commence within twenty-four (24) hours after receipt of notice from the designer, and shall make satisfactory progress, as determined by the designer, until completed.
- c. Should the contractor fail to proceed with the required corrections, then the owner may complete the work in accordance with the provisions of Article 28.

ARTICLE 27 - CORRECTION OF WORK AFTER FINAL PAYMENT

See Article 35, Performance Bond and Payment Bond, and Article 42, Guarantee. Neither the final certificate, final payment, occupancy of the premises by the owner, nor any provision of the contract, nor any other act or instrument of the owner, nor the designer, shall relieve the contractor from responsibility for negligence, or faulty material or workmanship, or failure to comply with the drawings and specifications. Contractor shall correct or make good any defects due thereto and repair any damage resulting there from, which may appear during the guarantee period following final acceptance of the work except as stated otherwise under Article 42, Guarantee. The owner will report any defects as they may appear to the contractor and establish a time limit for completion of corrections by the contractor. The owner will be the judge as to the responsibility for correction of defects.

ARTICLE 28 - OWNER'S RIGHT TO DO WORK

If, during the progress of the work or during the period of guarantee, the contractor fails to prosecute the work properly or to perform any provision of the contract, the owner, after seven (7) days' written notice sent by certified mail, return receipt requested, to the contractor from the designer, may perform or have performed that portion of the work. The cost of the work may be deducted from any amounts due or to become due to the contractor, such action and cost of same having been first approved by the designer. Should the cost of such action of the owner exceed the amount due or to become due the contractor, then the contractor or his surety, or both, shall be liable for and shall pay to the owner the amount of said excess.

ARTICLE 29 - ANNULMENT OF CONTRACT

If the contractor fails to begin the work under the contract within the time specified, or the progress of the work is not maintained on schedule, or the work is not completed within the time above specified, or fails to perform the work with sufficient workmen and equipment or with sufficient materials to ensure the prompt completion of said work, or shall perform the work unsuitably or shall discontinue the prosecution of the work, or if the contractor shall become insolvent or be declared bankrupt or commit any act of bankruptcy or insolvency, or allow any final judgment to stand against him unsatisfied for a period of forty-eight (48) hours, or shall make an assignment for the benefit of creditors, or for any other cause whatsoever shall not carry on the work in an acceptable manner, the owner may give notice in writing, sent by certified mail, return receipt requested, to the contractor and his surety of such delay, neglect or default, specifying the same, and if the contractor within a period of seven (7) days after such notice shall not proceed in accordance therewith, then the owner shall, declare this contract in default, and, thereupon, the surety shall promptly take over the work and complete the performance of this contract in the manner and within the time frame specified. In the event the surety shall fail to take over the work to be done under this contract within seven (7) days after being so notified and notify the owner in writing, sent by certified mail, return receipt requested, that he is taking the same over and stating that he will diligently pursue and complete the same, the owner shall have full power and authority, without violating the contract, to take the prosecution of the work out of the hands of said contractor, to appropriate or use any or all contract materials and equipment on the grounds as may be suitable and acceptable and may enter into an agreement, either by public letting or negotiation, for the completion of said contract according to the terms and provisions thereof

or use such other methods as in his opinion shall be required for the completion of said contract in an acceptable manner. All costs and charges incurred by the owner, together with the costs of completing the work under contract, shall be deducted from any monies due or which may become due said contractor and surety. In case the expense so incurred by the owner shall be less than the sum which would have been payable under the contract, if it had been completed by said contractor, then the said contractor and surety shall be entitled to receive the difference, but in case such expense shall exceed the sum which would have been payable under the contract, then the contractor and the surety shall be liable and shall pay to the owner the amount of said excess.

ARTICLE 30 - CONTRACTOR'S RIGHT TO STOP WORK OR TERMINATE THE CONTRACT

- a. Should the work be stopped by order of a court having jurisdiction, or by order of any other public authority for a period of three months, due to cause beyond the fault or control of the contractor, or if the owner should fail or refuse to make payment on account of a certificate issued by the designer within forty-five (45) days after receipt of same, then the contractor, after fifteen (15) days' written notice sent by certified mail, return receipt requested, to the owner and the designer, may suspend operations on the work or terminate the contract.
- b. The owner shall be liable to the contractor for the cost of all materials delivered and work performed on this contract plus 10 percent overhead and profit and shall make such payment. The designer shall be the judge as to the correctness of such payment.

ARTICLE 31 - REQUEST FOR PAYMENT

- a. Not later than the fifth day of the month, the contractor shall submit to the designer a request for payment for work done during the previous month. The request shall be in the form agreed upon between the contractor and the designer, but shall show substantially the value of work done and materials delivered to the site during the period since the last payment, and shall sum up the financial status of the contract with the following information:
 1. Total of contract including change orders.
 2. Value of work completed to date.
 3. Less five percent (5%) retainage, provided however, that after fifty percent (50%) of the contractor's work has been satisfactorily completed on schedule, with approval of the owner and the State Construction Office and written consent of the surety, further requirements for retainage will be waived only so long as work continues to be completed satisfactorily and on schedule.
 4. Less previous payments.
 5. Current amount due.
- b. The contractor, upon request of the designer, shall substantiate the request with invoices of vouchers or payrolls or other evidence.
- c. Prior to submitting the first request, the contractor shall prepare for the designer a schedule showing a breakdown of the contract price into values of the various parts of the work, so arranged as to facilitate payments to subcontractors in accordance with Article 17, Contractor and Subcontractor Relationships. The contractor(s) shall list the

value of each subcontractor and supplier, identifying each minority business subcontractor and supplier as listed in Affidavit C, if applicable.

- d. When payment is made on account of stored materials and equipment, such materials must be stored on the owner's property, and the requests for payments shall be accompanied by invoices or bills of sale or other evidence to establish the owner's title to such materials and equipment. Such payments will be made only for materials that have been customized or fabricated specifically for this project. Raw materials or commodity products including but not limited to piping, conduit, CMU, metal studs and gypsum board may not be submitted. Responsibility for such stored materials and equipment shall remain with the contractor regardless of ownership title. Such stored materials and equipment shall not be removed from the owner's property. Should the space for storage on-site be limited, the contractor, at his option, shall be permitted to store such materials and/or equipment in a suitable space off-site. Should the contractor desire to include any such materials or equipment in his application for payment, they must be stored in the name of the owner in an independent, licensed, bonded warehouse approved by the designer, owner and the State Construction Office and located as close to the site as possible. The warehouse selected must be approved by the contractor's bonding and insurance companies; the material to be paid for shall be assigned to the owner and shall be inspected by the designer. Upon approval by the designer, owner and SCO of the storage facilities and materials and equipment, payment therefore will be certified. Responsibility for such stored materials and equipment shall remain with the contractor. Such stored materials and equipment shall not be moved except for transportation to the project site. Under certain conditions, the designer may approve storage of materials at the point of manufacture, which conditions shall be approved by the designer, the owner and the State Construction Office prior to approval for the storage and shall include an agreement by the storing party which unconditionally gives the State absolute right to possession of the materials at anytime. Bond, security and insurance protection shall continue to be the responsibility of the contractor(s).
- e. In the event of beneficial occupancy, retainage of funds due the contractor(s) may be reduced with the approval of the State Construction Office to an equitable amount to cover the list of items to be completed or corrected. Retainage may not be reduced to less than two and one-half (2 1/2) times the estimated value of the work to be completed or corrected. Reduction of retainage must be with the consent and approval of the contractor's bonding company.

ARTICLE 32 - CERTIFICATES OF PAYMENT AND FINAL PAYMENT

- a. Within five (5) days from receipt of request for payment from the contractor, the designer shall issue and forward to the owner a certificate for payment. This certificate shall indicate the amount requested or as approved by the designer. If the certificate is not approved by the designer, he shall state in writing to the contractor and the owner his reasons for withholding payment.
- b. No certificate issued or payment made shall constitute an acceptance of the work or any part thereof. The making and acceptance of final payment shall constitute a waiver of all claims by the owner except:
 - 1. Claims arising from unsettled liens or claims against the contractor.
 - 2. Faulty work or materials appearing after final payment.
 - 3. Failure of the contractor to perform the work in accordance with drawings and specifications, such failure appearing after payment.

4. As conditioned in the performance bond and payment bond.
- c. The making and acceptance of final payment shall constitute a waiver of all claims by the contractor except those claims previously made and remaining unsettled (Article 20(c)).
- d. Prior to submitting request for final payment to the designer for approval, the contractor shall fully comply with all requirements specified in the “project closeout” section of the specifications. These requirements include but not limited to the following:
 1. Submittal of Product and Operating Manuals, Warranties and Bonds, Guarantees, Maintenance Agreements, As-Built Drawings, Certificates of Inspection or Approval from agencies having jurisdiction. (The designer must approve the Manuals prior to delivery to the owner).
 2. Transfer of Required attic stock material and all keys in an organized manner.
 3. Record of Owner’s training.
 4. Resolution of any final inspection discrepancies.
 5. Granting access to Contractor’s records, if Owner’s internal auditors have made a request for such access pursuant to Article 52.
- e. The contractor shall forward to the designer, the final application for payment along with the following documents:
 1. List of minority business subcontractors and material suppliers showing breakdown of contract amounts and total actual payments to subs and material suppliers.
 2. Affidavit of Release of Liens.
 3. Affidavit of contractors of payment to material suppliers and subcontractors. (See Article 36).
 4. Consent of Surety to Final Payment.
 5. Certificates of state agencies required by state law.
- f. The designer will not authorize final payment until the work under contract has been certified by designer, certificates of compliance issued, and the contractor has complied with the closeout requirements. The designer shall forward the contractor’s final application for payment to the owner along with respective certificate(s) of compliance required by law.

ARTICLE 33 - PAYMENTS WITHHELD

- a. The designer with the approval of the State Construction Office may withhold payment for the following reasons:
 1. Faulty work not corrected.

2. The unpaid balance on the contract is insufficient to complete the work in the judgment of the designer.
 3. To provide for sufficient contract balance to cover liquidated damages that will be assessed.
- b. The secretary of the Department of Administration may authorize the withholding of payment for the following reasons:
 1. Claims filed against the contractor or evidence that a claim will be filed.
 2. Evidence that subcontractors have not been paid.
 - c. The Owner may withhold all or a portion of Contractor's general conditions costs set forth in the approved schedule of values, if Contractor has failed to comply with: (1) a request to access its records by Owner's internal auditors pursuant to Article 52; (2) a request for a plan of action and/or recovery schedule under Article 14.j or provide The Owner; (3) a request to provide an electronic copies of Contractor's baseline schedule, updates with all logic used to create the schedules in the original format of the scheduling software; and (4) Contractor's failure to have its Superintendent on the Project full-time; (
 - d. When grounds for withholding payments have been removed, payment will be released. Delay of payment due the contractor without cause will make owner liable for payment of interest to the contractor in accordance with G.S. 143-134.1. As provided in G.S.143-134.1(e) the owner shall not be liable for interest on payments withheld by the owner for unsatisfactory job progress, defective construction not remedied, disputed work, or third-party claims filed against the owner or reasonable evidence that a third-party claim will be filed.

ARTICLE 34 - MINIMUM INSURANCE REQUIREMENTS

The work under this contract shall not commence until the contractor has obtained all required insurance and verifying certificates of insurance have been approved in writing by the owner. These certificates shall document that coverages afforded under the policies will not be cancelled, reduced in amount or coverages eliminated until at least thirty (30) days after mailing written notice, by certified mail, return receipt requested, to the insured and the owner of such alteration or cancellation. If endorsements are needed to comply with the notification or other requirements of this article copies of the endorsements shall be submitted with the certificates.

a. Worker's Compensation and Employer's Liability

The contractor shall provide and maintain, until final acceptance, workmen's compensation insurance, as required by law, as well as employer's liability coverage with minimum limits of \$100,000.

b. Public Liability and Property Damage

The contractor shall provide and maintain, until final acceptance, comprehensive general liability insurance, including coverage for premises operations, independent contractors, completed operations, products and contractual exposures, as shall protect such contractors from claims arising out of any bodily injury, including accidental death, as well as from claims for property damages which may arise from operations under this contract, whether such operations be by the contractor or by any subcontractor, or by

anyone directly or indirectly employed by either of them and the minimum limits of such insurance shall be as follows:

Bodily Injury:	\$500,000 per occurrence
Property Damage:	\$100,000 per occurrence / \$300,000 aggregate

In lieu of limits listed above, a \$500,000 combined single limit shall satisfy both conditions.

Such coverage for completed operations must be maintained for at least two (2) years following final acceptance of the work performed under the contract.

c. Property Insurance (Builder's Risk/Installation Floater)

The contractor shall purchase and maintain property insurance until final acceptance, upon the entire work at the site to the full insurable value thereof. This insurance shall include the interests of the owner, the contractor, the subcontractors and sub-subcontractors in the work and shall insure against the perils of fire, wind, rain, flood, extended coverage, and vandalism and malicious mischief. If the owner is damaged by failure of the contractor to purchase or maintain such insurance, then the contractor shall bear all reasonable costs properly attributable thereto; the contractor shall effect and maintain similar property insurance on portions of the work stored off the site when request for payment per articles so includes such portions.

d. Deductible

Any deductible, if applicable to loss covered by insurance provided, is to be borne by the contractor.

e. Other Insurance

The contractor shall obtain such additional insurance as may be required by the owner or by the General Statutes of North Carolina including motor vehicle insurance, in amounts not less than the statutory limits.

f. Proof of Carriage

The contractor shall furnish the owner with satisfactory proof of carriage of the insurance required before written approval is granted by the owner.

ARTICLE 35 - PERFORMANCE BOND AND PAYMENT BOND

- a. Each contractor shall furnish a performance bond and payment bond executed by a surety company authorized to do business in North Carolina. The bonds shall be in the full contract amount. Bonds shall be executed in the form bound with these specifications.
- b. All bonds shall be countersigned by an authorized agent of the bonding company who is licensed to do business in North Carolina.

ARTICLE 36 - CONTRACTOR'S AFFIDAVIT

The final payment of retained amount due the contractor on account of the contract shall not become due until the contractor has furnished to the owner through the designer an affidavit signed, sworn and notarized to the effect that all payments for materials, services or subcontracted work in connection with his contract have been satisfied, and that no claims or

liens exist against the contractor in connection with this contract. In the event that the contractor cannot obtain similar affidavits from subcontractors to protect the contractor and the owner from possible liens or claims against the subcontractor, the contractor shall state in his affidavit that no claims or liens exist against any subcontractor to the best of his (the contractor's) knowledge, and if any appear afterward, the contractor shall save the owner harmless.

ARTICLE 37 - ASSIGNMENTS

The contractor shall not assign any portion of this contract nor subcontract in its entirety. Except as may be required under terms of the performance bond or payment bond, no funds or sums of money due or become due the contractor under the contract may be assigned.

ARTICLE 38 - USE OF PREMISES

- a. The contractor(s) shall confine his apparatus, the storage of materials and the operations of his workmen to limits indicated by law, ordinances, permits or directions of the designer and owner and shall not exceed those established limits in his operations.
- b. The contractor(s) shall not load or permit any part of the structure to be loaded with a weight that will endanger its safety.
- c. The contractor(s) shall enforce the designer's and owner's instructions regarding signs, advertisements, fires and smoking.
- d. No firearms, any type of alcoholic beverages, or drugs (other than those prescribed by a physician) will be permitted at the job site.

ARTICLE 39 - CUTTING, PATCHING AND DIGGING

- a. The contractor shall do all cutting, fitting or patching of his work that may be required to make its several parts come together properly and fit it to receive or be received by work of other contractors shown upon or reasonably implied by the drawings and specifications for the completed structure, as the designer may direct.
- b. Any cost brought about by defective or ill-timed work shall be borne by the party responsible therefor.
- c. No contractor shall endanger any work of another contractor by cutting, digging or other means. No contractor shall cut or alter the work of any other contractor without the consent of the designer and the affected contractor(s).

ARTICLE 40 - UTILITIES, STRUCTURES, SIGNS

- a. The contractor shall provide necessary and adequate facilities for water, electricity, gas, oil, sewer and other utility services which maybe necessary and required for completion of the project including all utilities required for testing, cleaning, balancing, and sterilization of designated plumbing, mechanical and electrical systems. Any permanent meters installed shall be listed in the contractor's name until work has a final acceptance. The contractor will be solely responsible for all utility costs prior to final acceptance. Contractor shall contact all affected utility companies prior to bid to determine their requirements to provide temporary and permanent service and include all costs associated with providing those services in their bid. Coordination of the work of the utility companies during construction is the sole responsibility of the contractor.

- b. Meters shall be relisted in the owner's name on the day following final acceptance of the Project Expediter's work, and the owner shall pay for services used after that date.
- c. The owner shall be reimbursed for all metered utility charges after the meter is relisted in the owner's name and prior to completion and acceptance of the work of **all** contractors. Reimbursement shall be made by the contractor whose work has not been completed and accepted. If the work of two or more contractors has not been completed and accepted, reimbursement to the owner shall be paid by the contractors involved on the basis of assessments by the designer.
- d. Prior to the operation of permanent systems, the Project Expediter will provide temporary power, lighting, water, and heat to maintain space temperature above freezing, as required for construction operations.
- e. All contractors shall have the permanent building systems in sufficient readiness for furnishing temporary climatic control at the time a building is enclosed and secured. The HVAC systems shall maintain climatic control throughout the enclosed portion of the building sufficient to allow completion of the interior finishes of the building. A building shall be considered enclosed and secured when windows, doorways (exterior, mechanical, and electrical equipment rooms), and hardware are installed; and other openings have protection which will provide reasonable climatic control. The appropriate time to start the mechanical systems and climatic condition shall be jointly determined by the contractor(s), the designer and owner. Use of the equipment in this manner shall be subject to the approval of the Designer and owner and shall in no way affect the warranty requirements of the contractor(s).
- f. The electrical contractor shall have the building's permanent power wiring distribution system in sufficient readiness to provide power as required by the HVAC contractor for temporary climatic control.
- g. The electrical contractor shall have the building's permanent lighting system ready at the time the general contractor begins interior painting and shall provide adequate lighting in those areas where interior painting and finishing is being performed.
- h. Each prime contractor shall be responsible for his permanently fixed service facilities and systems in use during progress of the work. The following procedures shall be strictly adhered to:
 - 1. Prior to final acceptance of work by the State Construction Office, each contractor shall remove and replace any parts of the permanent building systems damaged through use during construction.
 - 2. Temporary filters as recommended by the equipment manufacturer in order to keep the equipment and ductwork clean and free of dust and debris shall be installed in each of the heating and air conditioning units and at each return grille during construction. New filters shall be installed in each unit prior to the owner's acceptance of the work.
 - 3. Extra effort shall be maintained to keep the building and the site adjacent to the building clean and under no circumstances shall air systems be operated if finishing and site work operations are creating dust in excess of what would be considered normal if the building were occupied.
 - 4. It shall be understood that any warranty on equipment presented to the owner shall extend from the day of final acceptance by the owner. The cost of warranting the

equipment during operation in the finishing stages of construction shall be borne by the contractor whose system is utilized.

5. The electrical contractor shall have all lamps in proper working condition at the time of final project acceptance.
- i. The Project Expediter shall provide, if required and where directed, a shed for toilet facilities and shall furnish and install in this shed all water closets required for a complete and adequate sanitary arrangement. These facilities will be available to other contractors on the job and shall be kept in a neat and sanitary condition at all times. Chemical toilets are acceptable.
- j. The Project Expediter shall, if required by the Supplementary General Conditions and where directed, erect a temporary field office, complete with lights, telephone, heat and air conditioning. A portion of this office shall be partitioned off, of sufficient size, for the use of a resident inspector, should the designer so direct.
- k. On multi-story construction projects, the Project Expediter shall provide temporary elevators, lifts, or other special equipment for the general use of all contractors. The cost for such elevators, lifts or other special equipment and the operation thereof shall be included in the Project Expediter's bid.
- l. The Project Expediter will erect one sign on the project if required. The sign shall be of sound construction, and shall be neatly lettered with black letters on white background. The sign shall bear the name of the project, and the names of prime contractors on the project, and the name of the designer and consultants. Directional signs may be erected on the owner's property subject to approval of the owner with respect to size, style and location of such directional signs. Such signs may bear the name of the contractor and a directional symbol. No other signs will be permitted except by permission of the owner.

ARTICLE 41 - CLEANING UP

- a. The contractors shall keep the building and surrounding area reasonably free from rubbish at all times, and shall remove debris from the site on a timely basis or when directed to do so by the designer or Project Expediter. The Project Expediter shall provide an on site refuse container(s) for the use of all contractors. Each contractor shall remove their rubbish and debris from the building on a daily basis. The Project Expediter shall broom clean the building as required to minimize dust and dirt accumulation.
- b. The Project Expediter shall provide and maintain suitable all-weather access to the building.
- c. Before final inspection and acceptance of the building, each contractor shall clean his portion of the work, including glass, hardware, fixtures, masonry, tile and marble (using no acid), clean and wax all floors as specified, and completely prepare the building for use by the owner, with no cleaning required by the owner.

ARTICLE 42 - GUARANTEE

- a. The contractor shall unconditionally guarantee materials and workmanship against patent defects arising from faulty materials, faulty workmanship or negligence for a period of twelve (12) months following the date of final acceptance of the work or beneficial occupancy and shall replace such defective materials or workmanship without cost to the owner.

- b. Where items of equipment or material carry a manufacturer's warranty for any period in excess of twelve (12) months, then the manufacturer's warranty shall apply for that particular piece of equipment or material. The contractor shall replace such defective equipment or materials, without cost to the owner, within the manufacturer's warranty period.
- c. Additionally, the owner may bring an action for latent defects caused by the negligence of the contractor which is hidden or not readily apparent to the owner at the time of beneficial occupancy or final acceptance, whichever occurred first, in accordance with applicable law.
- d. Guarantees for roof, equipment, materials, and supplies shall be stipulated in the specifications sections governing such roof, equipment, materials, or supplies.

ARTICLE 43 - CODES AND STANDARDS

Wherever reference is given to codes, standard specifications or other data published by regulating agencies including, but not limited to, national electrical codes, North Carolina state building codes, federal specifications, ASTM specifications, various institute specifications, etc., it shall be understood that such reference is to the latest edition including addenda published prior to the date of the contract documents.

ARTICLE 44 - INDEMNIFICATION

To the fullest extent permitted by law, the contractor shall indemnify and hold harmless the owner, the designer and the agents, consultants and employees of the owner and designer, from and against all claims, damages, losses and expenses, including, but not limited to, attorneys' fees, arising out of or resulting from the performance or failure of performance of the work, provided that any such claim, damage, loss or expense (1) is attributable to bodily injury, sickness, disease or death, or to injury to or destruction of tangible property (other than the work itself) including the loss of use resulting there from, and (2) is caused in whole or in part by any negligent act or omission of the contractor, the contractor's subcontractor, or the agents of either the contractor or the contractor's subcontractor. Such obligation shall not be construed to negate, abridge or otherwise reduce any other right or obligation of indemnity which would otherwise exist as to any party or person described in this article.

ARTICLE 45 - TAXES

- a. Federal excise taxes do not apply to materials entering into state work (Internal Revenue Code, Section 3442(3)).
- b. Federal transportation taxes do not apply to materials entering into state work (Internal Revenue Code, Section 3475(b) as amended).
- c. North Carolina sales tax and use tax, as required by law, do apply to materials entering into state work and such costs shall be included in the bid proposal and contract sum.
- d. Local option sales and use taxes, as required by law, do apply to materials entering into state work as applicable and such costs shall be included in the bid proposal and contract sum.
- e. **Accounting Procedures for Refund of County Sales & Use Tax**

Amount of county sales and use tax paid per contractor's statements:

Contractors performing contracts for state agencies shall give the state agency for whose project the property was purchased a signed statement containing the information listed in G.S. 105-164.14(e).

The Department of Revenue has agreed that in lieu of obtaining copies of sales receipts from contractors, an agency may obtain a certified statement as of April 1, 1991 from the contractor setting forth the date, the type of property and the cost of the property purchased from each vendor, the county in which the vendor made the sale and the amount of local sales and use taxes paid thereon. If the property was purchased out-of-state, the county in which the property was delivered should be listed. The contractor should also be notified that the certified statement may be subject to audit.

In the event the contractors make several purchases from the same vendor, such certified statement must indicate the invoice numbers, the inclusive dates of the invoices, the total amount of the invoices, the counties, and the county sales and use taxes paid thereon.

Name of taxing county: The position of a sale is the retailer's place of business located within a taxing county where the vendor becomes contractually obligated to make the sale. Therefore, it is important that the county tax be reported for the county of sale rather than the county of use.

When property is purchased from out-of-state vendors and the county tax is charged, the county should be identified where delivery is made when reporting the county tax.

Such statement must also include the cost of any tangible personal property withdrawn from the contractor's warehouse stock and the amount of county sales or use tax paid thereon by the contractor.

Similar certified statements by his subcontractors must be obtained by the general contractor and furnished to the claimant.

Contractors are not to include any tax paid on supplies, tools and equipment which they use to perform their contracts and should include only those building materials, supplies, fixtures and equipment which actually become a part of or annexed to the building or structure.

ARTICLE 46 - EQUAL OPPORTUNITY CLAUSE

The non-discrimination clause contained in Section 202 (Federal) Executive Order 11246, as amended by Executive Order 11375, relative to equal employment opportunity for all persons without regard to race, color, religion, sex or national origin, and the implementing rules and regulations prescribed by the secretary of Labor, are incorporated herein.

ARTICLE 47 - EMPLOYMENT OF INDIVIDUALS WITH DISABILITIES

The contractor(s) agree not to discriminate against any employee or applicant for employment because of physical or mental disabilities in regard to any position for which the employee or applicant is qualified. The contractor agrees to take affirmative action to employ, advance in employment and otherwise treat qualified individuals with such disabilities without discrimination based upon their physical or mental disability in all employment practices.

ARTICLE 48 - ASBESTOS-CONTAINING MATERIALS (ACM)

The State of North Carolina has attempted to address all asbestos-containing materials that are to be disturbed in the project. However, there may be other asbestos-containing materials in the work areas that are not to be disturbed and do not create an exposure hazard.

Contractors are reminded of the requirements of instructions under Instructions to Bidders and General Conditions of the Contract, titled Examination of Conditions. Statute 130A, Article 19, amended August 3, 1989, established the Asbestos Hazard Management Program that controls asbestos abatement in North Carolina. The latest edition of *Guideline Criteria for Asbestos Abatement* from the State Construction Office is to be incorporated in all asbestos abatement projects for the Capital Improvement Program.

ARTICLE 49 - MINORITY BUSINESS PARTICIPATION

GS 143-128.2 establishes a ten percent (10%) goal for participation by minority businesses in total value of work for each State building project. The document, *Guidelines for Recruitment and Selection of Minority Businesses for Participation in State Construction Contracts* including Affidavits and Appendix E are hereby incorporated into and made a part of this contract.

ARTICLE 50 – CONTRACTOR EVALUATION

The contractor's overall work performance on the project shall be fairly evaluated in accordance with the State Building Commission policy and procedures, for determining qualifications to bid on future State capital improvement projects. In addition to final evaluation, interim evaluation may be prepared during the progress of project. The document, Contractor Evaluation Procedures, is hereby incorporated and made a part of this contract. The owner may request the contractor's comments to evaluate the designer.

ARTICLE 51 – GIFTS

Pursuant to N.C. Gen. Stat. § 133-32, it is unlawful for any vendor or contractor (i.e. architect, bidder, contractor, construction manager, design professional, engineer, subcontractor, supplier, vendor, etc.), to make gifts or to give favors to any State employee. This prohibition covers those vendors and contractors who: (1) have a contract with a governmental agency; or (2) have performed under such a contract within the past year; or (3) anticipate bidding on such a contract in the future. For additional information regarding the specific requirements and exemptions, vendors and contractors are encouraged to review G.S. Sec. 133-32.

During the construction of the Project, the Contractor is prohibited from making gifts to any of the Owner's employees, Owner's project representatives (architect, engineers, construction manager and their employees), employees of the State Construction Office and/or any other State employee that may have any involvement, influence, responsibilities, oversight, management and/or duties that pertain to and/or relate to the contract administration, financial administration and/or disposition of claims arising from and/or relating to the Contract and/or Project.

ARTICLE 52 – AUDITING-ACCESS TO PERSONS AND RECORDS

In accordance with N.C. General Statute 147-64.7, the State Auditor shall have access to Contractor's officers, employees, agents and/or other persons in control of and/or responsible for the Contractor's records that relate to this Contracts for purposes of conducting audits under the referenced statute. The Owner's internal auditors shall also have the right to access and copy the Contractor's records relating to the Contract and Project during the term of the Contract and within two years following the completion of the Project/close-out of the Contract to verify accounts, accuracy, information, calculations and/or data affecting and/or

relating to Contractor's requests for payment, requests for change orders, change orders, claims for extra work, requests for time extensions and related claims for delay/extended general conditions costs, claims for lost productivity, claims for loss efficiency, claims for idle equipment or labor, claims for price/cost escalation, pass-through claims of subcontractors and/or suppliers, and/or any other type of claim for payment or damages from Owner and/or its project representatives.

ARTICLE 53 – NORTH CAROLINA FALSE CLAIMS ACT

The North Carolina False Claims Act ("NCFCA"), N.C Gen. Stat. § 1-605 through 1-618, applies to this Contract. The Contractor should familiarize itself with the entire NCFCA and should seek the assistance of an attorney if it has any questions regarding the NCFCA and its applicability to any requests, demands and/or claims for payment its submits to the State through the contracting state agency, institution, university or community college.

The purpose of the NCFCA "is to deter persons from knowingly causing or assisting in causing the State to pay claims that are false or fraudulent and to provide remedies in the form of treble damages and civil penalties when money is obtained from the State by reason of a false or fraudulent claim." (Section 1-605(b).) A contractor's liability under the NCFCA may arise from, but is not limited to: requests for payment, invoices, billing, claims for extra work, requests for change orders, requests for time extensions, claims for delay damages/extended general conditions costs, claims for lost productivity, claims for loss efficiency, claims for idle equipment or labor, claims for price/cost escalation, pass-through claims of subcontractors and/or suppliers, documentation used to support any of the foregoing requests or claims, and/or any other request for payment from the State through the contracting state agency, institution, university or community college. The parts of the NCFCA that are most likely to be enforced with respect to this type of contract are as follows:

- A "claim" is "[a]ny request or demand, whether under a contract or otherwise, for money or property and whether or not the State has title to the money or property that (i) is presented to an officer, employee, or agent of the State or (ii) is made to a contractor ... if the money or property is to be spent or used on the State's behalf or to advance a State program or interest and if the State government: (a) provides or has provided any portion of the money or property that is requested or demanded; or (b) will reimburse such contractor ... for any portion of the money or property which is requested or demanded." (Section 1-606(2).)
- "Knowing" and "knowingly." – Whenever a person, with respect to information, does any of the following: (a) Has actual knowledge of the information; (b) Acts in deliberate ignorance of the truth or falsity of the information; and/or (c) Acts in reckless disregard of the truth or falsity of the information. (Section 1-606(4).) Proof of specific intent to defraud is not required. (Section 1-606(4).)
- "Material" means having a natural tendency to influence, or be capable of influencing, the payment or receipt of money or property. (Section 1-606(4).)
- Liability. – "Any person who commits any of the following acts shall be liable to the State for three times the amount of damages that the State sustains because of the act of that person[:]" ... (1) Knowingly presents or causes to be presented a false or fraudulent claim for payment or approval. (2) Knowingly makes, uses, or causes to be made or used, a false record or statement material to a false or fraudulent claim. (3) Conspires to commit a violation of subdivision (1), (2) ..." (Section 1-607(a)(1), (2).)

- The NCFCA shall be interpreted and construed so as to be consistent with the federal False Claims Act, 31 U.S.C. § 3729, et seq., and any subsequent amendments to that act. (Section 1-616(c).)

Finally, the contracting state agency, institution, university or community college may refer any suspected violation of the NCFCA by the Contractor to the Attorney General's Office for investigation. Under Section 1-608(a), the Attorney General is responsible for investigating any violation of NCFCA, and may bring a civil action against the Contractor under the NCFCA. The Attorney General's investigation and any civil action relating thereto are independent and not subject to any dispute resolution provision set forth in this Contract. (See Section 1-608(a).)

ARTICLE 54 – TERMINATION FOR CONVENIENCE

Owner may at any time and for any reason terminate Contractor's services and work at Owner's convenience. Upon receipt of such notice, Contractor shall, unless the notice directs otherwise, immediately discontinue the work and placing of orders for materials, facilities and supplies in connection with the performance of this Agreement.

Upon such termination, Contractor shall be entitled to payment only as follows: (1) the actual cost of the work completed in conformity with this Agreement; plus, (2) such other costs actually incurred by Contractor as are permitted by the prime contract and approved by Owner; (3) plus ten percent (10%) of the cost of the work referred to in subparagraph (1) above for overhead and profit. There shall be deducted from such sums as provided in this subparagraph the amount of any payments made to Contractor prior to the date of the termination of this Agreement. Contractor shall not be entitled to any claim or claim of lien against Owner for any additional compensation or damages in the event of such termination and payment.

SUPPLEMENTARY GENERAL CONDITIONS (SGC's)

1. TIME OF COMPLETION/LIQUIDATED DAMAGES

The Contractor shall commence work to be performed under this Contract on the date to be specified in the Notice to Proceed from the Contract Administrator and shall fully complete all work hereunder within **180** consecutive calendar days from date of Notice to Proceed. Anticipated Notice to Proceed January 23, 2023.

For each day in excess of the above number of days, the Contractor(s) shall pay the Owner liquidated damages in the amount of \$5,000.00 per consecutive calendar day.

If the Contractor is delayed at any time in the progress of the Contractor's work by any act or negligence of the Owner, the Owner's employees or the Owner's separate Contractor; by changes ordered in the work; by abnormal weather conditions; by any causes beyond the Contractor's control; or by other causes deemed justifiable by Owner, then the contract time may be reasonably extended in a written order from the Owner upon written request from the Contractor within ten (10) days following the cause for delay.

2. CONSTRUCTION SCHEDULE

The Contractor shall start work within two (2) weeks upon receipt of Notice to Proceed. The Contractor shall submit a project work schedule before beginning work. The starting date and work schedule shall be adhered to, and the work shall be performed during the Owner's normal working hours, 7:00AM to 7:00PM. Requests by the Contractor to work outside normal working hours shall be made a minimum of one (1) week in advance to Fayetteville State University. The Contractor's bid shall include all costs associated with workers working outside of normal business hours and/or costs associated with workers working overtime as required to meet the specified project schedule. The Owner reserves the right to request work to be performed outside normal working hours and to limit Contractor activities when they conflict with Owner operations. Any increased costs due to Owner requirements for work outside normal hours not specified in the Contract Documents will be negotiated.

3. UTILITIES

The Owner will provide water and electricity to the extent they are available at the project site.

The Contractor shall provide restroom facilities. The Contractor's personnel shall not use toilet or washroom facilities in the existing building.

The Contractor shall be responsible for procedures for making temporary disruptions to existing utilities serving the building, and roads and pedestrian walks shall be planned well in advance of the work and the work shall be executed in a manner to provide reasonably continuous service throughout the construction period. Interruptions of service shall be coordinated with the Contract Administrator at least seven (7) days in advance.

4. SECURITY

Contractor shall coordinate security requirements with Fayetteville State University. Contractor shall review and sign Contractor's Certification form (Attachment A) regarding Fayetteville State University's criminal background check requirements.

5. USE OF SITE

Work under this contract shall be performed in such a manner as to avoid interruption or interference with the operation of any existing activity on the premises or at the location of the work. The Owner may enforce extra restrictions during certain periods of the year. During examination periods, the Contractor shall restrict noise-making activities. If the project involves work in or near a building in which an exam is being conducted, the Contractor shall be required to restrict operations which are disturbing to students during the hours of the exam(s). Work will not be permitted on Graduation Day, or the day preceding it (Saturday).

While on campus, Contractor's and Sub-Contractor's personnel shall be identifiable at all times, for example, by wearing company names or logos on garments or hard hats.

Damage done to the University premises that are under the control of the Contractor, or damage caused by the contractor to premises used by the contractor, shall be corrected at the Contractor's expense.

The contractor shall schedule deliveries between 8:00 am and 4:00 pm. The contractor shall notify Fayetteville State University of any deliveries of equipment, material or road work that will impede the flow of vehicular or pedestrian traffic. The contractor shall provide traffic control by certified traffic control personnel (vehicular and pedestrian) during these deliveries. Staging for multiple concrete / steel / other large material deliveries, crane and other large pieces of equipment must be coordinated with Fayetteville State University. Walks, streets, and drives are most congested with pedestrians at the top of the hour, when making deliveries the carrier should be made aware of this and plan his deliveries accordingly.

Roads, streets, drives, fire lanes must remain open at all times. Adequate clearance must be maintained for emergency vehicles to negotiate the drive. Maintain a minimum of 20 feet for fire lanes. Construction vehicles are not allowed to block, park, or stage in a fire lanes. Vehicles blocking fire lanes will be ticketed and towed at the Contractor's expense.

Construction fences should be covered with fabric screening unless it blocks the view of oncoming traffic. Construction gates will swing into the construction area. The construction fences should not obstruct pedestrian or vehicle traffic.

The Contractor will provide additional cleanup and warning signs and barricades if deemed necessary by the Owner.

The Contractor's scheduling and staging requirements must be coordinated with, and approved by, the Fayetteville State University.

The work shall be performed during the Owner's normal working hours, 7:00 a.m. – 7:00 p.m., Monday – Friday. Requests by the Contractor to work outside normal working hours shall be made in advance to Fayetteville State University. The Contractor's bid shall include all costs associated with workers working outside of normal business hours and/or costs associated with workers working overtime as required to meet specified project schedule. The Owner reserves the right to request work to be performed outside normal working hours and to limit contractor activities when they conflict with Owner operations. Any increased costs due to Owner requirements for work outside normal hours not specified in the Contract Documents will be negotiated.

CONTRACTOR'S CERTIFICATION

I acknowledge the obligation as a contractor/vendor of Fayetteville State University (FSU) to conduct criminal background checks. I certify that only employees, subcontractors or agents who have been appropriately cleared will be assigned to work in FSU's facilities. I further certify that before assigning any employee, subcontractor or agent hired after the date of my signature below to work in FSU's facilities, I will require a criminal background check and will conduct a review of the results consistent with the factors outlined below. I understand that failure to comply with this certification will constitute a breach of my contract with FSU and may result in termination of the contract and loss of opportunity to be considered for future contracts.

By signing this Certification, I certify that I have performed or had performed a criminal background check on applicants, employees, subcontractors or agents to be assigned to work at or in any FSU Facilities.

I further certify that I have reviewed the criminal background checks of the applicants, employees, subcontractors or agents to be assigned to work at or in any FSU facilities and determined that such individuals did not have any felony convictions for violent acts, rape or other sex offenses or offenses involving minors and thus are suitable to work in FSU facilities.

I further agree to review the criminal background checks of all applicants, employees, subcontractors or agents and determine whether felony convictions or non-violent offenses should prevent an individual from being assigned to work in an FSU facility. Suitability shall be determined by considering factors that include, but are not limited to, the following:

- Age at time of conviction(s)
- Number of convictions
- Nature of conviction(s)
- Severity of conviction(s)
- Length of time since conviction
- Behavior since conviction
- Any other potential risk factors.

Further, I agree not to allow any of contractor's employees, subcontractors or agents who are arrested for felony offenses involving minors, violent acts, rape or other sex offenses, weapons or drug trafficking/distribution to work on FSU's campus unless the case has been dismissed or the individual is found not guilty of the offense.

Company/Contractor's Name

Authorized Official's Signature

Authorized Official's Printed Name

Date

GUIDELINES FOR RECRUITMENT AND SELECTION OF MINORITY BUSINESSES FOR PARTICIPATION IN STATE CONSTRUCTION CONTRACTS

In accordance with G.S. 143-128.2 (effective January 1, 2002) these guidelines establish goals for minority participation in single-prime bidding, separate-prime bidding, construction manager at risk, and alternative contracting methods, on State construction projects in the amount of \$300,000 or more. The legislation provides that the State shall have a verifiable ten percent (10%) goal for participation by minority businesses in the total value of work for each project for which a contract or contracts are awarded. These requirements are published to accomplish that end.

SECTION A: INTENT

It is the intent of these guidelines that the State of North Carolina, as awarding authority for construction projects, and the contractors and subcontractors performing the construction contracts awarded shall cooperate and in good faith do all things legal, proper and reasonable to achieve the statutory goal of ten percent (10%) for participation by minority businesses in each construction project as mandated by GS 143-128.2. Nothing in these guidelines shall be construed to require contractors or awarding authorities to award contracts or subcontracts to or to make purchases of materials or equipment from minority-business contractors or minority-business subcontractors who do not submit the lowest responsible, responsive bid or bids.

SECTION B: DEFINITIONS

1. Minority - a person who is a citizen or lawful permanent resident of the United States and who is:
 - a. Black, that is, a person having origins in any of the black racial groups in Africa;
 - b. Hispanic, that is, a person of Spanish or Portuguese culture with origins in Mexico, South or Central America, or the Caribbean Islands, regardless of race;
 - c. Asian American, that is, a person having origins in any of the original peoples of the Far East, Southeast Asia and Asia, the Indian subcontinent, the Pacific Islands;
 - d. American Indian, that is, a person having origins in any of the original peoples of North America; or
 - e. Female
2. Minority Business - means a business:
 - a. In which at least fifty-one percent (51%) is owned by one or more minority persons, or in the case of a corporation, in which at least fifty-one percent (51%) of the stock is owned by one or more minority persons or socially and economically disadvantaged individuals; and
 - b. Of which the management and daily business operations are controlled by one or more of the minority persons or socially and economically disadvantaged individuals who own it.
3. Socially and economically disadvantaged individual - means the same as defined in 15 U.S.C. 637. "Socially disadvantaged individuals are those who have been subjected to racial or ethnic prejudice or cultural bias because of their identity as a member of a group without regard to their individual qualities". "Economically disadvantaged individuals are those socially disadvantaged individuals whose ability to compete in the free enterprise system has been impaired due to diminished capital and credit opportunities as compared to others in the same business area who are not socially disadvantaged".
4. Public Entity - means State and all public subdivisions and local governmental units.
5. Owner - The State of North Carolina, through the Agency/Institution named in the contract.
6. Designer - Any person, firm, partnership, or corporation, which has contracted with the State of North Carolina to perform architectural or engineering, work.
7. Bidder - Any person, firm, partnership, corporation, association, or joint venture seeking to be awarded a public contract or subcontract.

8. Contract - A mutually binding legal relationship or any modification thereof obligating the seller to furnish equipment, materials or services, including construction, and obligating the buyer to pay for them.
9. Contractor - Any person, firm, partnership, corporation, association, or joint venture which has contracted with the State of North Carolina to perform construction work or repair.
10. Subcontractor - A firm under contract with the prime contractor or construction manager at risk for supplying materials or labor and materials and/or installation. The subcontractor may or may not provide materials in his subcontract.

SECTION C: RESPONSIBILITIES

1. Office for Historically Underutilized Businesses, Department of Administration (hereinafter referred to as HUB Office).

The HUB Office has established a program, which allows interested persons or businesses qualifying as a minority business under G.S. 143-128.2, to obtain certification in the State of North Carolina procurement system. The information provided by the minority businesses will be used by the HUB Office to:

- a. Identify those areas of work for which there are minority businesses, as requested.
- b. Make available to interested parties a list of prospective minority business contractors and subcontractors.
- c. Assist in the determination of technical assistance needed by minority business contractors.

In addition to being responsible for the certification/verification of minority businesses that want to participate in the State construction program, the HUB Office will:

- (1) Maintain a current list of minority businesses. The list shall include the areas of work in which each minority business is interested.
- (2) Inform minority businesses on how to identify and obtain contracting and subcontracting opportunities through the State Construction Office and other public entities.
- (3) Inform minority businesses of the contracting and subcontracting process for public construction building projects.
- (4) Work with the North Carolina trade and professional organizations to improve the ability of minority businesses to compete in the State construction projects.
- (5) The HUB Office also oversees the minority business program by:
 - a. Monitoring compliance with the program requirements.
 - b. Assisting in the implementation of training and technical assistance programs.
 - c. Identifying and implementing outreach efforts to increase the utilization of minority businesses.
 - d. Reporting the results of minority business utilization to the Secretary of the Department of Administration, the Governor, and the General Assembly.

2. State Construction Office

The State Construction Office will be responsible for the following:

- a. Furnish to the HUB Office a minimum of twenty-one days prior to the bid opening the following:
 - (1) Project description and location;
 - (2) Locations where bidding documents may be reviewed;
 - (3) Name of a representative of the owner who can be contacted during the advertising period to advise who the prospective bidders are;
 - (4) Date, time and location of the bid opening.
 - (5) Date, time and location of prebid conference, if scheduled.
- b. Attending scheduled prebid conference, if necessary, to clarify requirements of the general statutes regarding minority-business participation, including the bidders' responsibilities.

- c. Reviewing the apparent low bidders' statutory compliance with the requirements listed in the proposal, that must be complied with, if the bid is to be considered as responsive, prior to award of contracts. The State reserves the right to reject any or all bids and to waive informalities.
- d. Reviewing of minority business requirements at Preconstruction conference.
- e. Monitoring of contractors' compliance with minority business requirements in the contract documents during construction.
- f. Provide statistical data and required reports to the HUB Office.
- g. Resolve any protest and disputes arising after implementation of the plan, in conjunction with the HUB Office.

3. Owner

Before awarding a contract, owner shall do the following:

- a. Develop and implement a minority business participation outreach plan to identify minority businesses that can perform public building projects and to implement outreach efforts to encourage minority business participation in these projects to include education, recruitment, and interaction between minority businesses and non-minority businesses.
- b. Attend the scheduled prebid conference.
- c. At least 10 days prior to the scheduled day of bid opening, notify minority businesses that have requested notices from the public entity for public construction or repair work and minority businesses that otherwise indicated to the Office for Historically Underutilized Businesses an interest in the type of work being bid or the potential contracting opportunities listed in the proposal. The notification shall include the following:
 - 1. A description of the work for which the bid is being solicited.
 - 2. The date, time, and location where bids are to be submitted.
 - 3. The name of the individual within the owner's organization who will be available to answer questions about the project.
 - 4. Where bid documents may be reviewed.
 - 5. Any special requirements that may exist.
- d. Utilize other media, as appropriate, likely to inform potential minority businesses of the bid being sought.
- e. Maintain documentation of any contacts, correspondence, or conversation with minority business firms made in an attempt to meet the goals.
- f. Review, jointly with the designer, all requirements of G.S. 143-128.2(c) and G.S. 143-128.2(f) – (i.e. bidders' proposals for identification of the minority businesses that will be utilized with corresponding total dollar value of the bid and affidavit listing good faith efforts, or affidavit of self-performance of work, if the contractor will perform work under contract by its own workforce) - prior to recommendation of award to the State Construction Office.
- g. Evaluate documentation to determine good faith effort has been achieved for minority business utilization prior to recommendation of award to State Construction Office.
- h. Review prime contractors' pay applications for compliance with minority business utilization commitments prior to payment.
- i. Make documentation showing evidence of implementation of Owner's responsibilities available for review by State Construction Office and HUB Office, upon request

4. Designer

Under the single-prime bidding, separate prime bidding, construction manager at risk, or alternative contracting method, the designer will:

- a. Attend the scheduled prebid conference to explain minority business requirements to the prospective bidders.
- b. Assist the owner to identify and notify prospective minority business prime and subcontractors of potential contracting opportunities.
- c. Maintain documentation of any contacts, correspondence, or conversation with minority business firms made in an attempt to meet the goals.
- d. Review jointly with the owner, all requirements of G.S. 143-128.2(c) and G.S.143-128.2(f) – (i.e. bidders' proposals for identification of the minority businesses that will be utilized with

corresponding total dollar value of the bid and affidavit listing Good Faith Efforts, or affidavit of self-performance of work, if the contractor will perform work under contract by its own workforce) - prior to recommendation of award.

- e. During construction phase of the project, review “MBE Documentation for Contract Payment” – (Appendix E) for compliance with minority business utilization commitments. Submit Appendix E form with monthly pay applications to the owner and forward copies to the State Construction Office.
- f. Make documentation showing evidence of implementation of Designer’s responsibilities available for review by State Construction Office and HUB Office, upon request.

5. Prime Contractor(s), CM at Risk, and Its First-Tier Subcontractors

Under the single-prime bidding, the separate-prime bidding, construction manager at risk and alternative contracting methods, contractor(s) will:

- a. Attend the scheduled prebid conference.
- b. Identify or determine those work areas of a subcontract where minority businesses may have an interest in performing subcontract work.
- c. At least ten (10) days prior to the scheduled day of bid opening, notify minority businesses of potential subcontracting opportunities listed in the proposal. The notification will include the following:
 - (1) A description of the work for which the subbid is being solicited.
 - (2) The date, time and location where subbids are to be submitted.
 - (3) The name of the individual within the company who will be available to answer questions about the project.
 - (4) Where bid documents may be reviewed.
 - (5) Any special requirements that may exist, such as insurance, licenses, bonds and financial arrangements.

If there are more than three (3) minority businesses in the general locality of the project who offer similar contracting or subcontracting services in the specific trade, the contractor(s) shall notify three (3), but may contact more, if the contractor(s) so desires.

- d. During the bidding process, comply with the contractor(s) requirements listed in the proposal for minority participation.
- e. Identify on the bid, the minority businesses that will be utilized on the project with corresponding total dollar value of the bid and affidavit listing good faith efforts as required by G.S. 143-128.2(c) and G.S. 143-128.2(f).
- f. Make documentation showing evidence of implementation of PM, CM-at-Risk and First-Tier Subcontractor responsibilities available for review by State Construction Office and HUB Office, upon request.
- g. Upon being named the apparent low bidder, the Bidder shall provide one of the following: (1) an affidavit (Affidavit C) that includes a description of the portion of work to be executed by minority businesses, expressed as a percentage of the total contract price, which is equal to or more than the applicable goal; (2) if the percentage is not equal to the applicable goal, then documentation of all good faith efforts taken to meet the goal. Failure to comply with these requirements is grounds for rejection of the bid and award to the next lowest responsible and responsive bidder.
- h. The contractor(s) shall identify the name(s) of minority business subcontractor(s) and corresponding dollar amount of work on the schedule of values. The schedule of values shall be provided as required in Article 31 of the General Conditions of the Contract to facilitate payments to the subcontractors.
- i. The contractor(s) shall submit with each monthly pay request(s) and final payment(s), “MBE Documentation for Contract Payment” – (Appendix E), for designer’s review.
- j. During the construction of a project, at any time, if it becomes necessary to replace a minority business subcontractor, immediately advise the owner, State Construction Office, and the Director of the HUB Office in writing, of the circumstances involved. The prime contractor shall make a good faith effort to replace a minority business subcontractor with another minority business subcontractor.

- k. If during the construction of a project additional subcontracting opportunities become available, make a good faith effort to solicit subbids from minority businesses.
- l. It is the intent of these requirements apply to all contractors performing as prime contractor and first tier subcontractor under construction manager at risk on state projects.

6. **Minority Business Responsibilities**

While minority businesses are not required to become certified in order to participate in the State construction projects, it is recommended that they become certified and should take advantage of the appropriate technical assistance that is made available. In addition, minority businesses who are contacted by owners or bidders must respond promptly whether or not they wish to submit a bid.

SECTION 4: DISPUTE PROCEDURES

It is the policy of this state that disputes that involves a person's rights, duties or privileges, should be settled through informal procedures. To that end, minority business disputes arising under these guidelines should be resolved as governed under G.S. 143-128(g).

SECTION 5: These guidelines shall apply upon promulgation on state construction projects. Copies of these guidelines may be obtained from the Department of Administration, State Construction Office, (physical address) 301 North Wilmington Street, Suite 450, NC Education Building, Raleigh, North Carolina, 27601-2827, (mail address) 1307 Mail Service Center, Raleigh, North Carolina, 27699-1307, phone (919) 807-4100, Website: www.nc-sco.com

SECTION 6: In addition to these guidelines, there will be issued with each construction bid package provisions for contractual compliance providing minority business participation in the state construction program.

MINORITY BUSINESS CONTRACT PROVISIONS (CONSTRUCTION)

APPLICATION:

The **Guidelines for Recruitment and Selection of Minority Businesses for Participation in State Construction Contracts** are hereby made a part of these contract documents. These guidelines shall apply to all contractors regardless of ownership. Copies of these guidelines may be obtained from the Department of Administration, State Construction Office, (physical address) 301 North Wilmington Street, Suite 450, NC Education Building, Raleigh, North Carolina, 27601-2827, (mail address) 1307 Mail Service Center, Raleigh, North Carolina, 27699-1307, phone (919) 807-4100, Website: <http://www.nc-sco.com>

MINORITY BUSINESS SUBCONTRACT GOALS:

The goals for participation by minority firms as subcontractors on this project have been set at 10%.

The bidder must identify on its bid, the minority businesses that will be utilized on the project with corresponding total dollar value of the bid and affidavit (Affidavit A) listing good faith efforts or affidavit (Affidavit B) of self-performance of work, if the bidder will perform work under contract by its own workforce, as required by G.S. 143-128.2(c) and G.S. 143-128.2(f).

The lowest responsible, responsive bidder must provide Affidavit C, that includes a description of the portion of work to be executed by minority businesses, expressed as a percentage of the total contract price, which is equal to or more than the applicable goal.

OR

Provide Affidavit D, that includes a description of the portion of work to be executed by minority businesses, expressed as a percentage of the total contract price, **with documentation of Good Faith Effort, if the percentage is not equal to the applicable goal.**

OR

Provide Affidavit B, which includes sufficient information for the State to determine that the bidder does not customarily subcontract work on this type project.

The above information must be provided as required. Failure to submit these documents is grounds for rejection of the bid.

MINIMUM COMPLIANCE REQUIREMENTS:

All written statements, affidavits or intentions made by the Bidder shall become a part of the agreement between the Contractor and the State for performance of this contract. Failure to comply with any of these statements, affidavits or intentions, or with the minority business Guidelines shall constitute a breach of the contract. A finding by the State that any information submitted either prior to award of the contract or during the performance of the contract is inaccurate, false or incomplete, shall also constitute a breach of the contract. Any such breach may result in termination of the contract in accordance with the termination provisions contained in the contract. It shall be solely at the option of the State whether to terminate the contract for breach.

In determining whether a contractor has made Good Faith Efforts, the State will evaluate all efforts made by the Contractor and will determine compliance in regard to quantity, intensity, and results of these efforts. Good Faith Efforts include:

- (1) Contacting minority businesses that reasonably could have been expected to submit a quote and that were known to the contractor or available on State or local government maintained lists at least 10 days before the bid or proposal date and notifying them of the nature and scope of the work to be performed.
- (2) Making the construction plans, specifications and requirements available for review by prospective minority businesses, or providing these documents to them at least 10 days before the bid or proposals are due.
- (3) Breaking down or combining elements of work into economically feasible units to facilitate minority participation.
- (4) Working with minority trade, community, or contractor organizations identified by the Office for Historically Underutilized Businesses and included in the bid documents that provide assistance in recruitment of minority businesses.
- (5) Attending any prebid meetings scheduled by the public owner.
- (6) Providing assistance in getting required bonding or insurance or providing alternatives to bonding or insurance for subcontractors.
- (7) Negotiating in good faith with interested minority businesses and not rejecting them as unqualified without sound reasons based on their capabilities. Any rejection of a minority business based on lack of qualification should have the reasons documented in writing.
- (8) Providing assistance to an otherwise qualified minority business in need of equipment, loan capital, lines of credit, or joint pay agreements to secure loans, supplies, or letters of credit, including waiving credit that is ordinarily required. Assisting minority businesses in obtaining the same unit pricing with the bidder's suppliers in order to help minority businesses in establishing credit.
- (9) Negotiating joint venture and partnership arrangements with minority businesses in order to increase opportunities for minority business participation on a public construction or repair project when possible.
- (10) Providing quick pay agreements and policies to enable minority contractors and suppliers to meet cash-flow demands.

APPENDIX E

MBE DOCUMENTATION FOR CONTRACT PAYMENTS

Prime Contractor/Architect: _____

Address & Phone: _____

Project Name: _____

Pay Application #: _____ Period: _____

The following is a list of payments made to Minority Business Enterprises on this project for the above-mentioned period.

MBE FIRM NAME	* INDICATE TYPE OF MBE	AMOUNT PAID THIS MONTH	TOTAL PAYMENTS TO DATE	TOTAL AMOUNT COMMITTED

*Minority categories: Black, African American (B), Hispanic (H), Asian American (A), American Indian (I), Female (F), Social and Economically Disadvantage (D)

Date: _____ Approved/Certified By: _____

Name

Title

Signature

SUBMIT WITH EACH PAY REQUEST & FINAL PAYMENT

SECTION 011000 - SUMMARY

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:

1. Project information.
2. Work covered by Contract Documents.
3. Phased construction.
4. Work under separate contracts.
5. Access to site.
6. Coordination with occupants.
7. Work restrictions.
8. Specification and Drawing conventions.

B. Related Requirements:

1. Section 015000 "Temporary Facilities and Controls" for limitations and procedures governing temporary use of Owner's facilities.

1.2 PROJECT INFORMATION

A. Project Identification: 23050002.00A Fayetteville State University – FSU HVAC Renovation McLeod Hall.

1. Project Location: 1200 Murchison Road Fayetteville, NC 28301.

B. Owner: Fayetteville State University.

1. Owner's Representative: Jon Parsons.

C. Architect: BSA LifeStructures, 510 Glenwood Ave Suite 321, Raleigh, NC 27603 - Patrick D. Hines II – T. (919) 334-7301.

1.3 WORK COVERED BY CONTRACT DOCUMENTS

A. The Work of Project is defined by the Contract Documents and consists of the following:

1. The work of the project is defined by the contract documents and consists of the following.: renovation / alteration of the existing 1st floor mechanical room and lobby/ corridor ceilings. With minor ceiling patch work to the upper floors. Minor changes will be made to the exiting mechanical systems. The alterations will take place in the exiting building located on 1200 Murchison Road Fayetteville, NC 28301. The existing building is type R-2 construction and has a type IIB construction.

B. Type of Contract:

1. Project will be constructed under a single prime contract.

2. Project will be constructed under coordinated, concurrent multiple contracts. See Section 011200 "Multiple Contract Summary" for a description of work included under each of the multiple contracts and for the responsibilities of Project coordinator. Contracts for this Project include the following:

1.4 ACCESS TO SITE

- A. General: Contractor shall have full use of Project site for construction operations during construction period. Contractor's use of Project site is limited only by Owner's right to perform work or to retain other contractors on portions of Project.
- B. General: Contractor shall have limited use of Project site for construction operations as indicated on Drawings by the Contract limits and as indicated by requirements of this Section.
- C. Use of Site: Limit use of Project site to indicated. Do not disturb portions of Project site beyond areas in which the Work is indicated.
 1. Driveways, Walkways, and Entrances: Keep driveways loading areas, and entrances serving premises clear and available to Owner, Owner's employees, and emergency vehicles at all times. Do not use these areas for parking or for storage of materials.
 - a. Schedule deliveries to minimize use of driveway and entrances by construction operations
 - b. Schedule deliveries to minimize space and time requirements for storage of materials and equipment on-site.
- D. Condition of Existing Building: Maintain portions of existing building affected by construction operations in a weathertight condition throughout construction period. Repair damage caused by construction operations.

1.5 COORDINATION WITH OCCUPANTS

- A. Full Owner Occupancy: Owner will occupy site and existing building during entire construction period. Cooperate with Owner during construction operations to minimize conflicts and facilitate Owner usage. Perform the Work so as not to interfere with Owner's day-to-day operations. Maintain existing exits unless otherwise indicated.
- B. Partial Owner Occupancy: Owner will occupy the premises during entire construction period, with the exception of areas under construction. Cooperate with Owner during construction operations to minimize conflicts and facilitate Owner usage. Perform the Work so as not to interfere with Owner's operations. Maintain existing exits unless otherwise indicated.
 1. Maintain access to existing walkways, corridors, and other adjacent occupied or used facilities. Do not close or obstruct walkways, corridors, or other occupied or used facilities without written permission from Owner and authorities having jurisdiction.
 2. Provide not less than 72 hours' notice to Owner of activities that will affect Owner's operations.
- C. Owner Limited Occupancy of Completed Areas of Construction: Owner reserves the right to occupy and to place and install equipment in completed portions of the Work, prior to Substantial Completion of the Work, provided such occupancy does not interfere with completion of the Work. Such placement of equipment and limited occupancy shall not constitute acceptance of the total Work.

1.6 WORK RESTRICTIONS

- A. Work Restrictions, General: Comply with restrictions on construction operations.

1. Comply with limitations on use of public streets and with other requirements of authorities having jurisdiction.
- B. On-Site Work Hours: Limit work in the existing building to normal business working hours of 6:00 a.m. to 6:00 p.m., Monday through Friday, unless otherwise indicated.
- C. Existing Utility Interruptions: Do not interrupt utilities serving facilities occupied by Owner or others unless permitted under the following conditions and then only after providing temporary utility services according to requirements indicated:
 1. Notify Architect / Engineer and Owner not less than two days in advance of proposed utility interruptions.
 2. Obtain Architect / Engineer and Owner written permission before proceeding with utility interruptions.
- D. Restricted Substances: Use of tobacco products and other controlled substances within the existing building and campus / project site is not permitted.

1.7 SPECIFICATION AND DRAWING CONVENTIONS

- A. Specification Content: The Specifications use certain conventions for the style of language and the intended meaning of certain terms, words, and phrases when used in particular situations. These conventions are as follows:
 1. Imperative mood and streamlined language are generally used in the Specifications. The words "shall," "shall be," or "shall comply with," depending on the context, are implied where a colon (:) is used within a sentence or phrase.
 2. Specification requirements are to be performed by Contractor unless specifically stated otherwise.
- B. Division 01 General Requirements: Requirements of Sections in Division 01 apply to the Work of all Sections in the Specifications.

END OF SECTION 011000

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SECTION 012500 - SUBSTITUTION PROCEDURES

PART 1 - GENERAL

1.1 SUMMARY

- A. Section includes administrative and procedural requirements for substitutions.
- B. Related Requirements:
 - 1. Section 016000 "Product Requirements" for requirements for submitting comparable product submittals for products by listed manufacturers.

1.2 DEFINITIONS

- A. Substitutions: Changes in products, materials, equipment, and methods of construction from those required by the Contract Documents and proposed by Contractor.
 - 1. Substitutions for Cause: Changes proposed by Contractor that are required due to changed Project conditions, such as unavailability of product, regulatory changes, or unavailability of required warranty terms.
 - 2. Substitutions for Convenience: Changes proposed by Contractor or Owner that are not required in order to meet other Project requirements but may offer advantage to Contractor or Owner.

1.3 ACTION SUBMITTALS

- A. Substitution Requests: Submit three copies of each request for consideration. Identify product or fabrication or installation method to be replaced. Include Specification Section number and title and Drawing numbers and titles.
 - 1. Documentation: Show compliance with requirements for substitutions and the following, as applicable:
 - a. Statement indicating why specified product or fabrication or installation method cannot be provided, if applicable.
 - b. Coordination of information, including a list of changes or revisions needed to other parts of the Work and to construction performed by Owner and separate contractors that will be necessary to accommodate proposed substitution.
 - c. Detailed comparison of significant qualities of proposed substitutions with those of the Work specified. Include annotated copy of applicable Specification Section. Significant qualities may include attributes, such as performance, weight, size, durability, visual effect, sustainable design characteristics, warranties, and specific features and requirements indicated. Indicate deviations, if any, from the Work specified.
 - d. Product Data, including drawings and descriptions of products and fabrication and installation procedures.
 - e. Samples, where applicable or requested.
 - f. Certificates and qualification data, where applicable or requested.
 - g. List of similar installations for completed projects, with project names and addresses as well as names and addresses of architects and owners.

- h. Material test reports from a qualified testing agency, indicating and interpreting test results for compliance with requirements indicated.
 - i. Research reports evidencing compliance with building code in effect for Project, from ICC-ES.
 - j. Detailed comparison of Contractor's construction schedule using proposed substitutions with products specified for the Work, including effect on the overall Contract Time. If specified product or method of construction cannot be provided within the Contract Time, include letter from manufacturer, on manufacturer's letterhead, stating date of receipt of purchase order, lack of availability, or delays in delivery.
 - k. Cost information, including a proposal of change, if any, in the Contract Sum.
 - l. Contractor's certification that proposed substitution complies with requirements in the Contract Documents, except as indicated in substitution request, is compatible with related materials and is appropriate for applications indicated.
 - m. Contractor's waiver of rights to additional payment or time that may subsequently become necessary because of failure of proposed substitution to produce indicated results.
- 2. Architect's Action: If necessary, Architect will request additional information or documentation for evaluation within 7 days of receipt of a request for substitution. Architect will notify Contractor of acceptance or rejection of proposed substitution within 15 days of receipt of request, or 7 days of receipt of additional information or documentation, whichever is later.
 - a. Forms of Acceptance: Change Order, Construction Change Directive, or Architect's Supplemental Instructions for minor changes in the Work.
 - b. Use product specified if Architect does not issue a decision on use of a proposed substitution within time allocated.

1.4 QUALITY ASSURANCE

- A. Compatibility of Substitutions: Investigate and document compatibility of proposed substitution with related products and materials. Engage a qualified testing agency to perform compatibility tests recommended by manufacturers.

1.5 PROCEDURES

- A. Coordination: Revise or adjust affected work as necessary to integrate work of the approved substitutions.

1.6 SUBSTITUTIONS

- A. Substitutions for Cause: Submit requests for substitution immediately on discovery of need for change, but not later than 15 days prior to time required for preparation and review of related submittals.
 - 1. Conditions: Architect will consider Contractor's request for substitution when the following conditions are satisfied. If the following conditions are not satisfied, Architect will return requests without action, except to record noncompliance with these requirements:
 - a. Requested substitution is consistent with the Contract Documents and will produce indicated results.
 - b. Substitution request is fully documented and properly submitted.
 - c. Requested substitution will not adversely affect Contractor's construction schedule.
 - d. Requested substitution has received necessary approvals of authorities having jurisdiction.
 - e. Requested substitution is compatible with other portions of the Work.
 - f. Requested substitution has been coordinated with other portions of the Work.

- g. Requested substitution provides specified warranty.
 - h. If requested substitution involves more than one contractor, requested substitution has been coordinated with other portions of the Work, is uniform and consistent, is compatible with other products, and is acceptable to all contractors involved.
 - B. Substitutions for Convenience: Not allowed unless otherwise indicated and reviewed by Architect, Engineer, and Owner.
 - C. Substitutions for Convenience: Architect will consider requests for substitution if received within 60 days after the Notice to Proceed. Requests received after that time may be considered or rejected at discretion of Architect.
 - 1. Conditions: Architect will consider Contractor's request for substitution when the following conditions are satisfied. If the following conditions are not satisfied, Architect will return requests without action, except to record noncompliance with these requirements:
 - a. Requested substitution offers Owner a substantial advantage in cost, time, energy conservation, or other considerations, after deducting additional responsibilities Owner must assume. Owner's additional responsibilities may include compensation to Architect for redesign and evaluation services, increased cost of other construction by Owner, and similar considerations.
 - b. Requested substitution does not require extensive revisions to the Contract Documents.
 - c. Requested substitution is consistent with the Contract Documents and will produce indicated results.
 - d. Substitution request is fully documented and properly submitted.
 - e. Requested substitution will not adversely affect Contractor's construction schedule.
 - f. Requested substitution has received necessary approvals of authorities having jurisdiction.
 - g. Requested substitution is compatible with other portions of the Work.
 - h. Requested substitution has been coordinated with other portions of the Work.
 - i. Requested substitution provides specified warranty.
 - j. If requested substitution involves more than one contractor, requested substitution has been coordinated with other portions of the Work, is uniform and consistent, is compatible with other products, and is acceptable to all contractors involved.

D. TRANSFER AGREEMENT FOR TRANSFER OF ELECTRONIC FILES

The transfer and use of the enclosed electronic files is subject to the following terms of use, hereinafter called the "Transfer Agreement." All rights not expressly granted here-in are reserved. Consultants under a fully executed written contract with BSA Life-Structures for referenced project are excepted from this transfer agreement.

Whereas the Owner of the above referenced Project, hereinafter called the "Project", has requested that BSA LifeStructures [defined as any of the following: BSA LifeStructures of Colorado, Inc., BSA LifeStructures of Connecticut, LLC, BSA LifeStructures P.C., District of Columbia, BSA LifeStructures of Idaho, LLC, BSA LifeStructures of Massachusetts,

LLC, BSA LifeStructures of Michigan, LLC, BSA LifeStructures of Mississippi, PLLC, BSA LifeStructures of Nevada, LLC, BSA LifeStructures of New Jersey Architects and Engineers, LLC, BSA LifeStructures of New York, LLC, BSA LifeStructures of North Dakota, LLC, and BSA LifeStructures of Oregon Architects and Engineers, LLC, hereinafter called 'Architect,' make copies of ELECTRONIC FILES available to the Owner and its consultants and contractors, jointly and severally called 'User' herein, in electronic form, hereinafter called "ELECTRONIC FILES," for interim review and purposes of reference and/or facility management; and whereas, the ELECTRONIC FILES were developed by the Architect and/or its consultants for its use in preparation of either paper and/or electronic construction documents for the Project; and whereas, User understands and acknowledges that the ELECTRONIC FILES were not created or intended for use as construction documents or for use as back-grounds for documents prepared by User or third parties, and after the ELECTRONIC FILES are provided they can deteriorate undetected, can be modified without the Architect's knowledge, may not be readable by User or by third parties, and the original ELECTRONIC FILES may be modified by the Architect after the ELECTRONIC FILES are transferred pursuant to the protocol described in this Transfer Agreement, any of which circumstance could

cause damage or loss to User; and whereas, User understands and acknowledges that these risks are inherent with any use of the ELECTRONIC FILES and that use of the ELECTRONIC FILES will save the User considerable time and expense in the coordination and management of the Project, which represents good and valuable consideration for the following indemnification and release; therefore, in consideration of the Architect's agreement to transfer the ELECTRONIC FILES to User for interim review, reference, and/or facility management, hereinafter called "Reference Uses," and not for use for pricing, bidding, permitting, regulatory approval, or construction purposes, for modification or reuse on the Project, for use for additions to the Project, use for completion of the Project by others, or use for other projects, hereinafter called "Drawing Uses."

User agrees, jointly and severally, to the fullest extent permitted by law, to release, indemnify, and defend the architect/engineer, its officers, shareholders, employees and Consultants, collectively called "indemnitees," from any and all claims, demands, suits, liabilities, losses, damages, and costs, including but not limited to attorneys' fees, Expert witness fees, and courts costs, called "liabilities," arising out of or in any way connected with any use of the electronic files provided by the architect pursuant to this agreement, subject to the following: with regard to the reference uses, the foregoing release, indemnification, and defense shall be provided on a comparative responsibility basis; with regard to the drawing uses, the foregoing release, indemnification, and defense shall apply to any liabilities electronic files provided by the architect/engineer, whether or not caused in whole or in part by the sole or comparative negligence, strict liability or other fault of any of the indemnitees. The foregoing notwithstanding, electronic files in uneditable formats, such as but not limited to "dwf" "pdf" or "tif" with a professional seal and signature may be used for pricing, bidding, permitting, regulatory approval, or construction purposes subject to the terms of this agreement applicable to the reference uses.

User acknowledges that the transfer of electronic files is a service and shall not constitute a sale of goods; and, the architect/engineer makes no warranty, express or implied, of merchantability or fitness for any purpose in connection with the service of providing access to, and the transfer of, the electronic files, or that the electronic files will be usable or accurate, which warranties and representations are expressly disclaimed.

END OF SECTION 012500

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SECTION 012900 - PAYMENT PROCEDURES

PART 1 - GENERAL

1.1 SUMMARY

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

1.2 SCHEDULE OF VALUES

- A. Coordination: Coordinate preparation of the schedule of values with preparation of Contractor's construction schedule.
 - 1. Coordinate line items in the schedule of values with items required to be indicated as separate activities in Contractor's construction schedule.
 - 2. Submit the schedule of values to Architect / Engineer at earliest possible date, but no later than Seven days before the date scheduled for submittal of initial Applications for Payment.
- B. Format and Content: Use Project Manual table of contents as a guide to establish line items for the schedule of values. Provide at least one line item for each Specification Section.
 - 1. Arrange schedule of values consistent with format of AIA Document G703 and EJCDC Document C-620
 - 2. Provide a breakdown of the Contract Sum in enough detail to facilitate continued evaluation of Applications for Payment and progress reports. Provide multiple line items for principal subcontract amounts in excess of five percent of the Contract Sum.
 - 3. Provide a separate line item in the schedule of values for each part of the Work where Applications for Payment may include materials or equipment purchased or fabricated and stored, but not yet installed.
 - a. Differentiate between items stored on-site and items stored off-site.
 - 4. Allowances: Provide a separate line item in the schedule of values for each allowance. Show line-item value of unit-cost allowances, as a product of the unit cost, multiplied by measured quantity. Use information indicated in the Contract Documents to determine quantities.
 - 5. Overhead Costs: Include total cost and proportionate share of general overhead and profit for each line item.
 - 6. Overhead Costs: Show cost of temporary facilities and other major cost items that are not direct cost of actual work-in-place as separate line items.
 - 7. Closeout Costs. Include separate line items under Contractor and principal subcontracts for Project closeout requirements in an amount totaling five percent of the Contract Sum and subcontract amount.
 - 8. Schedule of Values Revisions: Revise the schedule of values when Change Orders or Construction Change Directives result in a change in the Contract Sum. Include at least one separate line item for each Change Order and Construction Change Directive.

1.3 APPLICATIONS FOR PAYMENT

- A. Each Application for Payment following the initial Application for Payment shall be consistent with previous applications and payments as certified by Architect / Engineer, General Contractor and paid for by Owner.
- B. Application for Payment Forms: Use AIA Document G702 and AIA Document G703, AIA Document G732 and AIA Document G703, EJCDC Document C-620 as form for Applications for Payment.
- C. Transmittal: Submit three signed and notarized original copies of each Application for Payment to Architect / Engineer by a method ensuring receipt within 24 hours. One copy shall include waivers of lien and similar attachments if required.
 - 1. Transmit each copy with a transmittal form listing attachments and recording appropriate information about application.
- D. Waivers of Mechanic's Lien: With each Application for Payment, submit waivers of mechanic's lien from entities lawfully entitled to file a mechanic's lien arising out of the Contract and related to the Work covered by the payment.
 - 1. Submit partial waivers on each item for amount requested in previous application, after deduction for retainage, on each item.
 - 2. When an application shows completion of an item, submit conditional final or full waivers.
 - 3. 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 conditional final waivers from every entity involved with performance of the Work covered by the application who is lawfully entitled to a lien.
 - 5. Waiver Forms: Submit executed waivers of lien on forms acceptable to Owner.
- E. Initial Application for Payment: Administrative actions and submittals that must precede or coincide with submittal of first Application for Payment include the following:
 - 1. List of subcontractors.
 - 2. Schedule of values.
 - 3. Contractor's construction schedule (preliminary if not final).
 - 4. Products list (preliminary if not final).
 - 5. Sustainable design action plans, including preliminary project materials cost data.
 - 6. Schedule of unit prices.
 - 7. Submittal schedule (preliminary if not final).
 - 8. List of Contractor's staff assignments.
 - 9. List of Contractor's principal consultants.
 - 10. Copies of building permits.
 - 11. Copies of authorizations and licenses from authorities having jurisdiction for performance of the Work.
 - 12. Initial progress report.
 - 13. Report of preconstruction conference.
 - 14. Certificates of insurance and insurance policies.
 - 15. Performance and payment bonds.
 - 16. Data needed to acquire Owner's insurance.
- F. Application for Payment at Substantial Completion: After Architect issues the Certificate of Substantial Completion, submit an Application for Payment showing 100 percent completion for portion of the Work claimed as substantially complete.

1. Include documentation supporting claim that the Work is substantially complete and a statement showing an accounting of changes to the Contract Sum.
 2. This application shall reflect Certificate(s) of Substantial Completion issued previously for Owner occupancy of designated portions of the Work.
- G. Final Payment Application: After completing Project closeout requirements, submit final Application for Payment with releases and supporting documentation not previously submitted and accepted, including, but not limited, to the following:
1. Evidence of completion of Project closeout requirements.
 2. Insurance certificates for products and completed operations where required and proof that taxes, fees, and similar obligations were paid.
 3. Updated final statement, accounting for final changes to the Contract Sum.
 4. AIA Document G706.
 5. AIA Document G706A.
 6. AIA Document G707.
 7. Evidence that claims have been settled.
 8. Final meter readings for utilities, a measured record of stored fuel, and similar data as of date of Substantial Completion or when Owner took possession of and assumed responsibility for corresponding elements of the Work.
 9. Final liquidated damages settlement statement.

END OF SECTION 012900

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SECTION 013100 - PROJECT MANAGEMENT AND COORDINATION

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

- A. Section includes administrative provisions for coordinating construction operations on Project including, but not limited to, the following:
 - 1. General coordination procedures.
 - 2. Coordination drawings.
 - 3. RFIs.
 - 4. Digital project management procedures.
 - 5. Project meetings.
- B. Related Requirements:
 - 1. Section 011200 "Multiple Contract Summary" for a description of the division of work among separate contracts and responsibility for coordination activities not in this Section.
 - 2. Section 017300 "Execution" for procedures for coordinating general installation and field-engineering services, including establishment of benchmarks and control points.
 - 3. Section 019113 "General Commissioning Requirements" for coordinating the Work with Owner's Commissioning Authority.

1.3 DEFINITIONS

- A. BIM: Building Information Modeling.
- B. RFI: Request for Information. Request from Owner, Construction Manager, Architect / Engineer, or Contractor seeking information required by or clarifications of the Contract Documents.

1.4 INFORMATIONAL SUBMITTALS

- A. Subcontract List: Prepare a written summary identifying individuals or firms proposed for each portion of the Work, including those who are to furnish products or equipment fabricated to a special design. Include the following information in tabular form:
 - 1. Name, address, telephone number, and email address of entity performing subcontract or supplying products.
 - 2. Number and title of related Specification Section(s) covered by subcontract.
 - 3. Drawing number and detail references, as appropriate, covered by subcontract.

1.5 GENERAL COORDINATION PROCEDURES

- A. Coordination: Coordinate construction operations included in different Sections of the Specifications to ensure efficient and orderly installation of each part of the Work. Coordinate construction operations included in different Sections that depend on each other for proper installation, connection, and operation.
 - 1. Schedule construction operations in sequence required to obtain the best results where installation of one part of the Work depends on installation of other components, before or after its own installation.
 - 2. Coordinate installation of different components to ensure maximum performance and accessibility for required maintenance, service, and repair.
 - 3. Make adequate provisions to accommodate items scheduled for later installation.
- B. Administrative Procedures: Coordinate scheduling and timing of required administrative procedures with other construction activities and scheduled activities of other contractors to avoid conflicts and to ensure orderly progress of the Work. Such administrative activities include, but are not limited to, the following:
 - 1. Preparation of Contractor's construction schedule.
 - 2. Preparation of the schedule of values.
 - 3. Installation and removal of temporary facilities and controls.
 - 4. Delivery and processing of submittals.
 - 5. Progress meetings.
 - 6. Preinstallation conferences.
 - 7. Project closeout activities.
 - 8. Startup and adjustment of systems.

1.6 COORDINATION DRAWINGS

- A. Coordination Drawings, General: Prepare coordination drawings according to requirements in individual Sections, and additionally where installation is not completely indicated on Shop Drawings, where limited space availability necessitates coordination, or if coordination is required to facilitate integration of products and materials fabricated or installed by more than one entity.
 - 1. Content: Project-specific information, drawn accurately to a scale large enough to indicate and resolve conflicts. Do not base coordination drawings on standard printed data. Include the following information, as applicable:
 - a. Indicate functional and spatial relationships of components of architectural, structural, civil, mechanical, and electrical systems.
 - b. Indicate dimensions shown on Drawings. Specifically note dimensions that appear to be in conflict with submitted equipment and minimum clearance requirements. Provide alternative sketches to Architect indicating proposed resolution of such conflicts. Minor dimension changes and difficult installations will not be considered changes to the Contract.
- B. Coordination Drawing Organization: Organize coordination drawings as follows:
 - 1. Floor Plans and Reflected Ceiling Plans: Show architectural and structural elements, and mechanical, plumbing, fire-protection, fire-alarm, and electrical Work. Show locations of visible ceiling-mounted devices relative to acoustical ceiling grid. Supplement plan drawings with section drawings where required to adequately represent the Work.
 - 2. Plenum Space: Indicate subframing for support of ceiling and wall systems, mechanical and electrical equipment, and related Work. Locate components within plenums to accommodate layout of light fixtures and other components indicated on Drawings. Indicate areas of conflict between light fixtures and other components.

3. Mechanical Rooms: Provide coordination drawings for mechanical rooms showing plans and elevations of mechanical, plumbing, fire-protection, fire-alarm, and electrical equipment.
4. Structural Penetrations: Indicate penetrations and openings required for all disciplines.
5. Slab Edge and Embedded Items: Indicate slab edge locations and sizes and locations of embedded items for metal fabrications, sleeves, anchor bolts, bearing plates, angles, door floor closers, slab depressions for floor finishes, curbs and housekeeping pads, and similar items.
6. Review: Architect will review coordination drawings to confirm that in general the Work is being coordinated, but not for the details of the coordination, which are Contractor's responsibility.

1.7 REQUEST FOR INFORMATION (RFI)

- A. General: Immediately on discovery of the need for additional information, clarification, or interpretation of the Contract Documents, Contractor shall prepare and submit an RFI in the form specified.
 1. Architect / Engineer will return without response those RFIs submitted to Architect / Engineer by other entities controlled by Contractor.
 2. Coordinate and submit RFIs in a prompt manner so as to avoid delays in Contractor's work or work of subcontractors.
- B. Content of the RFI: Include a detailed, legible description of item needing information or interpretation and the following:
 1. Project name.
 2. Project number.
 3. Date.
 4. Name of Contractor.
 5. Name of Architect / Engineer
 6. RFI number, numbered sequentially.
 7. RFI subject.
 8. Specification Section number and title and related paragraphs, as appropriate.
 9. Drawing number and detail references, as appropriate.
 10. Field dimensions and conditions, as appropriate.
 11. Contractor's suggested resolution. If Contractor's suggested resolution impacts the Contract Time or the Contract Sum, Contractor shall state impact in the RFI.
 12. Contractor's signature.
 13. Attachments: Include sketches, descriptions, measurements, photos, Product Data, Shop Drawings, coordination drawings, and other information necessary to fully describe items needing interpretation.
- C. RFI Forms: AIA Document G716 and Form bound in Project Manual.
- D. Architect's / Engineer's Action: Architect / Engineer's will review each RFI, determine action required, and respond. Allow seven working days for Architect's response for each RFI. RFIs received by Architect / Engineer after 1:00 p.m. will be considered as received the following working day.
 1. The following Contractor-generated RFIs will be returned without action:
 - a. Requests for approval of submittals.
 - b. Requests for approval of substitutions.
 - c. Requests for approval of Contractor's means and methods.
 - d. Requests for coordination information already indicated in the Contract Documents.
 - e. Requests for adjustments in the Contract Time or the Contract Sum.
 - f. Requests for interpretation of Architect's actions on submittals.
 - g. Incomplete RFIs or inaccurately prepared RFIs.

2. Architect's / Engineer's action may include a request for additional information, in which case Architect's time for response will date from time of receipt by Architect / Engineer of additional information.
 3. Architect's / Engineer's action on RFIs that may result in a change to the Contract Time or the Contract Sum may be eligible for Contractor to submit Change Proposal according to Section 012600 "Contract Modification Procedures."
 - a. If Contractor believes the RFI response warrants change in the Contract Time or the Contract Sum, notify Architect / Engineer's in writing within ten days of receipt of the RFI response.
- E. RFI Log: Prepare, maintain, and submit a tabular log of RFIs organized by the RFI number. Submit log weekly.
1. Project name.
 2. Name and address of Contractor.
 3. Name and address of Architect / Engineer.
 4. RFI number including RFIs that were returned without action or withdrawn.
 5. RFI description.
 6. Date the RFI was submitted.
 7. Date Architect's / Engineer's response was received.
- F. On receipt of Architect's / Engineer's action, update the RFI log and immediately distribute the RFI response to affected parties. Review response and notify Architect / Engineer within seven days if Contractor disagrees with response.

1.8 DIGITAL PROJECT MANAGEMENT PROCEDURES

- A. Architect's Data Files Not Available: Architect will not provide Architect's BIM model or CAD drawing digital data files for Contractor's use during construction.
- B. Use of Architect's Digital Data Files: Digital data files of Architect's BIM model and CAD drawings will be provided by Architect / Engineer for Contractor's use during construction.
1. Digital data files may be used by Contractor in preparing coordination drawings, Shop Drawings, and Project record Drawings.
 2. Architect makes no representations as to the accuracy or completeness of digital data files as they relate to Contract Drawings.
 3. Contractor shall execute a data licensing agreement in the form of AIA Document C106 Digital Data Licensing Agreement, Agreement included in Project Manual, and Agreement form acceptable to Owner and Architect / Engineer.
 - a. Subcontractors, and other parties granted access by Contractor to Architect's digital data files shall execute a data licensing agreement in the form of AIA Document C106, Agreement included in this Project Manual, and Agreement acceptable to Owner and Architect / Engineer's.
 4. The following digital data files will be furnished for each appropriate discipline:
 - a. Floor plans.
 - b. Reflected ceiling plans.
 - c. Autodesk; Buzzsaw or Constructware.
 - d. Corecon Technologies, Inc.
 - e. Meridian Systems; Prolog.
 - f. Newforma, Inc.

- g. Procore Technologies, Inc.
- h. Viewpoint, Inc.; Viewpoint for Project Collaboration.

C. PDF Document Preparation: Where PDFs are required to be submitted to Architect, prepare as follows:

- 1. Assemble complete submittal package into a single indexed file incorporating submittal requirements of a single Specification Section and transmittal form with links enabling navigation to each item.
- 2. Name file with submittal number or other unique identifier, including revision identifier.
- 3. Certifications: Where digitally submitted certificates and certifications are required, provide a digital signature with digital certificate on where indicated.

1.9 PROJECT MEETINGS

A. General: Schedule and conduct of meetings and conferences at Project site unless otherwise indicated.

B. Preconstruction Conference: Schedule and conduct a preconstruction conference before starting construction, at a time convenient to Owner and Architect, but no later than 15 days after execution of the Agreement.

- 1. Attendees: Authorized representatives of Owner, Architect / Engineer's, and their consultants; Contractor and its superintendent; major subcontractors; suppliers; and other concerned parties shall attend the conference. Participants at the conference shall be familiar with Project and authorized to conclude matters relating to the Work.
- 2. Agenda: Discuss items of significance that could affect progress, including the following:
 - a. Responsibilities and personnel assignments.
 - b. Tentative construction schedule.
 - c. Phasing.
 - d. Critical work sequencing and long lead items.
 - e. Designation of key personnel and their duties.
 - f. Lines of communications.
 - g. Procedures for processing field decisions and Change Orders.
 - h. Procedures for RFIs.
 - i. Procedures for testing and inspecting.
 - j. Procedures for processing Applications for Payment.
 - k. Distribution of the Contract Documents.
 - l. Submittal procedures.
 - m. Sustainable design requirements.
 - n. Preparation of Record Documents.
 - o. Use of the premises and existing building.
 - p. Work restrictions.
 - q. Working hours.
 - r. Owner's occupancy requirements.
 - s. Responsibility for temporary facilities and controls.
 - t. Procedures for moisture and mold control.
 - u. Procedures for disruptions and shutdowns.
 - v. Construction waste management and recycling.
 - w. Parking availability.
 - x. Office, work, and storage areas.
 - y. Equipment deliveries and priorities.
 - z. First aid.
 - aa. Security.
 - bb. Progress cleaning.

3. Minutes: Entity responsible for conducting meeting will record and distribute meeting minutes.
- C. Preinstallation Conferences: Conduct a preinstallation conference at Project site before each construction activity when required by other sections and when required for coordination with other construction.
1. Attendees: Installer and representatives of manufacturers and fabricators involved in or affected by the installation and its coordination or integration with other materials and installations that have preceded or will follow, shall attend the meeting. Advise Architect / Engineer, of scheduled meeting dates.
 2. Agenda: Review progress of other construction activities and preparations for the particular activity under consideration, including requirements for the following:
 - a. Contract Documents.
 - b. Options.
 - c. Related RFIs.
 - d. Related Change Orders.
 - e. Purchases.
 - f. Deliveries.
 - g. Submittals.
 - h. Sustainable design requirements.
 - i. Review of mockups.
 - j. Possible conflicts.
 - k. Compatibility requirements.
 - l. Time schedules.
 - m. Weather limitations.
 - n. Manufacturer's written instructions.
 - o. Warranty requirements.
 - p. Compatibility of materials.
 - q. Acceptability of substrates.
 - r. Temporary facilities and controls.
 - s. Space and access limitations.
 - t. Regulations of authorities having jurisdiction.
 - u. Testing and inspecting requirements.
 - v. Installation procedures.
 - w. Coordination with other work.
 - x. Required performance results.
 - y. Protection of adjacent work.
 - z. Protection of construction and personnel.
 3. Record significant conference discussions, agreements, and disagreements, including required corrective measures and actions.
 4. Reporting: Distribute minutes of the meeting to each party present and to other parties requiring information.
 5. Do not proceed with installation if the conference cannot be successfully concluded. Initiate whatever actions are necessary to resolve impediments to performance of the Work and reconvene the conference at earliest feasible date.
- D. Progress Meetings: Conduct progress meetings at biweekly intervals.
1. Coordinate dates of meetings with preparation of payment requests.
 2. Attendees: In addition to representatives of Owner, and Architect / Engineer, each contractor, subcontractor, supplier, and other entity concerned with current progress or involved in planning, coordination, or performance of future activities shall be represented at these meetings. All participants at the meeting shall be familiar with Project and authorized to conclude matters relating to the Work.

3. Agenda: Review and correct or approve minutes of previous progress meeting. Review other items of significance that could affect progress. Include topics for discussion as appropriate to status of Project.
 - a. Contractor's Construction Schedule: Review progress since the last meeting. Determine whether each activity is on time, ahead of schedule, or behind schedule, in relation to Contractor's construction schedule. Determine how construction behind schedule will be expedited; secure commitments from parties involved to do so. Discuss whether schedule revisions are required to ensure that current and subsequent activities will be completed within the Contract Time.
 - 1) Review schedule for next period.
 - b. Review present and future needs of each entity present, including the following:
 - 1) Interface requirements.
 - 2) Sequence of operations.
 - 3) Resolution of BIM component conflicts.
 - 4) Status of submittals.
 - 5) Status of sustainable design documentation.
 - 6) Deliveries.
 - 7) Off-site fabrication.
 - 8) Access.
 - 9) Site use.
 - 10) Temporary facilities and controls.
 - 11) Progress cleaning.
 - 12) Quality and work standards.
 - 13) Status of correction of deficient items.
 - 14) Field observations.
 - 15) Status of RFIs.
 - 16) Status of Proposal Requests.
 - 17) Pending changes.
 - 18) Status of Change Orders.
 - 19) Pending claims and disputes.
 - 20) Documentation of information for payment requests.
4. Minutes: Entity responsible for conducting the meeting will record and distribute the meeting minutes to each party present and to parties requiring information.
 - a. Schedule Updating: Revise Contractor's construction schedule after each progress meeting where revisions to the schedule have been made or recognized. Issue revised schedule concurrently with the report of each meeting.

END OF SECTION 013100

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SECTION 013200 - CONSTRUCTION PROGRESS DOCUMENTATION

1.1 SUMMARY

- A. Section includes administrative and procedural requirements for documenting the progress of construction during performance of the Work, including the following:
 - 1. Contractor's Construction Schedule.
 - 2. Construction schedule updating reports.
 - 3. Daily construction reports.
 - 4. Site condition reports.
- B. Related Requirements:
 - 1. Section 011200 "Multiple Contract Summary" for preparing a combined Contractor's Construction Schedule.

1.2 DEFINITIONS

- A. Activity: A discrete part of a project that can be identified for planning, scheduling, monitoring, and controlling the construction Project. Activities included in a construction schedule consume time and resources.
 - 1. Critical Activity: An activity on the critical path that must start and finish on the planned early start and finish times.
 - 2. Predecessor Activity: An activity that precedes another activity in the network.
 - 3. Successor Activity: An activity that follows another activity in the network.
- B. CPM: Critical path method, which is a method of planning and scheduling a construction project where activities are arranged based on activity relationships. Network calculations determine when activities can be performed and the critical path of Project.
- C. Critical Path: The longest connected chain of interdependent activities through the network schedule that establishes the minimum overall Project duration and contains no float.
- D. Event: The starting or ending point of an activity.
- E. Float: The measure of leeway in starting and completing an activity.
 - 1. Float time is not for the exclusive use or benefit of either Owner or Contractor, but is a jointly owned, expiring Project resource available to both parties as needed to meet schedule milestones and Contract completion date.
 - 2. Free float is the amount of time an activity can be delayed without adversely affecting the early start of the successor activity.
 - 3. Total float is the measure of leeway in starting or completing an activity without adversely affecting the planned Project completion date.

1.3 INFORMATIONAL SUBMITTALS

- A. Format for Submittals: Submit required submittals in the following format:

1. Working electronic copy of schedule file, where indicated.
 2. PDF file.
 3. 2 paper copies of sufficient size to display entire period or schedule, as required.
- B. Startup Network Diagram: Of size required to display entire network for entire construction period. Show logic ties for activities.
- C. Contractor's Construction Schedule: Initial schedule, of size required to display entire schedule for entire construction period.
1. Submit a working digital copy of schedule, using software indicated, and labeled to comply with requirements for submittals.
- D. CPM Reports: Concurrent with CPM schedule, submit each of the following reports. Format for each activity in reports shall contain activity number, activity description, original duration, remaining duration, early start date, early finish date, late start date, late finish date, and total float in calendar days.
1. Activity Report: List of activities sorted by activity number and then early start date, or actual start date if known.
 2. Logic Report: List of preceding and succeeding activities for each activity, sorted in ascending order by activity number and then by early start date, or actual start date if known.
 3. Total Float Report: List of activities sorted in ascending order of total float.
- E. Construction Schedule Updating Reports: Submit with Applications for Payment.
- F. Daily Construction Reports: Submit at weekly intervals.
- G. Site Condition Reports: Submit at time of discovery of differing conditions.

1.4 COORDINATION

- A. Coordinate Contractor's Construction Schedule with the schedule of values, list of subcontracts, submittal schedule, progress reports, payment requests, and other required schedules and reports.
1. Secure time commitments for performing critical elements of the Work from entities involved.
 2. Coordinate each construction activity in the network with other activities and schedule them in proper sequence.

1.5 CONTRACTOR'S CONSTRUCTION SCHEDULE, GENERAL

- A. Time Frame: Extend schedule from date established for the Notice of Award to date of final completion.
1. Contract completion date shall not be changed by submission of a schedule that shows an early completion date, unless specifically authorized by Change Order.
- B. Activities: Treat each floor or separate area as a separate numbered activity for each main element of the Work. Comply with the following:
1. Activity Duration: Define activities so no activity is longer than 20 days, unless specifically allowed by Architect.
 2. Procurement Activities: Include procurement process activities for the following long lead items and major items, requiring a cycle of more than 60 days, as separate activities in schedule.

Procurement cycle activities include, but are not limited to, submittals, approvals, purchasing, fabrication, and delivery.

3. Submittal Review Time: Include review and resubmittal times indicated in Section 013300 "Submittal Procedures" in schedule. Coordinate submittal review times in Contractor's Construction Schedule with submittal schedule.
 4. Startup and Testing Time: Include no fewer than 15 days for startup and testing.
 5. Commissioning Time: Include no fewer than 15 days for commissioning.
 6. Substantial Completion: Indicate completion in advance of date established for Substantial Completion, and allow time for Architect's / Engineer's administrative procedures necessary for certification of Substantial Completion.
 7. Punch List and Final Completion: Include not more than 30 days for completion of punch list items and final completion.
- C. Milestones: Include milestones indicated in the Contract Documents in schedule, including, but not limited to, the Notice to Proceed, Substantial Completion, and final completion.
- D. Upcoming Work Summary: Prepare summary report indicating activities scheduled to occur or commence prior to submittal of next schedule update. Summarize the following issues:
1. Unresolved issues.
 2. Unanswered Requests for Information.
 3. Rejected or unreturned submittals.
 4. Notations on returned submittals.
 5. Pending modifications affecting the Work and the Contract Time.
- E. Contractor's Construction Schedule Updating: At weekly intervals, update schedule to reflect actual construction progress and activities. Issue schedule biweekly before each regularly scheduled progress meeting.
1. Revise schedule immediately after each meeting or other activity where revisions have been recognized or made. Issue updated schedule concurrently with the report of each such meeting.
 2. Include a report with updated schedule that indicates every change, including, but not limited to, changes in logic, durations, actual starts and finishes, and activity durations.
 3. As the Work progresses, indicate final completion percentage for each activity.
- F. Recovery Schedule: When periodic update indicates the Work is 14 or more calendar days behind the current approved schedule, submit a separate recovery schedule indicating means by which Contractor intends to regain compliance with the schedule. Indicate changes to working hours, working days, crew sizes, equipment required to achieve compliance, and date by which recovery will be accomplished.
- G. Distribution: Distribute copies of approved schedule to Architect / Engineer's Owner, separate contractors, testing and inspecting agencies, and other parties identified by Contractor with a need-to-know schedule responsibility.
1. Post copies in Project meeting rooms and temporary field offices.
 2. When revisions are made, distribute updated schedules 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 performance of construction activities.
- 1.6 CPM SCHEDULE REQUIREMENTS
- A. CPM Schedule: Prepare Contractor's Construction Schedule using a time-scaled CPM network analysis diagram for the Work.

1. Develop network diagram in sufficient time to submit CPM schedule so it can be accepted for use no later than 60 days after date established for commencement of the Work.
 - a. Failure to include any work item required for performance of this Contract shall not excuse Contractor from completing all work within applicable completion dates.
 2. Conduct educational workshops to train and inform key Project personnel, including subcontractors' personnel, in proper methods of providing data and using CPM schedule information.
 3. Establish procedures for monitoring and updating CPM schedule and for reporting progress. Coordinate procedures with progress meeting and payment request dates.
 4. Use "one workday" as the unit of time for individual activities. Indicate nonworking days and holidays incorporated into the schedule to coordinate with the Contract Time.
- B. CPM Schedule Preparation: Prepare a list of all activities required to complete the Work. Using the startup network diagram, prepare a skeleton network to identify probable critical paths.
1. Activities: Indicate the estimated time duration, sequence requirements, and relationship of each activity in relation to other activities. Include estimated time frames for the following activities:
 - a. Preparation and processing of submittals.
 - b. Mobilization and demobilization.
 - c. Purchase of materials.
 - d. Delivery.
 - e. Fabrication.
 - f. Utility interruptions.
 - g. Installation.
 - h. Work by Owner that may affect or be affected by Contractor's activities.
 - i. Testing and inspection.
 - j. Commissioning.
 - k. Punch list and final completion.
 - l. Activities occurring following final completion.
 2. Critical Path Activities: Identify critical path activities, including those for interim completion dates. Scheduled start and completion dates shall be consistent with Contract milestone dates.
 3. Processing: Process data to produce output data on a computer-drawn, time-scaled network. Revise data, reorganize activity sequences, and reproduce as often as necessary to produce the CPM schedule within the limitations of the Contract Time.
 4. Format: Mark the critical path. Locate the critical path near center of network; locate paths with most float near the edges.
 - a. Subnetworks on separate sheets are permissible for activities clearly off the critical path.
- C. Contract Modifications: For each proposed contract modification and concurrent with its submission, prepare a time-impact analysis using a network fragment to demonstrate the effect of the proposed change on the overall Project schedule.
- D. Initial Issue of Schedule: Prepare initial network diagram from a sorted activity list indicating straight "early start-total float." Identify critical activities. Prepare tabulated reports showing the following:
1. Contractor or subcontractor and the Work or activity.
 2. Description of activity.
 3. Main events of activity.
 4. Immediate preceding and succeeding activities.
 5. Early and late start dates.
 6. Early and late finish dates.

7. Activity duration in workdays.
 8. Total float or slack time.
 9. Average size of workforce.
 10. Dollar value of activity (coordinated with the schedule of values).
- E. Schedule Updating: Concurrent with making revisions to schedule, prepare tabulated reports showing the following:
1. Identification of activities that have changed.
 2. Changes in early and late start dates.
 3. Changes in early and late finish dates.
 4. Changes in activity durations in workdays.
 5. Changes in the critical path.
 6. Changes in total float or slack time.
 7. Changes in the Contract Time.
- F. Value Summaries: Prepare two cumulative value lists, sorted by finish dates.
1. In first list, tabulate activity number, early finish date, dollar value, and cumulative dollar value.
 2. In second list, tabulate activity number, late finish date, dollar value, and cumulative dollar value.
 3. In subsequent issues of both lists, substitute actual finish dates for activities completed as of list date.
 4. Prepare list for ease of comparison with payment requests; coordinate timing with progress meetings.
 - a. In both value summary lists, tabulate "actual percent complete" and "cumulative value completed" with total at bottom.
 - b. Submit value summary printouts one week before each regularly scheduled progress meeting.

1.7 REPORTS

- A. Daily Construction Reports: Prepare a daily construction report recording the following information concerning events at Project site:
1. List of subcontractors at Project site.
 2. List of separate contractors at Project site.
 3. Approximate count of personnel at Project site.
 4. Equipment at Project site.
 5. Material deliveries.
 6. High and low temperatures and general weather conditions, including presence of rain or snow.
 7. Testing and inspection.
 8. Accidents.
 9. Meetings and significant decisions.
 10. Stoppages, delays, shortages, and losses.
 11. Meter readings and similar recordings.
 12. Emergency procedures.
 13. Orders and requests of authorities having jurisdiction.
 14. Change Orders received and implemented.
 15. Change Directives received and implemented.
 16. Services connected and disconnected.
 17. Equipment or system tests and startups.
 18. Partial completions and occupancies.
 19. Substantial Completions authorized.

- B. Site Condition Reports: Immediately on discovery of a difference between site conditions and the Contract Documents, prepare and submit a detailed report. Submit with a Request for Information. Include a detailed description of the differing conditions, together with recommendations for changing the Contract Documents.

END OF SECTION 013200

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SECTION 01 32 33 - PHOTOGRAPHIC DOCUMENTATION

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 includes administrative and procedural requirements for the following:
 - 1. Preconstruction photographs.
 - 2. Periodic construction photographs.
 - 3. Final Completion construction photographs.
- B. Related Sections include the following:
 - 1. Section 01 33 00, "Submittal Procedures" for submitting photographic documentation.
 - 2. Section 01 77 00, "Closeout Procedures" for submitting digital media as Project Record Documents at Project closeout.
 - 3. Section 01 79 00, "Demonstration and Training" for submitting video of demonstration of equipment and training of Owner's personnel.
 - 4. Division 2 Section "Building Demolition" for photographic documentation before building demolition operations commence.

1.3 SUBMITTALS

- A. Key Plan: Submit key plan of Project site and building with notation of vantage points marked for location and direction of each photograph. Indicate elevation or story of construction. Include same label information as corresponding set of photographs.
- B. Construction Photographs: Submit two (2) prints of each photographic view within seven days of taking photographs.
 - 1. Format: 8-by-10-inch (203-by-254-mm) smooth-surface matte prints on single-weight commercial-grade photographic paper, enclosed back to back in clear plastic sleeves that are punched for standard 3-ring binder.
 - 2. Identification: On back of each print, provide an applied label or rubber-stamped impression with the following information:
 - a. Name of Project.
 - b. Name and address of photographer.
 - c. Name of Architect/Engineer.
 - d. Name of Contractor.
 - e. Date photograph was taken if not date stamped by camera.
 - f. Description of vantage point, indicating location, direction (by compass point), and elevation or story of construction.
 - g. Unique sequential identifier.

1.4 Digital Images: Submit a complete set of digital image electronic files with each submittal of prints and as a Project Record Document via LifeStructures Link. Identify electronic media with date photographs were taken. Submit images that have same aspect ratio as the sensor, uncropped.

1.5 QUALITY ASSURANCE

- A. Photographer Qualifications: An individual who has been regularly engaged as a professional photographer of construction projects for not less than three (3) years.

1.6 COORDINATION

- A. Auxiliary Services: Cooperate with photographer and provide auxiliary services requested, including access to Project site and use of temporary facilities, including temporary lighting required to produce clear, well-lit photographs without obscuring shadows.

1.7 USAGE RIGHTS

- A. Obtain and transfer copyright usage rights from photographer to Owner for unlimited reproduction of photographic documentation.

PART 2 - PRODUCTS

2.1 PHOTOGRAPHIC MEDIA

- A. Format below is compatible with all digital cameras. Minimum CCD is a measure of resolution. (The greater the number (in millions), the greater the resolution) Digital Images: Provide images in JPEG format, produced by a digital camera with minimum CCD of 4.0 megapixels, and at an image resolution of not less than 1600 by 1200 pixels.

PART 3 - EXECUTION

3.1 CONSTRUCTION PHOTOGRAPHS

- A. Photographer: Engage a qualified amateur photographer to take construction photographs.
- B. General: Take photographs using the maximum range of depth of field, and that are in focus, to clearly show the Work. Photographs with blurry or out-of-focus areas will not be accepted.
 - 1. Maintain key plan with each set of construction photographs that identifies each photographic location.
- C. Film Images:

1. Date Stamp: Unless otherwise indicated, date and time stamp each photograph as it is being taken so stamp is integral to photograph.
 2. Field Office Prints: Retain one (1) set of prints of progress photographs in the field office at Project site, available at all times for reference. Identify photographs same as for those submitted to Architect/Engineer.
- D. Digital Images: Submit digital images exactly as originally recorded in the digital camera, without alteration, manipulation, editing, or modifications using image-editing software.
1. Date and Time: Include date and time in filename for each image.
 2. Field Office Images: Maintain one set of images on CD-ROM in the field office at Project site, available at all times for reference. Identify images same as for those submitted to Architect/Engineer .
- E. Preconstruction Photographs: Before commencement of demolition and starting construction, take color, digital photographs of Project site and surrounding properties, including existing items to remain during construction, from different vantage points, as directed by Architect/Engineer.
1. Flag construction limits before taking construction photographs.
 2. Take eight (8) photographs to show existing conditions adjacent to property before starting the Work.
 3. Take eight (8) photographs of existing buildings either on or adjoining property to accurately record physical conditions at start of construction.
 4. Take additional photographs as required to record settlement or cracking of adjacent NOT structures, pavements, and improvements.
- F. Periodic Construction Photographs: Take twelve (12) color, digital photographs weekly, with timing each month adjusted to coincide with the cutoff date associated with each Application for Payment. Select vantage points to show status of construction and progress since last photographs were taken.
- G. Architect/Engineer Directed Construction Photographs: From time to time, Architect/Engineer will instruct photographer about number and frequency of color, digital photographs and general directions on vantage points. Select actual vantage points and take photographs to show the status of construction and progress since last photographs were taken.
- H. Time-Lapse Sequence Construction Photographs: Take five (5) color, digital photographs as indicated, to show status of construction and progress since last photographs were taken.
1. Frequency: Take photographs weekly, with timing each month adjusted to coincide with the cutoff date associated with each Application for Payment.
 2. Vantage Points: Following suggestions by Architect/Engineer and Contractor, photographer to select vantage points. During each of the following construction phases, take not less than two of the required shots from same vantage point each time to create a time-lapse sequence as follows:
 - a. Commencement of the Work, through completion of subgrade construction.
 - b. Above-grade structural framing.
 - c. Exterior building enclosure.
 - d. Interior Work, through date of Substantial Completion.
- I. Final Completion Construction Photographs: Take eight (8) color photographs after date of Substantial Completion for submission as Project Record Documents. Architect/Engineer will direct photographer for desired vantage points.

- J. Additional Photographs: Architect/Engineer may issue requests for additional photographs, in addition to periodic photographs specified. Additional photographs will be paid for by Change Order and are not included in the Contract Sum.
1. Three (3) days' notice will be given, where feasible.
 2. In emergency situations, take additional photographs within 24 hours of request.
 3. Circumstances that could require additional photographs include, but are not limited to, the following:
 - a. Special events planned at Project site.
 - b. Immediate follow-up when on-site events result in construction damage or losses.
 - c. Photographs to be taken at fabrication locations away from Project site. These photographs are not subject to unit prices or unit-cost allowances.
 - d. Substantial Completion of a major phase or component of the Work.
 - e. Extra record photographs at time of final acceptance.
 - f. Owner's request for special publicity photographs.

PART 4 - END OF SECTION 01 32 33

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SECTION 013300 - SUBMITTAL PROCEDURES

PART 1 - GENERAL

1.1 SUMMARY

- A. Section Includes:
 - 1. Submittal schedule requirements.
 - 2. Administrative and procedural requirements for submittals.

1.2 DEFINITIONS

- A. Action Submittals: Written and graphic information and physical samples that require Architect's / Engineer's responsive action. Action submittals are those submittals indicated in individual Specification Sections as "action submittals."
- B. Informational Submittals: Written and graphic information and physical samples that do not require Architect's / Engineer's responsive action. Submittals may be rejected for not complying with requirements. Informational submittals are those submittals indicated in individual Specification Sections as "informational submittals."

1.3 SUBMITTAL SCHEDULE

- A. Submittal Schedule: Submit, as an action submittal, a list of submittals, arranged in chronological order by dates required by construction schedule. Include time required for review, ordering, manufacturing, fabrication, and delivery when establishing dates. Include additional time required for making corrections or revisions to submittals noted by Architect / Engineer's and additional time for handling and reviewing submittals required by those corrections.

1.4 SUBMITTAL FORMATS

- A. Submittal Information: Include the following information in each submittal:
 - 1. Project name.
 - 2. Date.
 - 3. Name of Architect.
 - 4. Name of Construction Manager.
 - 5. Name of Contractor.
 - 6. Name of firm or entity that prepared submittal.
 - 7. Names of subcontractor, manufacturer, and supplier.
 - 8. Unique submittal number, including revision identifier. Include Specification Section number with sequential alphanumeric identifier; and alphanumeric suffix for resubmittals.
 - 9. Category and type of submittal.
 - 10. Submittal purpose and description.
 - 11. Number and title of Specification Section, with paragraph number and generic name for each of multiple items.
 - 12. Drawing number and detail references, as appropriate.
 - 13. Indication of full or partial submittal.

14. Location(s) where product is to be installed, as appropriate.
15. Other necessary identification.
16. Remarks.
17. Signature of transmitter.

- B. Options: Identify options requiring selection by Architect.
- C. Deviations and Additional Information: On each submittal, clearly indicate deviations from requirements in the Contract Documents, including minor variations and limitations; include relevant additional information and revisions, other than those requested by Architect / Engineer on previous submittals. Indicate by highlighting on each submittal or noting on attached separate sheet.
- D. Electronic Submittals: Identify and incorporate information in each electronic submittal file as follows:
1. Assemble complete submittal package into a single indexed file incorporating submittal requirements of a single Specification Section and transmittal form with links enabling navigation to each item.
- E. PDF Submittals: Prepare submittals as PDF package, incorporating complete information into each PDF file. Name PDF file with submittal number.

1.5 SUBMITTAL PROCEDURES

- A. Prepare and submit submittals required by individual Specification Sections. Types of submittals are indicated in individual Specification Sections.
1. Enter required data to fully identify submittal.
 - a. PDF format preferred.
 - b. All submittals shall be clearly labeled as to equipment being proposed and shall be for this specific project.
 - c. Data of a general nature will not be accepted.
 - d. Periodic submittals of individual components within a specified section will be returned to the contractor unapproved.
 - e. All submittals shall contain complete data on each section at the time of submission for approval.
 - f. Arrange product data, drawings and information for submission in complete and separate sets for each project manual section listed.
 - 1) When more than one product is specified in a specific section, a complete set of literature shall be collated into a single brochure containing information on each product.
 - 2) When only one product is specified in a given section, a brochure is not necessary.
 - 3) The first page of each brochure shall contain an index of the products enclosed in addition to all the required information.
 - 4) Submit number of samples specified in each of project manual sections.
 - g. Architect/Engineer will review these instructions to contractors, subcontractors and suppliers on the detailed use of this process during the pre-construction meeting.
 - h. Allow enough time for submittal review, including time for resubmittals, as follows. Time for review shall commence on architect/engineer's receipt of submittal.
 - 1) Initial review: allow fourteen (14) calendar days for initial review of each submittal. Allow additional time if processing must be delayed permitting coordination with subsequent submittals. Architect/engineer will advise contractor when a submittal must be delayed for coordination.
 - 2) Concurrent review: where concurrent review of submittals by architect/engineer's consultants, owner, or other parties is required, allow twenty-eight (28) calendar days for initial review of each submittal.

- 3) Direct transmittal to consultant: where the contract documents indicate that submittals may be transmitted directly to architect/engineer's consultants, provide duplicate copy of transmittal to architect/engineer. Submittal will be returned through architect/engineer, before being returned to contractor.
 - 4) If intermediate submittal is necessary, process it in same manner as initial submittal.
 - 5) General contractor shall re-submit submittals stamped either "revise and resubmit", "note markings and comments – resubmit" or "other comment – resubmittal required" within fourteen (14) calendar days from receipt date of the returned submittal.
 - 6) Allow fourteen (14) calendar days for processing each resubmittal.
 - 7) No extension of the contract time will be authorized because of failure to transmit submittals enough in advance of the work to permit processing.
 - i. Place a permanent label or title block on each submittal for identification.
 - 1) Indicate name of firm or entity that prepared each submittal on label or title block.
 - 2) Retain space on the submittal cover sheet to record contractor's review and approval markings and action taken by architect/engineer.
 - 3) Include the following information on for each submittal:
 - a) Project name and owner's and architect/engineer's project number.
 - b) Date and revision date.
 - c) Name and address of prime contractor.
 - d) Name and address of subcontractor.
 - e) Name of manufacturer.
 - f) Unique identifier, including revision number.
 - g) Number and title of appropriate specification section as described in the project manual.
 - h) Drawing number and detail references, as appropriate.
 - i) Identification of product or material.
 - j) Field dimensions clearly identified as such.
 - k) Applicable standards, such as astm number or federal specification.
 - l) Contractor's stamp, initialed or signed, certifying to review of submittal, verification of field measurements and compliance with contract documents. Any materials submitted without contractor's stamp of approval will be returned to the contractor for resubmission.
 - m) Notification of deviations from contract documents.
 - j. Deviations: encircle or otherwise identify deviations from the contract documents on submittals.
 - k. Transmittal form: package each electronic submittal and large format submittal individually and appropriately for transmittal and handling using the submittal coversheet.
 - 1) Architect/engineer will return submittals, without review if the proper transmittal is not used.
 - 2) Architect/engineer will discard submittals received from sources other than contractor.
 - 3) On an attached separate sheet, prepared on contractor's letterhead, record relevant information, requests for data, revisions other than those requested by architect/engineer on previous submittals, and deviations from requirements of the contract documents, including minor variations and limitations. Include the same label information as the related submittal.
 - 4) Include contractor's certification stating that information submitted complies with requirements of the contract documents.
- B. Coordination: Coordinate preparation and processing of submittals with performance of construction activities.
1. Coordinate each submittal with fabrication, purchasing, testing, delivery, other submittals, and related activities that require sequential activity.

2. Submit all submittal items required for each Specification Section concurrently unless partial submittals for portions of the Work are indicated on approved submittal schedule.
 3. Submit action submittals and informational submittals required by the same Specification Section as separate packages under separate transmittals.
- C. Processing Time: Allow time for submittal review, including time for resubmittals, as follows. Time for review shall commence on Architect / Engineer receipt of submittal. No extension of the Contract Time will be authorized because of failure to transmit submittals enough in advance of the Work to permit processing, including resubmittals.
1. Initial Review: Allow 15 days for initial review of each submittal. Allow additional time if coordination with subsequent submittals is required. Architect / Engineer will advise Contractor when a submittal being processed must be delayed for coordination.
 2. Resubmittal Review: Allow 15 days for review of each resubmittal.
- D. Resubmittals: Make resubmittals in same form and number of copies as initial submittal.
- E. Distribution: Furnish copies of final submittals to manufacturers, subcontractors, suppliers, fabricators, installers, authorities having jurisdiction, and others as necessary for performance of construction activities. Show distribution on transmittal forms.
- F. Use for Construction: Retain complete copies of submittals on Project site. Use only final action submittals that are marked with approval notation from Architect's / Engineer's action stamp.

1.6 SUBMITTAL REQUIREMENTS

- A. Product Data: Collect information into a single submittal for each element of construction and type of product or equipment.
1. If information must be specially prepared for submittal because standard published data are unsuitable for use, submit as Shop Drawings, not as Product Data.
 2. Mark each copy of each submittal to show which products and options are applicable.
 3. Include the following information, as applicable:
 - a. Manufacturer's catalog cuts.
 - b. Manufacturer's product specifications.
 - c. Standard color charts.
 - d. Statement of compliance with specified referenced standards.
 - e. Testing by recognized testing agency.
 - f. Application of testing agency labels and seals.
 - g. Notation of coordination requirements.
 - h. Availability and delivery time information.
 4. For equipment, include the following in addition to the above, as applicable:
 - a. Wiring diagrams that show factory-installed wiring.
 - b. Printed performance curves.
 - c. Operational range diagrams.
 - d. Clearances required to other construction, if not indicated on accompanying Shop Drawings.
 5. Submit Product Data before Shop Drawings, and before or concurrent with Samples.
- B. Shop Drawings: Prepare Project-specific information, drawn accurately to scale. Do not base Shop Drawings on reproductions of the Contract Documents or standard printed data.

1. Preparation: Fully illustrate requirements in the Contract Documents. Include the following information, as applicable:
 - a. Identification of products.
 - b. Schedules.
 - c. Compliance with specified standards.
 - d. Notation of coordination requirements.
 - e. Notation of dimensions established by field measurement.
 - f. Relationship and attachment to adjoining construction clearly indicated.
 - g. Seal and signature of professional engineer if specified.
 2. Paper Sheet Size: Except for templates, patterns, and similar full-size Drawings, submit Shop Drawings on sheets at least 8-1/2 by 11 inches (215 by 280 mm), but no larger than 30 by 42 inches (750 by 1067 mm).
 - a. 2 opaque (bond) copies of each submittal. Architect / Engineer will return 1 copy(ies).
 - b. 3 opaque copies of each submittal. Architect will retain 2 copies; remainder will be returned.
- C. Samples: Submit Samples for review of kind, color, pattern, and texture for a check of these characteristics with other materials.
1. Transmit Samples that contain multiple, related components such as accessories together in one submittal package.
 2. Identification: Permanently attach label on unexposed side of Samples that includes the following:
 - a. Project name and submittal number.
 - b. Generic description of Sample.
 - c. Product name and name of manufacturer.
 - d. Sample source.
 - e. Number and title of applicable Specification Section.
 - f. Specification paragraph number and generic name of each item.
 3. Email Transmittal: Provide PDF transmittal. Include digital image file illustrating Sample characteristics, and identification information for record.
 4. Paper Transmittal: Include paper transmittal including complete submittal information indicated.
 5. Disposition: Maintain sets of approved Samples at Project site, available for quality-control comparisons throughout the course of construction activity. Sample sets may be used to determine final acceptance of construction associated with each set.
 - a. Samples that may be incorporated into the Work are indicated in individual Specification Sections. Such Samples must be in an undamaged condition at time of use.
 - b. Samples not incorporated into the Work, or otherwise designated as Owner's property, are the property of Contractor.
 6. Samples for Initial Selection: Submit manufacturer's color charts consisting of units or sections of units showing the full range of colors, textures, and patterns available.
 - a. Number of Samples: Submit 1 full set(s) of available choices where color, pattern, texture, or similar characteristics are required to be selected from manufacturer's product line. Architect / Engineer will return submittal with options selected.
 7. Samples for Verification: Submit full-size units or Samples of size indicated, prepared from same material to be used for the Work, cured and finished in manner specified, and physically identical with material or product proposed for use, and that show full range of color and texture variations expected. Samples include, but are not limited to, the following: partial sections of manufactured or

fabricated components; small cuts or containers of materials; complete units of repetitively used materials; swatches showing color, texture, and pattern; color range sets; and components used for independent testing and inspection.

- a. Number of Samples: Submit 3 sets of Samples. Architect will retain 2 Sample sets; remainder will be returned. Mark up and retain one returned Sample set as a project record Sample.
 - 1) Submit a single Sample where assembly details, workmanship, fabrication techniques, connections, operation, and other similar characteristics are to be demonstrated.
 - 2) If variation in color, pattern, texture, or other characteristic is inherent in material or product represented by a Sample, submit at least 3 sets of paired units that show approximate limits of variations.
 - 3) Where indicated to **“Match Existing”**. Please provide two existing sample and along with the proposed submittal samples for comparison. Mark on the back of existing sample “existing” and on proposed samples for approval “proposed”. Proposed samples **Will NOT** be approved if existing sample is not provided.
- D. Product Schedule: As required in individual Specification Sections, prepare a written summary indicating types of products required for the Work and their intended location. Include the following information in tabular form:
- E. Qualification Data: Prepare written information that demonstrates capabilities and experience of firm or person. Include lists of completed projects with project names and addresses, contact information of architects and owners, and other information specified.
- F. Design Data: Prepare and submit written and graphic information indicating compliance with indicated performance and design criteria in individual Specification Sections. Include list of assumptions and summary of loads. Include load diagrams if applicable. Provide name and version of software, if any, used for calculations. Number each page of submittal.
- G. Certificates:
 1. Certificates and Certifications Submittals: Submit a statement that includes signature of entity responsible for preparing certification. Certificates and certifications shall be signed by an officer or other individual authorized to sign documents on behalf of that entity. Provide a notarized signature where indicated.
 2. Installer Certificates: Submit written statements on manufacturer's letterhead certifying that Installer complies with requirements in the Contract Documents and, where required, is authorized by manufacturer for this specific Project.
 3. Manufacturer Certificates: Submit written statements on manufacturer's letterhead certifying that manufacturer complies with requirements in the Contract Documents. Include evidence of manufacturing experience where required.
 4. Material Certificates: Submit written statements on manufacturer's letterhead certifying that material complies with requirements in the Contract Documents.
 5. Product Certificates: Submit written statements on manufacturer's letterhead certifying that product complies with requirements in the Contract Documents.
 6. Welding Certificates: Prepare written certification that welding procedures and personnel comply with requirements in the Contract Documents. Submit record of Welding Procedure Specification and Procedure Qualification Record on AWS forms. Include names of firms and personnel certified.
- H. Test and Research Reports:
 1. Compatibility Test Reports: Submit reports written by a qualified testing agency, on testing agency's standard form, indicating and interpreting results of compatibility tests performed before installation

- of product. Include written recommendations for primers and substrate preparation needed for adhesion.
2. Field Test Reports: Submit written reports indicating and interpreting results of field tests performed either during installation of product or after product is installed in its final location, for compliance with requirements in the Contract Documents.
 3. Material Test Reports: Submit reports written by a qualified testing agency, on testing agency's standard form, indicating and interpreting test results of material for compliance with requirements in the Contract Documents.
 4. Preconstruction Test Reports: Submit reports written by a qualified testing agency, on testing agency's standard form, indicating and interpreting results of tests performed before installation of product, for compliance with performance requirements in the Contract Documents.
 5. Product Test Reports: Submit written reports indicating that current product produced by manufacturer complies with requirements in the Contract Documents. Base reports on evaluation of tests performed by manufacturer and witnessed by a qualified testing agency, or on comprehensive tests performed by a qualified testing agency.
 6. Research Reports: Submit written evidence, from a model code organization acceptable to authorities having jurisdiction, that product complies with building code in effect for Project. Include the following information:
 - a. Name of evaluation organization.
 - b. Date of evaluation.
 - c. Time period when report is in effect.
 - d. Product and manufacturers' names.
 - e. Description of product.
 - f. Test procedures and results.
 - g. Limitations of use.

1.7 DELEGATED-DESIGN SERVICES

- A. Performance and Design Criteria: Where professional design services or certifications by a design professional are specifically required of Contractor by the Contract Documents, provide products and systems complying with specific performance and design criteria indicated.
 1. If criteria indicated are insufficient to perform services or certification required, submit a written request for additional information to Architect.
- B. Delegated-Design Services Certification: In addition to Shop Drawings, Product Data, and other required submittals, submit digitally signed PDF file and three paper copies of certificate, signed and sealed by the responsible design professional, for each product and system specifically assigned to Contractor to be designed or certified by a design professional.
 1. Indicate that products and systems comply with performance and design criteria in the Contract Documents. Include list of codes, loads, and other factors used in performing these services.

1.8 CONTRACTOR'S REVIEW

- A. Action Submittals and Informational Submittals: Review each submittal and check for coordination with other Work of the Contract and for compliance with the Contract Documents. Note corrections and field dimensions. Mark with approval stamp before submitting to Architect / Engineer.
- B. Contractor's Approval: Indicate Contractor's approval for each submittal with a uniform approval stamp indication. Include name of reviewer, date of Contractor's approval, and statement certifying that submittal has been reviewed, checked, and approved for compliance with the Contract Documents.

1. Architect / Engineer will not review submittals received from Contractor that do not have Contractor's review and approval.

1.9 ARCHITECT'S/ ENGINEER REVIEW

- A. Action Submittals: Architect / Engineer will review each submittal, indicate corrections or revisions required, and return it.
- B. Informational Submittals: Architect / Engineer will review each submittal and will not return it, or will return it if it does not comply with requirements. Architect / Engineer will forward each submittal to appropriate party.
- C. Partial submittals prepared for a portion of the Work will be reviewed when use of partial submittals has received prior approval from Architect / Engineer.
- D. Incomplete submittals are unacceptable, will be considered nonresponsive, and will be returned for resubmittal without review.
- E. Architect / Engineer will return without review submittals received from sources other than Contractor.
- F. Submittals not required by the Contract Documents will be returned by Architect without action.

END OF SECTION 013300

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SECTION 016000 - PRODUCT REQUIREMENTS

PART 1 - GENERAL

1.1 SUMMARY

- A. Section includes administrative and procedural requirements for selection of products for use in Project; product delivery, storage, and handling; manufacturers' standard warranties on products; special warranties; and comparable products.
- B. Related Requirements:
 - 1. Section 012500 "Substitution Procedures" for requests for substitutions.

1.2 DEFINITIONS

- A. Products: Items obtained for incorporating into the Work, whether purchased for Project or taken from previously purchased stock. The term "product" includes the terms "material," "equipment," "system," and terms of similar intent.
 - 1. Named Products: Items identified by manufacturer's product name, including make or model number or other designation shown or listed in manufacturer's published product literature that is current as of date of the Contract Documents.
 - 2. New Products: Items that have not previously been incorporated into another project or facility. Products salvaged or recycled from other projects are not considered new products.
 - 3. Comparable Product: Product that is demonstrated and approved by Architect through submittal process to have the indicated qualities related to type, function, dimension, in-service performance, physical properties, appearance, and other characteristics that equal or exceed those of specified product.
- B. Basis-of-Design Product Specification: A specification in which a single manufacturer's product is named and accompanied by the words "basis-of-design product," including make or model number or other designation. In addition to the basis-of-design product description, product attributes and characteristics may be listed to establish the significant qualities related to type, function, in-service performance and physical properties, weight, dimension, durability, visual characteristics, and other special features and requirements for purposes of evaluating comparable products of additional manufacturers named in the specification.

1.3 ACTION SUBMITTALS

- A. Comparable Product Request Submittal: Submit request for consideration of each comparable product. Identify basis-of-design product or fabrication or installation method to be replaced. Include Specification Section number and title and Drawing numbers and titles.
 - 1. Include data to indicate compliance with the requirements specified in "Comparable Products" Article.
 - 2. Architect's Action: If necessary, Architect will request additional information or documentation for evaluation within 7 days of receipt of a comparable product request. Architect will notify Contractor of approval or rejection of proposed comparable product request within 15 days of receipt of request, or 7 days of receipt of additional information or documentation, whichever is later.

- a. Form of Architect's Approval of Submittal: As specified in Section 013300 "Submittal Procedures."
 - b. Use product specified if Architect does not issue a decision on use of a comparable product request within time allocated.
- B. Basis-of-Design Product Specification Submittal: Comply with requirements in Section 013300 "Submittal Procedures." Show compliance with requirements.

1.4 QUALITY ASSURANCE

- A. Compatibility of Options: If Contractor is given option of selecting between two or more products for use on Project, select product compatible with products previously selected, even if previously selected products were also options.

1.5 PRODUCT DELIVERY, STORAGE, AND HANDLING

- A. Deliver, store, and handle products using means and methods that will prevent damage, deterioration, and loss, including theft and vandalism. Comply with manufacturer's written instructions.
- B. Delivery and Handling:
 - 1. Schedule delivery to minimize long-term storage at Project site and to prevent overcrowding of construction spaces.
 - 2. 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.
 - 3. Deliver products to Project site in an undamaged condition in manufacturer's original sealed container or other packaging system, complete with labels and instructions for handling, storing, unpacking, protecting, and installing.
 - 4. Inspect products on delivery to determine compliance with the Contract Documents and to determine that products are undamaged and properly protected.
- C. Storage:
 - 1. Store products to allow for inspection and measurement of quantity or counting of units.
 - 2. Store materials in a manner that will not endanger Project structure.
 - 3. Store products that are subject to damage by the elements, under cover in a weathertight enclosure above ground, with ventilation adequate to prevent condensation.
 - 4. Protect foam plastic from exposure to sunlight, except to extent necessary for period of installation and concealment.
 - 5. Comply with product manufacturer's written instructions for temperature, humidity, ventilation, and weather-protection requirements for storage.
 - 6. Protect stored products from damage and liquids from freezing.

1.6 PRODUCT WARRANTIES

- A. Warranties specified in other Sections shall be in addition to, and run concurrent with, other warranties required by the Contract Documents. Manufacturer's disclaimers and limitations on product warranties do not relieve Contractor of obligations under requirements of the Contract Documents.
 - 1. Manufacturer's Warranty: Written warranty furnished by individual manufacturer for a particular product and specifically endorsed by manufacturer to Owner.

2. Special Warranty: Written warranty required by the Contract Documents to provide specific rights for Owner.
- B. Special Warranties: Prepare a written document that contains appropriate terms and identification, ready for execution.
1. Manufacturer's Standard Form: Modified to include Project-specific information and properly executed.
 2. Specified Form: When specified forms are included with the Specifications, prepare a written document using indicated form properly executed.
 3. See other Sections for specific content requirements and particular requirements for submitting special warranties.

PART 2 - PRODUCTS

2.1 PRODUCT SELECTION PROCEDURES

- A. General Product Requirements: Provide products that comply with the Contract Documents, are undamaged and, unless otherwise indicated, are new at time of installation.
1. Provide products complete with accessories, trim, finish, fasteners, and other items needed for a complete installation and indicated use and effect.
 2. Standard Products: If available, and unless custom products or nonstandard options are specified, provide standard products of types that have been produced and used successfully in similar situations on other projects.
 3. Owner reserves the right to limit selection to products with warranties meeting requirements of the Contract Documents.
 4. Where products are accompanied by the term "as selected," Architect will make selection.
 5. Descriptive, performance, and reference standard requirements in the Specifications establish salient characteristics of products.
- B. Product Selection Procedures:
1. Sole Product: Where Specifications name a single manufacturer and product, provide the named product that complies with requirements. Comparable products or substitutions for Contractor's convenience will not be considered.
 - a. Sole product may be indicated by the phrase: "Subject to compliance with requirements, provide the following: ..."
 2. Sole Manufacturer/Source: Where Specifications name a single manufacturer or source, provide a product by the named manufacturer or source that complies with requirements. Comparable products or substitutions for Contractor's convenience will not be considered.
 - a. Sole manufacturer/source may be indicated by the phrase: "Subject to compliance with requirements, provide products by the following: ..."
 3. Limited List of Products: Where Specifications include a list of names of both manufacturers and products, provide one of the products listed that complies with requirements. Comparable products or substitutions for Contractor's convenience will be considered unless otherwise indicated.
 - a. Limited list of products may be indicated by the phrase: "Subject to compliance with requirements, provide one of the following: ..."

4. Non-Limited List of Products: Where Specifications include a list of names of both available manufacturers and products, provide one of the products listed, or an unnamed product, which complies with requirements.
 - a. Non-limited list of products is indicated by the phrase: "Subject to compliance with requirements, available products that may be incorporated in the Work include, but are not limited to, the following: ..."
 5. Limited List of Manufacturers: Where Specifications include a list of manufacturers' names, provide a product by one of the manufacturers listed that complies with requirements. Comparable products or substitutions for Contractor's convenience will be considered unless otherwise indicated.
 - a. Limited list of manufacturers is indicated by the phrase: "Subject to compliance with requirements, provide products by one of the following: ..."
 6. Non-Limited List of Manufacturers: Where Specifications include a list of available manufacturers, provide a product by one of the manufacturers listed, or a product by an unnamed manufacturer, which complies with requirements.
 - a. Non-limited list of manufacturers is indicated by the phrase: "Subject to compliance with requirements, available manufacturers whose products may be incorporated in the Work include, but are not limited to, the following: ..."
 7. Basis-of-Design Product: Where Specifications name a product, or refer to a product indicated on Drawings, and include a list of manufacturers, provide the specified or indicated product or a comparable product by one of the other named manufacturers. Drawings and Specifications indicate sizes, profiles, dimensions, and other characteristics that are based on the product named. Comply with requirements in "Comparable Products" Article for consideration of an unnamed product by one of the other named manufacturers.
 - a. For approval of products by unnamed manufacturers, comply with requirements in Section 012500 "Substitution Procedures" for substitutions for convenience.
- C. Visual Matching Specification: Where Specifications require "match Architect's sample," provide a product that complies with requirements and matches Architect's sample. Architect's decision will be final on whether a proposed product matches.
1. If no product available within specified category matches and complies with other specified requirements, comply with requirements in Section 012500 "Substitution Procedures" for proposal of product.
- D. Visual Selection Specification: Where Specifications include the phrase "as selected by Architect from manufacturer's full range" or similar phrase, select a product that complies with requirements. Architect will select color, gloss, pattern, density, or texture from manufacturer's product line that includes both standard and premium items.
- 2.2 COMPARABLE PRODUCTS
- A. Conditions for Consideration of Comparable Products: Architect will consider Contractor's request for comparable product when the following conditions are satisfied. If the following conditions are not satisfied, Architect may return requests without action, except to record noncompliance with these requirements:

1. Evidence that proposed product does not require revisions to the Contract Documents, is consistent with the Contract Documents, will produce the indicated results, and is compatible with other portions of the Work. Detailed comparison of significant qualities of proposed product with those named in the Specifications. Significant product qualities include attributes such as type, function, in-service performance and physical properties, weight, dimension, durability, visual characteristics, and other specific features and requirements.
2. Evidence that proposed product provides specified warranty.
3. List of similar installations for completed projects with project names and addresses and names and addresses of architects and owners, if requested.
4. Samples, if requested.

END OF SECTION 016000

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SECTION 017300 - EXECUTION

PART 1 - GENERAL

1.1 SUMMARY

- A. Section includes general administrative and procedural requirements governing execution of the Work including, but not limited to, the following:
 - 1. Construction layout.
 - 2. Field engineering and surveying.
 - 3. Installation of the Work.
 - 4. Cutting and patching.
 - 5. Progress cleaning.
 - 6. Starting and adjusting.
 - 7. Protection of installed construction.
- B. Related Requirements:
 - 1. Section 011000 "Summary" for limits on use of Project site.
 - 2. Section 017700 "Closeout Procedures" for submitting final property survey with Project Record Documents, recording of Owner-accepted deviations from indicated lines and levels, replacing defective work, and final cleaning.

1.2 INFORMATIONAL SUBMITTALS

- A. Landfill Receipts: Submit copy of receipts issued by a landfill facility, licensed to accept hazardous materials, for hazardous waste disposal.

1.3 QUALITY ASSURANCE

- A. Cutting and Patching: Comply with requirements for and limitations on cutting and patching of construction elements.
 - 1. Structural Elements: When cutting and patching structural elements, notify Architect of locations and details of cutting and await directions from Architect before proceeding. Shore, brace, and support structural elements during cutting and patching. Do not cut and patch structural elements in a manner that could change their load-carrying capacity or increase deflection.
 - 2. Operational Elements: Do not cut and patch operating elements and related components in a manner that results in reducing their capacity to perform as intended or that results in increased maintenance or decreased operational life or safety.
 - 3. Other Construction Elements: Do not cut and patch other construction elements or components in a manner that could change their load-carrying capacity, that results in reducing their capacity to perform as intended, or that results in increased maintenance or decreased operational life or safety.
 - 4. Visual Elements: Do not cut and patch construction in a manner that results in visual evidence of cutting and patching. Do not cut and patch exposed construction in a manner that would, in Architect's opinion, reduce the building's aesthetic qualities. Remove and replace construction that has been cut and patched in a visually unsatisfactory manner.

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

PART 2 - PRODUCTS

2.1 MATERIALS

- A. General: Comply with requirements specified in other Sections.
 - 1. For projects requiring compliance with sustainable design and construction practices and procedures, use products for patching that comply with sustainable design requirements.
- B. In-Place Materials: Use materials for patching identical to in-place materials. For exposed surfaces, use materials that visually match in-place adjacent surfaces to the fullest extent possible.
 - 1. If identical materials are unavailable or cannot be used, use materials that, when installed, will provide a match acceptable to Architect for the visual and functional performance of in-place materials.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Existing Conditions: The existence and location of underground and other utilities and construction indicated as existing are not guaranteed. Before beginning sitework, investigate and verify the existence and location of underground utilities, other construction affecting the Work.
 - 1. Before construction, verify the location and invert elevation at points of connection of sanitary sewer, storm sewer, and water-service piping; underground electrical services; and other utilities.
 - 2. Furnish location data for work related to Project that must be performed by public utilities serving Project site.
- B. Examination and Acceptance of Conditions: Before proceeding with each component of the Work, examine substrates, areas, and conditions, with Installer or Applicator present where indicated, for compliance with requirements for installation tolerances and other conditions affecting performance. Record observations.
 - 1. Examine roughing-in for mechanical and electrical systems to verify actual locations of connections before equipment and fixture installation.
 - 2. Examine walls, floors, and roofs for suitable conditions where products and systems are to be installed.
 - 3. Verify compatibility with and suitability of substrates, including compatibility with existing finishes or primers.
- C. Proceed with installation only after unsatisfactory conditions have been corrected. Proceeding with the Work indicates acceptance of surfaces and conditions.

3.2 PREPARATION

- A. Existing Utility Information: Furnish information to Owner that is necessary to adjust, move, or relocate existing utility structures, utility poles, lines, services, or other utility appurtenances located in or affected by construction. Coordinate with authorities having jurisdiction.
- B. Field Measurements: Take field measurements as required to fit the Work properly. Recheck measurements before installing each product. Where portions of the Work are indicated to fit to other construction, verify dimensions of other construction by field measurements before fabrication. Coordinate fabrication schedule with construction progress to avoid delaying the Work.
- C. Space Requirements: Verify space requirements and dimensions of items shown diagrammatically on Drawings.
- D. Review of Contract Documents and Field Conditions: Immediately on discovery of the need for clarification of the Contract Documents caused by differing field conditions outside the control of Contractor, submit a request for information to Architect according to requirements in Section 013100 "Project Management and Coordination."

3.3 CONSTRUCTION LAYOUT

- A. Verification: Before proceeding to lay out the Work, verify layout information shown on Drawings, in relation to the property survey and existing benchmarks. If discrepancies are discovered, notify Architect promptly.
- B. Record Log: Maintain a log of layout control work. Record deviations from required lines and levels. Include beginning and ending dates and times of surveys, weather conditions, name and duty of each survey party member, and types of instruments and tapes used. Make the log available for reference by Architect / Engineer.

3.4 INSTALLATION

- A. General: Locate the Work and components of the Work accurately, in correct alignment and elevation, as indicated.
 - 1. Make vertical work plumb and make horizontal work level.
 - 2. Where space is limited, install components to maximize space available for maintenance and ease of removal for replacement.
 - 3. Conceal pipes, ducts, and wiring in finished areas unless otherwise indicated.
- B. Comply with manufacturer's written instructions and recommendations for installing products in applications indicated.
- C. Install products at the time and under conditions that will ensure the best possible results. Maintain conditions required for product performance until Substantial Completion.
- D. Conduct construction operations so no part of the Work is subjected to damaging operations or loading in excess of that expected during normal conditions of occupancy.
- E. Sequence the Work and allow adequate clearances to accommodate movement of construction items on site and placement in permanent locations.

- F. Tools and Equipment: Where possible, select tools or equipment that minimize production of excessive noise levels.
- G. Templates: Obtain and distribute to the parties involved templates for work specified to be factory prepared and field installed. Check Shop Drawings of other portions of the Work to confirm that adequate provisions are made for locating and installing products to comply with indicated requirements.
- H. Attachment: Provide blocking and attachment plates and anchors and fasteners of adequate size and number to securely anchor each component in place, accurately located and aligned with other portions of the Work. Where size and type of attachments are not indicated, verify size and type required for load conditions.
 - 1. Mounting Heights: Where mounting heights are not indicated, mount components at heights directed by Architect.
 - 2. Allow for building movement, including thermal expansion and contraction.
 - 3. Coordinate installation of anchorages. Furnish setting drawings, templates, and directions for installing anchorages, including sleeves, concrete inserts, anchor bolts, and items with integral anchors, that are to be embedded in concrete or masonry. Deliver such items to Project site in time for installation.
- I. Joints: Make joints of uniform width. Where joint locations in exposed work are not indicated, arrange joints for the best visual effect. Fit exposed connections together to form hairline joints.
- J. Remove and replace damaged, defective, or non-conforming Work.

3.5 CUTTING AND PATCHING

- A. Cutting and Patching, General: Employ skilled workers to perform cutting and patching. Proceed with cutting and patching at the earliest feasible time, and complete without delay.
 - 1. Cut in-place construction to provide for installation of other components or performance of other construction, and subsequently patch as required to restore surfaces to their original condition.
- B. Existing Warranties: Remove, replace, patch, and repair materials and surfaces cut or damaged during installation or cutting and patching operations, by methods and with materials so as not to void existing warranties.
- C. Temporary Support: Provide temporary support of work to be cut.
- D. Protection: Protect in-place construction during cutting and patching to prevent damage. Provide protection from adverse weather conditions for portions of Project that might be exposed during cutting and patching operations.
- E. Adjacent Occupied Areas: Where interference with use of adjoining areas or interruption of free passage to adjoining areas is unavoidable, coordinate cutting and patching according to requirements in Section 011000 "Summary."
- F. Existing Utility Services and Mechanical/Electrical Systems: Where existing services/systems are required to be removed, relocated, or abandoned, bypass such services/systems before cutting to minimize interruption to occupied areas.
- G. Cutting: Cut in-place construction by sawing, drilling, breaking, chipping, grinding, and similar operations, including excavation, using methods least likely to damage elements retained or adjoining construction. If possible, review proposed procedures with original Installer; comply with original Installer's written recommendations.

1. In general, use hand or small power tools designed for sawing and grinding, not hammering and chopping. Cut holes and slots neatly to minimum size required, and with minimum disturbance of adjacent surfaces. Temporarily cover openings when not in use.
 2. Finished Surfaces: Cut or drill from the exposed or finished side into concealed surfaces.
 3. Concrete and Masonry: Cut using a cutting machine, such as an abrasive saw or a diamond-core drill.
 4. Excavating and Backfilling: Comply with requirements in applicable Sections where required by cutting and patching operations.
 5. Mechanical and Electrical Services: Cut off pipe or conduit in walls or partitions to be removed. Cap, valve, or plug and seal remaining portion of pipe or conduit to prevent entrance of moisture or other foreign matter after cutting.
 6. Proceed with patching after construction operations requiring cutting are complete.
- H. Patching: Patch construction by filling, repairing, refinishing, closing up, and similar operations following performance of other work. Patch with durable seams that are as invisible as practicable. Provide materials and comply with installation requirements specified in other Sections, where applicable.
1. Inspection: Where feasible, test and inspect patched areas after completion to demonstrate physical integrity of installation.
 2. Exposed Finishes: Restore exposed finishes of patched areas and extend finish restoration into retained adjoining construction in a manner that will minimize evidence of patching and refinishing.
 3. Floors and Walls: Where walls or partitions that are removed extend one finished area into another, patch and repair floor and wall surfaces in the new space. Provide an even surface of uniform finish, color, texture, and appearance. Remove in-place floor and wall coverings and replace with new materials, if necessary, to achieve uniform color and appearance.
 4. Ceilings: Patch, repair, or rehang in-place ceilings as necessary to provide an even-plane surface of uniform appearance.
 5. Exterior Building Enclosure: Patch components in a manner that restores enclosure to a weathertight condition and ensures thermal and moisture integrity of building enclosure.
- I. Cleaning: Clean areas and spaces where cutting and patching are performed. Remove paint, mortar, oils, putty, and similar materials from adjacent finished surfaces.
- 3.6 PROGRESS CLEANING
- A. General: Clean Project site and work areas daily, including common areas. Enforce requirements strictly. Dispose of materials lawfully.
1. Comply with requirements in NFPA 241 for removal of combustible waste materials and debris.
 2. Do not hold waste materials more than seven days during normal weather or three days if the temperature is expected to rise above 80 deg F (27 deg C).
 3. Containerize hazardous and unsanitary waste materials separately from other waste. Mark containers appropriately and dispose of legally, according to regulations.
 - a. Use containers intended for holding waste materials of type to be stored.
 4. Coordinate progress cleaning for joint-use areas where Contractor and other contractors are working concurrently.
- B. Site: Maintain Project site free of waste materials and debris.
- C. Work Areas: Clean areas where work is in progress to the level of cleanliness necessary for proper execution of the Work.

1. Remove liquid spills promptly.
 2. Where dust would impair proper execution of the Work, broom-clean or vacuum the entire work area, as appropriate.
- D. Installed Work: Keep installed work clean. Clean installed surfaces according to written instructions of manufacturer or fabricator of product installed, using only cleaning materials specifically recommended. If specific cleaning materials are not recommended, use cleaning materials that are not hazardous to health or property and that will not damage exposed surfaces.
- E. Concealed Spaces: Remove debris from concealed spaces before enclosing the space.
- F. Exposed Surfaces in Finished Areas: Clean exposed surfaces and protect as necessary to ensure freedom from damage and deterioration at time of Substantial Completion.
- G. Waste Disposal: Do not bury or burn waste materials on-site. Do not wash waste materials down sewers or into waterways. Comply with waste disposal requirements in Section 017419 "Construction Waste Management and Disposal."
- H. During handling and installation, clean and protect construction in progress and adjoining materials already in place. Apply protective covering where required to ensure protection from damage or deterioration at Substantial Completion.
- I. Clean and provide maintenance on completed construction as frequently as necessary through the remainder of the construction period. Adjust and lubricate operable components to ensure operability without damaging effects.
- J. Limiting Exposures: Supervise construction operations 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.

3.7 STARTING AND ADJUSTING

- A. Coordinate startup and adjusting of equipment and operating components with requirements in Section 019113 "General Commissioning Requirements."
- B. Start equipment and operating components to confirm proper operation. Remove malfunctioning units, replace with new units, and retest.
- C. Adjust equipment for proper operation. Adjust operating components for proper operation without binding.
- D. Test each piece of equipment to verify proper operation. Test and adjust controls and safeties. Replace damaged and malfunctioning controls and equipment.
- E. Manufacturer's Field Service: Comply with qualification requirements in Section 014000 "Quality Requirements."

3.8 PROTECTION OF INSTALLED CONSTRUCTION

- A. Provide final protection and maintain conditions that ensure installed Work is without damage or deterioration at time of Substantial Completion.
- B. Protection of Existing Items: Provide protection and ensure that existing items to remain undisturbed by construction are maintained in condition that existed at commencement of the Work.

- C. Comply with manufacturer's written instructions for temperature and relative humidity.
- D. All rated assemblies must withhold their original rating if cutting and patching occur.

END OF SECTION 017300

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SECTION 01 73 29 - CUTTING AND PATCHING

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

- A. This Section includes procedural requirements for cutting and patching.
- B. The Contractor or Trade responsible for cutting or damaging existing work shall patch the work to match its unaltered condition at no additional cost to the Owner. The party or parties responsible for the cutting or damaging existing work shall be responsible for the costs associated with repairs and correction of the damaged existing work

1.3 DEFINITIONS

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

1.4 SUBMITTALS

- A. Cutting and Patching Proposal: Submit a proposal describing procedures at least ten (10) days before the time cutting and patching will be performed, requesting approval to proceed. Include the following information:
 - 1. Structural Elements: Where cutting and patching involve adding reinforcement to structural elements, submit details and engineering calculations showing integration of reinforcement with original structure.
 - 2. Owner Approval: Obtain approval of cutting and patching proposal before cutting and patching. Approval does not waive right to later require removal and replacement of unsatisfactory work.

1.5 QUALITY ASSURANCE

- A. Structural Elements: Do not cut and patch structural elements in a manner that could change their load-carrying capacity or load-deflection ratio.
- B. Operational Elements: Do not cut and patch operating elements and related components in a manner that results in reducing their capacity to perform as intended or that results in increased maintenance or decreased operational life or safety.

- C. Miscellaneous Elements: Do not cut and patch the following elements or related components in a manner that could change their load-carrying capacity, that results in reducing their capacity to perform as intended, or that results in increased maintenance or decreased operational life or safety.
 - 1. Water, moisture, or vapor barriers.
 - 2. Membranes and flashings.
 - 3. Exterior curtain-wall construction.
 - 4. Equipment supports.
 - 5. Piping, ductwork, vessels, and equipment.
 - 6. Noise- and vibration-control elements and systems.
- D. Visual Requirements: Do not cut and patch construction in a manner that results in visual evidence of cutting and patching. Do not cut and patch construction exposed on the exterior or in occupied spaces in a manner that would, in Architect / Engineer's opinion, reduce the building's aesthetic qualities. Remove and replace construction that has been cut and patched in a visually unsatisfactory manner.
- E. Cutting and Patching Conference: Before proceeding, meet at Project site with parties involved in cutting and patching, including mechanical and electrical trades. Review areas of potential interference and conflict. Coordinate procedures and resolve potential conflicts before proceeding.

1.6 WARRANTY

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

PART 2 - PRODUCTS

2.1 MATERIALS

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

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Examine surfaces to be cut and patched and conditions under which cutting and patching are to be performed.
 - 1. Compatibility: Before patching, verify compatibility with and suitability of substrates, including compatibility with existing finishes or primers.
 - 2. Proceed with installation only after unsafe or unsatisfactory conditions have been corrected.

3.2 PREPARATION

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

3.3 PERFORMANCE

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

color, texture, and appearance. Remove existing floor and wall coverings and replace with new materials, if necessary, to achieve uniform color and appearance.

- a. Where patching occurs in a painted surface, apply primer and intermediate paint coats over the patch and apply final paint coat over entire unbroken surface containing the patch. Provide additional coats until patch blends with adjacent surfaces.
4. Ceilings: Patch, repair, or rehang existing ceilings as necessary to provide an even-plane surface of uniform appearance.
5. Exterior Building Enclosure: Patch components in a manner that restores enclosure to a weathertight condition.
6. Fire separation: Patch areas shall maintain original fire separation ratings.

END OF SECTION 01 73 29

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SECTION 017700 - CLOSEOUT PROCEDURES

PART 1 - GENERAL

1.1 SUMMARY

- A. Section includes administrative and procedural requirements for contract closeout, including, but not limited to, the following:
 - 1. Substantial Completion procedures.
 - 2. Final completion procedures.
 - 3. Warranties.
 - 4. Final cleaning.
 - 5. Repair of the Work.
- B. Related Requirements:
 - 1. Section 017823 "Operation and Maintenance Data" for additional operation and maintenance manual requirements.
 - 2. Section 017839 "Project Record Documents" for submitting Record Drawings, Record Specifications, and Record Product Data.
 - 3. Section 017900 "Demonstration and Training" for requirements to train the Owner's maintenance personnel to adjust, operate, and maintain products, equipment, and systems.

1.2 ACTION SUBMITTALS

- A. Product Data: For each type of cleaning agent.
- B. Contractor's List of Incomplete Items: Initial submittal at Substantial Completion.
- C. Certified List of Incomplete Items: Final submittal at final completion.

1.3 CLOSEOUT SUBMITTALS

- A. Certificates of Release: From authorities having jurisdiction.
- B. Certificate of Insurance: For continuing coverage.
- C. Field Report: For pest control inspection.

1.4 SUBSTANTIAL COMPLETION PROCEDURES

- A. Contractor's List of Incomplete Items: Prepare and submit a list of items to be completed and corrected (Contractor's punch list), indicating the value of each item on the list and reasons why the Work is incomplete.
- B. Submittals Prior to Substantial Completion: Complete the following a minimum of 10 days prior to requesting inspection for determining date of Substantial Completion. List items below that are incomplete at time of request.

1. Certificates of Release: Obtain and submit releases from authorities having jurisdiction permitting Owner unrestricted use of the Work and access to services and utilities. Include occupancy permits, operating certificates, and similar releases.
 2. Submit closeout submittals specified in other Division 01 Sections, including project record documents, operation and maintenance manuals, damage or settlement surveys, property surveys, and similar final record information.
 3. Submit closeout submittals specified in individual Sections, including specific warranties, workmanship bonds, maintenance service agreements, final certifications, and similar documents.
 4. Submit maintenance material submittals specified in individual Sections, including tools, spare parts, extra materials, and similar items, and deliver to location designated by Owner. Label with manufacturer's name and model number.
 5. Submit testing, adjusting, and balancing records.
 6. Submit sustainable design submittals not previously submitted.
 7. Submit changeover information related to Owner's occupancy, use, operation, and maintenance.
- C. Procedures Prior to Substantial Completion: Complete the following a minimum of 10 days prior to requesting inspection for determining date of Substantial Completion. List items below that are incomplete at time of request.
1. Advise Owner of pending insurance changeover requirements.
 2. Make final changeover of permanent locks and deliver keys to Owner. Advise Owner's personnel of changeover in security provisions.
 3. Complete startup and testing of systems and equipment.
 4. Perform preventive maintenance on equipment used prior to Substantial Completion.
 5. Instruct Owner's personnel in operation, adjustment, and maintenance of products, equipment, and systems. Submit demonstration and training video recordings specified in Section 017900 "Demonstration and Training."
 6. Advise Owner of changeover in utility services.
 7. Participate with Owner in conducting inspection and walkthrough with local emergency responders.
 8. Terminate and remove temporary facilities from Project site, along with mockups, construction tools, and similar elements.
 9. Complete final cleaning requirements.
 10. Touch up paint and otherwise repair and restore marred exposed finishes to eliminate visual defects.
- D. Inspection: Submit a written request for inspection to determine Substantial Completion a minimum of 10 days prior to date the Work will be completed and ready for final inspection and tests. On receipt of request, Architect / Engineer will either proceed with inspection or notify Contractor of unfulfilled requirements. Architect will prepare the Certificate of Substantial Completion after inspection or will notify Contractor of items, either on Contractor's list or additional items identified by Architect, that must be completed or corrected before certificate will be issued.
- 1.5 FINAL COMPLETION PROCEDURES
- A. Submittals Prior to Final Completion: Before requesting final inspection for determining final completion, complete the following:
1. Submit a final Application for Payment according to Section 012900 "Payment Procedures."
 2. Certified List of Incomplete Items: Submit certified copy of Architect's Substantial Completion inspection list of items to be completed or corrected (punch list), endorsed and dated by Architect. Certified copy of the list shall state that each item has been completed or otherwise resolved for acceptance.
 3. Certificate of Insurance: Submit evidence of final, continuing insurance coverage complying with insurance requirements.
 4. Submit pest-control final inspection report.

- B. Inspection: Submit a written request for final inspection to determine acceptance a minimum of 10 days prior to date the work will be completed and ready for final inspection and tests. On receipt of request, Architect / Engineer will either proceed with inspection or notify Contractor of unfulfilled requirements. Architect will prepare a final Certificate for Payment after inspection or will notify Contractor of construction that must be completed or corrected before certificate will be issued.

1.6 LIST OF INCOMPLETE ITEMS (PUNCH LIST)

- A. Preparation: submit three copies of list. Include name and identification of each space and area affected by construction operations for incomplete items and items needing correction including, if necessary, areas disturbed by contractor that are outside the limits of construction.
 - 1. Organize list of spaces in sequential order, from office to print area.
 - 2. Organize items applying to each space by major element, including categories for ceiling, individual walls, floors, equipment, and building systems.

1.7 SUBMITTAL OF PROJECT WARRANTIES

- A. Time of Submittal: Submit written warranties on request of Architect for designated portions of the Work where warranties are indicated to commence on dates other than date of Substantial Completion, or when delay in submittal of warranties might limit Owner's rights under warranty.
- B. Organize warranty documents into an orderly sequence based on the table of contents of Project Manual.
- C. Warranty Electronic File: Provide warranties and bonds in PDF format. Assemble complete warranty and bond submittal package into a single electronic PDF file with bookmarks enabling navigation to each item. Provide bookmarked table of contents at beginning of document.
 - 1.
- D. Provide additional copies of each warranty to include in operation and maintenance manuals.

PART 2 - PRODUCTS

2.1 MATERIALS

- A. Cleaning Agents: Use cleaning materials and agents recommended by 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: Perform final cleaning. Conduct cleaning and waste-removal operations to comply with local laws and ordinances and Federal and local environmental and antipollution regulations.

- B. Cleaning: Employ experienced workers or professional cleaners for final cleaning. Clean each surface or unit to condition expected in an average commercial building cleaning and maintenance program. Comply with manufacturer's written instructions.
 - 1. Complete the following cleaning operations before requesting inspection for certification of Substantial Completion for entire Project or for a designated portion of Project:
 - a. Clean Project site, yard, and grounds, in areas disturbed by construction activities, including landscape development areas, of rubbish, waste material, litter, and other foreign substances.
 - b. 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.
 - c. Remove debris and surface dust from limited access spaces, including roofs, plenums, shafts, trenches, equipment vaults, manholes, attics, and similar spaces.
 - d. Sweep concrete floors broom clean in unoccupied spaces.
 - e. Vacuum carpet and similar soft surfaces, removing debris and excess nap; clean according to manufacturer's recommendations if visible soil or stains remain.
 - f. Clean plumbing fixtures to a sanitary condition, free of stains, including stains resulting from water exposure.
 - g. Replace disposable air filters and clean permanent air filters. Clean exposed surfaces of diffusers, registers, and grills.
 - h. Clean light fixtures, lamps, globes, and reflectors to function with full efficiency.
 - i. Leave Project clean and ready for occupancy.
 - C. Pest Control: Comply with pest control requirements in Section 015000 "Temporary Facilities and Controls." Prepare written report.
- 3.2 Comply with safety standards for cleaning. Do not burn waste materials. Do not bury debris or excess materials on owner's property. Do not discharge volatile, harmful, or dangerous materials into drainage systems. Remove waste materials from project site and dispose of lawfully. repair of the work
- A. Complete repair and restoration operations, before requesting inspection for determination of Substantial Completion.
 - B. Repair, or remove and replace, defective construction. Repairing includes replacing defective parts, refinishing damaged surfaces, touching up with matching materials, and properly adjusting operating equipment. Where damaged or worn items cannot be repaired or restored, provide replacements. Remove and replace operating components that cannot be repaired. Restore damaged construction and permanent facilities used during construction to specified condition.

END OF SECTION 017700

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SECTION 017823 - OPERATION AND MAINTENANCE DATA

PART 1 - GENERAL

1.1 SUMMARY

- A. Section includes administrative and procedural requirements for preparing operation and maintenance manuals, including the following:
 - 1. Operation and maintenance documentation directory manuals.
 - 2. Emergency manuals.
 - 3. Systems and equipment operation manuals.
 - 4. Systems and equipment maintenance manuals.
 - 5. Product maintenance manuals.

1.2 CLOSEOUT SUBMITTALS

- A. Submit operation and maintenance manuals indicated. Provide content for each manual as specified in individual Specification Sections, and as reviewed and approved at the time of Section submittals. Submit reviewed manual content formatted and organized as required by this Section.
 - 1. Architect will comment on whether content of operation and maintenance submittals is acceptable.
 - 2. Where applicable, clarify and update reviewed manual content to correspond to revisions and field conditions.
- B. Format: Submit operation and maintenance manuals in the following format:
 - 1. Enable reviewer comments on draft submittals.
 - 2. Submit 3 paper copies. Architect will return 2 copies.
- C. Final Manual Submittal: Submit each manual in final form prior to requesting inspection for Substantial Completion and at least 15 days before commencing demonstration and training. Architect / Engineer will return copy with comments.
 - 1. Correct or revise each manual to comply with Architect's / Engineers comments. Submit copies of each corrected manual within 15 days of receipt of Architect / Engineer's comments and prior to commencing demonstration and training.
- D. Comply with Section 017700 "Closeout Procedures" for schedule for submitting operation and maintenance documentation.

1.3 FORMAT OF OPERATION AND MAINTENANCE MANUALS

- A. Manuals, Electronic Files: Submit manuals in the form of a multiple file composite electronic PDF file for each manual type required.
 - 1. Electronic Files: Use electronic files prepared by manufacturer where available. Where scanning of paper documents is required, configure scanned file for minimum readable file size.
 - 2. File Names and Bookmarks: Bookmark individual documents based on file names. Name document files to correspond to system, subsystem, and equipment names used in manual directory and table

of contents. Group documents for each system and subsystem into individual composite bookmarked files, then create composite manual, so that resulting bookmarks reflect the system, subsystem, and equipment names in a readily navigated file tree. Configure electronic manual to display bookmark panel on opening file.

1.4 REQUIREMENTS FOR EMERGENCY, OPERATION, AND MAINTENANCE MANUALS

- A. Organization of Manuals: Unless otherwise indicated, organize each manual into a separate section for each system and subsystem, and a separate section for each piece of equipment not part of a system. Each manual shall contain the following materials, in the order listed:
 - 1. Title page.
 - 2. Table of contents.
 - 3. Manual contents.
- B. Title Page: Include the following information:
 - 1. Subject matter included in manual.
 - 2. Name and address of Project.
 - 3. Name and address of Owner.
 - 4. Date of submittal.
 - 5. Name and contact information for Contractor.
 - 6. Name and contact information for Construction Manager.
 - 7. Name and contact information for Architect.
 - 8. Name and contact information for Commissioning Authority.
 - 9. Names and contact information for major consultants to the Architect that designed the systems contained in the manuals.
 - 10. Cross-reference to related systems in other operation and maintenance manuals.
- C. Table of Contents: List each product included in manual, identified by product name, indexed to the content of the volume, and cross-referenced to Specification Section number in Project Manual.
- D. Manual Contents: Organize into sets of manageable size. Arrange contents alphabetically by system, subsystem, and equipment. If possible, assemble instructions for subsystems, equipment, and components of one system into a single binder.
- E. Identification: In the documentation directory and in each operation and maintenance manual, identify each system, subsystem, and piece of equipment with same designation used in the Contract Documents. If no designation exists, assign a designation according to ASHRAE Guideline 4, "Preparation of Operating and Maintenance Documentation for Building Systems."

1.5 EMERGENCY MANUALS

- A. Emergency Manual: Assemble a complete set of emergency information indicating procedures for use by emergency personnel and by Owner's operating personnel for types of emergencies indicated.
- B. Content: Organize manual into a separate section for each of the following:
 - 1. Type of emergency.
 - 2. Emergency instructions.
 - 3. Emergency procedures.

- C. Type of Emergency: Where applicable for each type of emergency indicated below, include instructions and procedures for each system, subsystem, piece of equipment, and component:
1. Fire.
 2. Flood.
 3. Gas leak.
 4. Water leak.
 5. Power failure.
 6. Water outage.
 7. System, subsystem, or equipment failure.
 8. Chemical release or spill.
- D. Emergency Instructions: Describe and explain warnings, trouble indications, error messages, and similar codes and signals. Include responsibilities of Owner's operating personnel for notification of Installer, supplier, and manufacturer to maintain warranties.
- E. Emergency Procedures: Include the following, as applicable:
1. Instructions on stopping.
 2. Shutdown instructions for each type of emergency.
 3. Operating instructions for conditions outside normal operating limits.
 4. Required sequences for electric or electronic systems.
 5. Special operating instructions and procedures.

1.6 SYSTEMS AND EQUIPMENT OPERATION MANUALS

- A. Systems and Equipment Operation Manual: Assemble a complete set of data indicating operation of each system, subsystem, and piece of equipment not part of a system. Include information required for daily operation and management, operating standards, and routine and special operating procedures.
- B. Content: In addition to requirements in this Section, include operation data required in individual Specification Sections and the following information:
1. System, subsystem, and equipment descriptions. Use designations for systems and equipment indicated on Contract Documents.
 2. Performance and design criteria if Contractor has delegated design responsibility.
 3. Operating standards.
 4. Operating procedures.
 5. Operating logs.
 6. Wiring diagrams.
 7. Control diagrams.
 8. Piped system diagrams.
 9. Precautions against improper use.
 10. License requirements including inspection and renewal dates.
- C. Descriptions: Include the following:
1. Product name and model number. Use designations for products indicated on Contract Documents.
 2. Manufacturer's name.
 3. Equipment identification with serial number of each component.
 4. Equipment function.
 5. Operating characteristics.
 6. Limiting conditions.
 7. Performance curves.

8. Engineering data and tests.
9. Complete nomenclature and number of replacement parts.

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

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

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

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

1.7 SYSTEMS AND EQUIPMENT MAINTENANCE MANUALS

A. Systems and Equipment Maintenance Manuals: Assemble a complete set of data indicating maintenance of each system, subsystem, and piece of equipment not part of a system. Include manufacturers' maintenance documentation, preventive maintenance procedures and frequency, repair procedures, wiring and systems diagrams, lists of spare parts, and warranty information.

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

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

1. Standard maintenance instructions and bulletins; include only sheets pertinent to product or component installed. Mark each sheet to identify each product or component incorporated into the Work. If data include more than one item in a tabular format, identify each item using appropriate references from the Contract Documents. Identify data applicable to the Work and delete references to information not applicable.
 - a. Prepare supplementary text if manufacturers' standard printed data are not available and where the information is necessary for proper operation and maintenance of equipment or systems.
2. Drawings, diagrams, and instructions required for maintenance, including disassembly and component removal, replacement, and assembly.
3. Identification and nomenclature of parts and components.
4. List of items recommended to be stocked as spare parts.

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

1. Test and inspection instructions.
2. Troubleshooting guide.

3. Precautions against improper maintenance.
 4. Disassembly; component removal, repair, and replacement; and reassembly instructions.
 5. Aligning, adjusting, and checking instructions.
 6. Demonstration and training video recording, if available.
- E. Maintenance and Service Schedules: Include service and lubrication requirements, list of required lubricants for equipment, and separate schedules for preventive and routine maintenance and service with standard time allotment.
- F. Spare Parts List and Source Information: Include lists of replacement and repair parts, with parts identified and cross-referenced to manufacturers' maintenance documentation and local sources of maintenance materials and related services.
- G. Warranties and Bonds: Include copies of warranties and bonds and lists of circumstances and conditions that would affect validity of warranties or bonds.
1. Include procedures to follow and required notifications for warranty claims.
- H. Drawings: Prepare drawings supplementing manufacturers' printed data to illustrate the relationship of component parts of equipment and systems and to illustrate control sequence and flow diagrams. Coordinate these drawings with information contained in record Drawings to ensure correct illustration of completed installation.

1.8 PRODUCT MAINTENANCE MANUALS

- A. Product Maintenance Manual: Assemble a complete set of maintenance data indicating care and maintenance of each product, material, and finish incorporated into the Work.
- B. Content: Organize manual into a separate section for each product, material, and finish. Include source information, product information, maintenance procedures, repair materials and sources, and warranties and bonds, as described below.
- C. Product Information: Include the following, as applicable:
1. Product name and model number.
 2. Manufacturer's name.
 3. Color, pattern, and texture.
 4. Material and chemical composition.
 5. Reordering information for specially manufactured products.
- D. Maintenance Procedures: Include manufacturer's written recommendations and the following:
1. Inspection procedures.
 2. Types of cleaning agents to be used and methods of cleaning.
 3. List of cleaning agents and methods of cleaning detrimental to product.
 4. Schedule for routine cleaning and maintenance.
 5. Repair instructions.
- E. Repair Materials and Sources: Include lists of materials and local sources of materials and related services.
- F. Warranties and Bonds: Include copies of warranties and bonds and lists of circumstances and conditions that would affect validity of warranties or bonds.
1. Include procedures to follow and required notifications for warranty claims.

END OF SECTION 017823

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SECTION 017839 - PROJECT RECORD DOCUMENTS

PART 1 - GENERAL

1.1 SUMMARY

- A. Section includes administrative and procedural requirements for project record documents, including the following:
 - 1. Record Drawings.
 - 2. Record Specifications.
 - 3. Record Product Data.
- B. Related Requirements:
 - 1. Section 017300 "Execution" for final property survey.
 - 2. Section 017823 "Operation and Maintenance Data" for operation and maintenance manual requirements.

1.2 CLOSEOUT SUBMITTALS

- A. Record Drawings: Comply with the following:
 - 1. Number of Copies: Submit 1 set(s) of marked-up record prints.
 - 2. Number of Copies: Submit copies of record Drawings as follows:
 - a. Initial Submittal:
 - 1) Submit 1 paper-copy set(s) of marked-up record prints.
 - 2) Submit PDF electronic files of scanned record prints and 1 of file prints.
 - 3) Submit record digital data files and 1 set(s) of plots.
 - 4) Architect will indicate whether general scope of changes, additional information recorded, and quality of drafting are acceptable.
 - b. Final Submittal:
 - 1) Submit 3 paper-copy set(s) of marked-up record prints.
 - 2) Submit PDF electronic files of scanned record prints and 3 set(s) of prints.
 - 3) Print each drawing, whether or not changes and additional information were recorded.
 - c. Final Submittal:
 - 1) Submit 1 paper-copy set(s) of marked-up record prints.
 - 2) Submit record digital data files and 3 set(s) of record digital data file plots.
 - 3) Plot each drawing file, whether or not changes and additional information were recorded.
- B. Record Specifications: Submit annotated PDF electronic files of Project's Specifications, including addenda and contract modifications.
- C. Record Product Data: Submit annotated PDF electronic files and directories of each submittal.

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

1.3 RECORD DRAWINGS

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

1. Preparation: Mark record prints to show the actual installation where installation varies from that shown originally. Require individual or entity who obtained record data, whether individual or entity is Installer, subcontractor, or similar entity, to provide information for preparation of corresponding marked-up record prints.
 - a. Give particular attention to information on concealed elements that would be difficult to identify or measure and record later.
 - b. Accurately record information in an acceptable drawing technique.
 - c. Record data as soon as possible after obtaining it.
 - d. Record and check the markup before enclosing concealed installations.
 - e. Cross-reference record prints to corresponding photographic documentation.
2. Content: Types of items requiring marking include, but are not limited to, the following:
 - a. Dimensional changes to Drawings.
 - b. Revisions to details shown on Drawings.
 - c. Depths of foundations.
 - d. Locations and depths of underground utilities.
 - e. Revisions to routing of piping and conduits.
 - f. Revisions to electrical circuitry.
 - g. Actual equipment locations.
 - h. Duct size and routing.
 - i. Locations of concealed internal utilities.
 - j. Changes made by Change Order.
 - k. Changes made following Architect's written orders.
 - l. Details not on the original Contract Drawings.
 - m. Field records for variable and concealed conditions.
 - n. Record information on the Work that is shown only schematically.
3. Mark the Contract Drawings and Shop Drawings completely and accurately. Use personnel proficient at recording graphic information in production of marked-up record prints.
4. Mark record sets with erasable, red-colored pencil. Use other colors to distinguish between changes for different categories of the Work at same location.
5. Mark important additional information that was either shown schematically or omitted from original Drawings.
6. Note Construction Change Directive numbers, alternate numbers, Change Order numbers, and similar identification, where applicable.

- B. Record Digital Data Files: Immediately before inspection for Certificate of Substantial Completion, review marked-up record prints with Architect / Engineer. When authorized, prepare a full set of corrected digital data files of the Contract Drawings, as follows:

1. Format: Same digital data software program, version, and operating system as the original Contract Drawings.
2. Format: DWG, Version Microsoft Windows operating system.

3. Format: Annotated PDF electronic file.
 4. Incorporate changes and additional information previously marked on record prints. Delete, redraw, and add details and notations where applicable.
 5. Refer instances of uncertainty to Architect / Engineer for resolution.
 6. Architect will furnish Contractor with one set of digital data files of the Contract Drawings for use in recording information.
 - a. See Section 013100 "Project Management and Coordination" for requirements related to use of Architect's digital data files.
 - b. Architect will provide data file layer information. Record markups in separate layers.
- C. Format: Identify and date each record Drawing; include the designation "PROJECT RECORD DRAWING" in a prominent location.
1. Record Prints: Organize record prints into manageable sets. Bind each set with durable paper cover sheets. Include identification on cover sheets.
 2. Format: Annotated PDF electronic file.
 3. Record Digital Data Files: Organize digital data information into separate electronic files that correspond to each sheet of the Contract Drawings. Name each file with the sheet identification. Include identification in each digital data file.
 4. Identification: As follows:
 - a. Project name.
 - b. Date.
 - c. Designation "PROJECT RECORD DRAWINGS."
 - d. Name of Architect / Engineer.
 - e. Name of Contractor.

1.4 RECORD SPECIFICATIONS

- A. Preparation: Mark Specifications to indicate the actual product installation where installation varies from that indicated in Specifications, addenda, and contract modifications.
1. Give particular attention to information on concealed products and installations that cannot be readily identified and recorded later.
 2. Mark copy with the proprietary name and model number of products, materials, and equipment furnished, including substitutions and product options selected.
 3. Record the name of manufacturer, supplier, Installer, and other information necessary to provide a record of selections made.
 4. For each principal product, indicate whether record Product Data has been submitted in operation and maintenance manuals instead of submitted as record Product Data.
 5. Note related Change Orders and record Drawings where applicable.
- B. Format: Submit record Specifications as annotated PDF electronic file.

1.5 RECORD PRODUCT DATA

- A. Recording: Maintain one copy of each submittal during the construction period for project record document purposes. Post changes and revisions to project record documents as they occur; do not wait until end of Project.
- B. Preparation: Mark Product Data to indicate the actual product installation where installation varies substantially from that indicated in Product Data submittal.

1. Give particular attention to information on concealed products and installations that cannot be readily identified and recorded later.
 2. Include significant changes in the product delivered to Project site and changes in manufacturer's written instructions for installation.
 3. Note related Change Orders, record Specifications, and record Drawings where applicable.
- C. Format: Submit record Product Data as annotated PDF electronic file.
1. Section number and title, electronically linked to each item of record Product Data.

1.6 MAINTENANCE OF RECORD DOCUMENTS

- A. Maintenance of Record Documents: Store record documents in the field office apart from the Contract Documents used for construction. Do not use project record documents for construction purposes. Maintain record documents in good order and in a clean, dry, legible condition, protected from deterioration and loss. Provide access to project record documents for Architect's / Engineer's reference during normal working hours.

END OF SECTION 017839

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SECTION 02 01 00 - MAINTENANCE OF EXISTING CONDITIONS

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:

1. Protection of existing buildings, facilities, utilities and site improvements to remain.
2. Verification of existing utilities, site improvements and site conditions.

B. Related Requirements:

1. Section 01 73 29 "Cutting and Patching."
2. Section 02 41 19 "Selective Demolition."

1.2 ACTION SUBMITTALS

- A. Shop Drawings:** Submit drawings showing details of any proposed construction which is necessary to protect existing construction and utilities.

1.3 INFORMATIONAL SUBMITTALS.

A. Engineering Design:

1. If required by job conditions, Contractor shall retain the services of a licensed Professional Engineer registered in the state in which the project is located to design temporary and permanent installations as required to protect existing improvements and conditions.
2. All information required for the design shall be the Contractor's responsibility to obtain.
3. Submit design drawings and calculations to the Architect/Engineer for review. Review by the Architect/Engineer shall not relieve Contractor of full responsibility for design or work. The purpose of the Architect/Engineer review shall be only to protect the Owner from inadequate or insufficient protection for existing improvements and conditions. By reviewing the design, the Architect/Engineer assumes no responsibility for the design or adequacy thereof.
4. Underpinning calculations, if required, shall be reviewed by the Geotechnical Engineer.
5. All design drawings and calculations submitted shall be signed and sealed by the Contractor's Engineer.

1.4 PROJECT CONDITIONS

A. Existing Site Conditions:

1. The Drawings do not propose to show all existing improvements on the site.
2. Information shown on the Drawings was obtained from drawings of previous construction projects and/or a site survey provided by the Owner.
3. Recorded information concerning existing construction is available for examination in the Architect/Engineer office.
4. Existing structures:
 - a. Bottom of existing footing elevations are unknown.

- b. Loads on existing footings and foundations are unknown.
 - c. Dimensions of existing foundations are unknown.
 - 5. Information regarding existing subsurface conditions is unconfirmed. See Section 00 31 32 "Geotechnical Data" for available information regarding Geotechnical Data and soils information.
 - 6. Information concerning the approximate locations of known existing underground utilities is shown on the Drawings. Depths and locations of existing utilities are unconfirmed.
 - 7. Utilities include all underground and above ground piping, conduits, cables and related structures and appurtenances. Utilities also include sewers.
- B. Contractor is responsible for field verifying all existing site conditions.

PART 2 - PRODUCTS

2.1 MATERIALS

- A. General:
- 1. Contractor may use materials and systems recognized as suitable for protection of existing improvements and conditions.
 - 2. Untreated wood may only be used for temporary protection, bracing, supports, shores, etc.
 - 3. The Owner or Architect/Engineer may prohibit certain materials and systems if they interfere with the Owner's operations.

PART 3 - EXECUTION

3.1 PREPARATION

- A. Pre-Bid Site Inspection:
- 1. Contractor shall examine the site, inspect existing buildings, review existing plans and become familiar with all conditions under which the contract work will be performed.
 - 2. This shall be completed during the bidding phase in order that bids include all costs for protection of existing improvements and conditions.
 - 3. Contractor shall notify Architect/Engineer during the bidding phase of any discrepancies in bidding documents, existing conditions documents and field conditions.
 - 4. No later claim for extra compensation will be allowed, unless it is determined by the Owner and Architect/Engineer to be unforeseen conditions.
- B. Pre-Construction Verification of Existing Conditions:
- 1. Contractor shall verify all existing site conditions and improvements prior to construction, which includes field verifying locations of existing utilities and all other existing above grade and below grade improvements which may affect proposed construction activities.
 - 2. Contractor shall notify Architect/Engineer immediately with conflicts or discrepancies from existing field conditions, existing conditions documentation and proposed new construction.
 - 3. These verifications are to be done well in advance of construction activities in order to allow time for revising design if required.

3.2 GENERAL

- A. Contractor shall have underground utilities marked prior to beginning any excavation or other underground work in area of proposed activity.
- B. Provide all permanent and temporary construction necessary to protect existing improvements and conditions as required by construction activities.
- C. Install all protection in a manner which will not interfere with the Owner's operations or adjacent work.
- D. If at any time movement or other failure is observed in existing improvements or conditions, cease operations, provide all additional protection necessary to stabilize and retain said existing installations and notify Owner immediately.

3.3 JOB COMPLETION

- A. Upon completion of construction activities, leave the site in a neat and orderly condition.
- B. Restore all areas disrupted by construction activities, which were to remain and not be altered, to their original condition at no additional cost to Owner.

END OF SECTION 02 01 00

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SECTION 02 41 19 - SELECTIVE DEMOLITION

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

- A. Section Includes:
 - 1. Demolition and removal of selected site elements.
 - 2. Repair procedures for selective demolition operations.
 - 3. Removal of all debris from the site.
 - 4. Non-destructive removal of materials, items, components, and equipment for reuse or salvage as shown on the drawings or as requested by the Owner. Repair and modification of existing openings, pits or depressions in floor as shown on the drawings and as required for installation of new work.
 - 5. Construction of dust barriers, barricades or temporary partitions where shown on the drawings, or where required for separation from occupied spaces or activities.
- B. Related Requirements:
 - 1. Section 01 11 00 "Summary of Work" for Owner-occupancy requirements, and phasing requirements.
 - 2. Section 01 14 00 "Work Restrictions" for restriction on use of premises due to Owner or tenant occupancy.
 - 3. Section 01 32 26 "Construction Progress Reporting" for preconstruction photographs taken before selective demolition.
 - 4. Section 01 32 33 "Photographic Documentation" for preconstruction photographs taken before selective demolition.
 - 5. Section 01 50 00 "Temporary Facilities and Controls" for temporary construction and environmental-protection measures for selective demolition operations.
 - 6. Section 01 73 29 "Cutting and Patching" for cutting and patching procedures for selective demolition operations.
 - 7. Section 01 74 19 "Construction Waste Management and Disposal" for recycling waste procedures.
 - 8. Divisions 22 and 23 Sections for demolishing, cutting, patching, or relocating plumbing and HVAC items.
 - 9. Division 26 Sections for demolishing, cutting, patching, or relocating electrical items.
 - 10. Section 31 11 00 "Site Clearing" for site clearing and removal of above- and below-grade improvements.

1.3 DEFINITIONS

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

- B. Remove and Salvage: Detach items from existing construction, in a manner to prevent damage, and deliver to Owner ready for reuse, unless otherwise directed.
- C. Remove and Reinstall: Detach items from existing construction, in a manner to prevent damage, prepare for reuse, and reinstall where indicated.
- D. Existing to Remain: Leave existing items that are not to be removed and that are not otherwise indicated to be salvaged or reinstalled.

1.4 MATERIALS OWNERSHIP

- A. Except for items or materials 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. Carefully salvage in a manner to prevent damage and promptly return to Owner.

1.5 PREINSTALLATION MEETINGS

- A. Predemolition Conference: Conduct conference at Project site.
 - 1. Inspect and discuss condition of construction to be selectively demolished.
 - 2. Review structural load limitations of existing structure.
 - 3. Review and finalize selective demolition schedule and verify availability of materials, demolition personnel, equipment, and facilities needed to make progress and avoid delays.
 - 4. Review requirements of work performed by other trades that rely on substrates exposed by selective demolition operations.
 - 5. Review areas where existing construction is to remain and requires protection.

1.6 INFORMATIONAL SUBMITTALS

- A. Qualification Data: For refrigerant recovery technician and for professional engineer.
- B. Proposed Protection Measures: Submit report, including Drawings, that indicates the measures proposed for protecting individuals and property, for environmental protection, for dust control and, for noise control. Indicate proposed locations and construction of barriers. Identify options if proposed measures are later determined to be inadequate.
- C. Schedule of Selective Demolition Activities: Indicate the following:
 - 1. Detailed sequence of selective demolition and removal work, with starting and ending dates for each activity. Ensure Owner's and other tenants' on-site operations are uninterrupted.
 - 2. Interruption of utility services. Indicate how long utility services will be interrupted.
 - 3. Coordination for shutoff, capping, and continuation of utility services.
 - 4. Use of elevator and stairs.
 - 5. Locations of temporary partitions and means of egress, including for other tenants affected by selective demolition operation.
 - 6. Coordination of Owner's continuing occupancy of portions of existing building and of Owner's partial occupancy of completed Work.

- D. Predemolition Photographs or Video: Show existing conditions of adjoining construction and site improvements, including finish surfaces that might be misconstrued as damage caused by demolition operations. Comply with Section 01 32 26 "Construction Progress Reporting Submit before Work begins.
- E. Statement of Refrigerant Recovery: Signed by refrigerant recovery technician responsible for recovering refrigerant, stating that all refrigerant that was present was recovered and that recovery was performed according to EPA regulations. Include name and address of technician and date refrigerant was recovered.

1.7 CLOSEOUT SUBMITTALS

- A. Inventory: After selective demolition is complete, submit a list of items that have been removed, salvaged and delivered to Owner.

1.8 QUALITY ASSURANCE

- A. Refrigerant Recovery Technician Qualifications: Certified by an EPA-approved certification program.
- B. Demolition Firm Qualifications: An experienced firm that has specialized in demolition work similar in material and extent to that indicated for this Project.
- C. Professional Engineer Qualifications: A professional engineer who is legally qualified to practice in jurisdiction where Project is located and who is experienced in providing engineering services of the kind indicated.
 - 1. Engineering survey services are defined as those performed for evaluation of existing structures for strength and stability during demolition operations.
 - 2. Engineering design services are defined as those performed for design of shoring or rigging necessary to ensure stability and safety of structures during demolition operations.
- D. Regulatory Requirements: Comply with governing EPA notification regulations before beginning selective demolition. Comply with hauling and disposal regulations of authorities having jurisdiction.
- E. Standards: Comply with ANSI A10.6 and NFPA 241.

1.9 FIELD CONDITIONS.

- A. Tenants will occupy portions of building immediately adjacent to selective demolition area. Conduct selective demolition so Owner's operations will not be disrupted. Provide not less than 48 hours' notice to Owner of activities that will affect Owner's operations.
 - 1. Demolition phasing, if required, shall be scheduled by the Contractor with the approval of the Architect/Engineer and Owner.
- B. 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.
 - 2. The removal of debris and construction traffic will be limited to the designated routes that shall be resolved with and approved by the Owner.
- C. 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.
- D. Notify Architect/Engineer of discrepancies between existing conditions and Drawings before proceeding with selective demolition.
- E. Hazardous Materials: It is not expected that hazardous materials will be encountered in the Work.
 1. If suspected hazardous materials are encountered, do not disturb; immediately notify Architect/Engineer and Owner. Hazardous materials will be removed by Owner under a separate contract.
- A. Hazardous Materials: Present in buildings and structures to be selectively demolished. A report on the presence of hazardous materials is on file for review and use. Examine report to become aware of locations where hazardous materials are present.
 1. Hazardous material remediation is specified elsewhere in the Contract Documents.
 2. Do not disturb hazardous materials or items suspected of containing hazardous materials except under procedures specified elsewhere in the Contract Documents.
 3. Owner will provide material safety data sheets for suspected hazardous materials that are known to be present in buildings and structures to be selectively demolished because of building operations or processes performed there.
- B. Storage or sale of removed items or materials on-site is not permitted.
- C. 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.

1.10 WARRANTY

- A. Existing Warranties: Remove, replace, patch, and repair materials and surfaces cut or damaged during selective demolition, by methods and with materials and using approved contractors so as not to void existing warranties. Notify warrantor before proceeding.
- B. Notify warrantor on completion of selective demolition, and obtain documentation verifying that existing system has been inspected and warranty remains in effect. Submit documentation at Project closeout.

PART 2 - PRODUCTS

2.1 PERFORMANCE REQUIREMENTS

- A. Regulatory Requirements: Comply with governing EPA notification regulations before beginning selective demolition. Comply with hauling and disposal regulations of authorities having jurisdiction.
- B. Standards: Comply with ASSE A10.6 and NFPA 241.

2.2 REPAIR MATERIALS

- A. Use repair materials identical to existing materials.

1. If identical materials are unavailable or cannot be used for exposed surfaces, use materials that visually match existing adjacent surfaces to the fullest extent possible.
 2. Use materials whose installed performance equals or surpasses that of existing materials.
- B. Comply with material and installation requirements specified in individual Specification Sections.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Verify that utilities have been disconnected and capped before starting selective demolition operations.
- B. Inventory and records the condition of items to be removed and salvaged.

3.2 PREPARATION

- A. Refrigerant: Before starting demolition, remove refrigerant from mechanical equipment according to 40 CFR 82 and regulations of authorities having jurisdiction.

3.3 UTILITY SERVICES AND MECHANICAL/ELECTRICAL SYSTEMS

- A. Existing Services/Systems to Remain: Maintain services/systems indicated to remain and protect them against damage during selective demolition operations.
- A. 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 48 hours' notice to Owner if shutdown of service is required during changeover.
- B. Utility Requirements: Locate, identify, disconnect, and seal or cap off utility services and mechanical/electrical systems serving areas to be selectively demolished.
1. The Contractor will arrange to shut off indicated utilities with the required utility companies. The Contractor shall also notify the Owner of the pending shut down a minimum of 48 hours prior to contacting the utility company.
 2. If services/systems are required to be removed, relocated, or abandoned, provide temporary services/systems that bypass area of selective demolition and that maintain continuity of services/systems to other parts of building.
 3. Cut off pipe or conduit in walls or partitions to be removed. Cap, valve, or plug and seal remaining portion of pipe or conduit after bypassing.
- C. Utility Requirements: Refer to Division 21, 22, 23 and 26 Sections for shutting off, disconnecting, removing, and sealing or capping utilities. Do not start selective demolition work until utility disconnecting and sealing have been completed and verified in writing.

3.4 PROTECTION

- A. Temporary Protection: Provide temporary barricades and other protection required to prevent injury to people and damage to adjacent buildings and facilities to remain.

1. Provide protection to ensure safe passage of people around selective demolition area and to and from occupied portions of building.
 2. Provide temporary weather protection, during interval between selective demolition of existing construction on exterior surfaces and new construction, to prevent water leakage and damage to structure and interior areas.
 3. Protect walls, ceilings, floors, and other existing finish work that are to remain or that are exposed during selective demolition operations.
 4. Cover and protect furniture, furnishings, and equipment that have not been removed.
- B. Temporary Enclosures: Provide temporary enclosures for protection of existing building and construction, in progress and completed, from exposure, foul weather, other construction operations, and similar activities. Provide temporary weathertight enclosure for building exterior.
1. Where heating or cooling is needed and permanent enclosure is not complete, provide insulated temporary enclosures. Coordinate enclosure with ventilating and material drying or curing requirements to avoid dangerous conditions and effects.
- C. Temporary Partitions: Erect and maintain dustproof partitions and temporary enclosures to limit dust and dirt migration and to separate areas from fumes and noise.
- D. Temporary Shoring: Design, provide, and maintain shoring, bracing, and structural supports as required to preserve stability and prevent movement, settlement, or collapse of construction and finishes to remain, and to prevent unexpected or uncontrolled movement or collapse of construction being demolished.
1. Strengthen or add new supports when required during progress of selective demolition.
- E. Remove temporary barricades and protections where hazards no longer exist.

SELECTIVE DEMOLITION, GENERAL

- F. 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. 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 fire watch during and for at least 48 hours after flame-cutting operations.
 5. Maintain adequate ventilation when using cutting torches.
 6. Remove decayed, vermin-infested, or otherwise dangerous or unsuitable materials and promptly dispose of off-site.
 7. Locate selective demolition equipment and remove debris and materials so as not to impose excessive loads on supporting walls, floors, or framing.
 8. Dispose of demolished items and materials promptly.
 9. Do Not use fuel burning / exhaust emitting demolition or cutting equipment where adjacent areas are occupied.

- G. The items listed below have unique or may have regulated disposal requirements and are to be removed and disposed of in the manner dictated by law or in the most environmentally responsible manner. Typical concerns are listed in parentheses:
1. Fluorescent light ballasts manufactured prior to 1978: PCB.
 2. Fluorescent lamps: Mercury.
 3. Refrigeration, air-conditioning, and other equipment containing refrigerants: CFC recovery.
 4. Batteries: Lead, acid, mercury.
 5. Paints, solvents, and other hazardous fluids.
 6. Corrugated cardboard.
 7. Asbestos based materials.
 8. Materials with lead based finishes.
- H. Existing Facilities: Comply with building manager's requirements for using and protecting elevators, stairs, walkways, loading docks, building entries, and other building facilities during selective demolition operations.
- I. 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.
- J. Removed and Salvaged Items: Comply with the following
1. Use caution during removal of salvaged items to eliminate possibility of damage to such items. All existing items, equipment, materials and fixtures shall remain the property of the Owner. All reusable items salvaged during demolition operations shall be retained for Owner's inspection. Only items so inspected and rejected by the Owner shall be disposed. All other such items shall be turned over to Owner for his disposition.
 2. Clean salvaged items.
 3. Pack or crate equipment items after cleaning. Identify contents of containers.
 4. Store items in a secure area until delivery to Owner.
 5. Transport items to Owner's storage area designated by Owner.
 6. Protect items from damage during transport and storage.
- K. Removed and Reinstalled Items:
1. Clean and repair items to functional condition adequate for intended reuse.
 2. Pack or crate items after cleaning and repairing. Identify contents of containers.
 3. Protect items from damage during transport and storage.
 4. Reinstall items in locations indicated. Comply with installation requirements for new materials and equipment. Provide connections, supports, and miscellaneous materials necessary to make item functional for use indicated.
- L. Existing Items to Remain: Protect construction indicated to remain against damage and soiling during selective demolition. When permitted by Architect/Engineer, items may be removed to a suitable, protected storage location during selective demolition, cleaned and reinstalled in their original locations after selective demolition operations are complete.

3.5 SELECTIVE DEMOLITION PROCEDURES FOR SPECIFIC MATERIALS

- A. Resilient Floor Coverings: Remove floor coverings and adhesive according to recommendations in RFCI's "Recommended Work Practices for the Removal of Resilient Floor Coverings" and its Addenda. Do not use methods requiring solvent-based adhesive strippers.

3.6 PATCHING AND REPAIRS

- A. General: Promptly repair damage to adjacent construction caused by selective demolition operations.
- B. Patching: Comply with Section 01 73 29 "Cutting and Patching."
- C. Repairs: Where repairs to existing surfaces are required, patch to produce surfaces suitable for new materials.
 - 1. Completely fill holes and depressions in existing masonry walls that are to remain with an approved masonry patching material applied according to manufacturer's written recommendations.
- D. Finishes: Restore exposed finishes of patched areas and extend restoration into adjoining construction in a manner that eliminates evidence of patching and refinishing.
- E. Floors and Walls: Where walls or partitions that are demolished extend one finished area into another, patch and repair floor and wall surfaces in the new space. Provide an even surface of uniform finish color, texture, and appearance. Remove existing floor and wall coverings and replace with new materials, if necessary, to achieve uniform color and appearance.
 - 1. Patch with durable seams that are as invisible as possible. Provide materials and comply with installation requirements specified in other Sections of these Specifications.
 - 2. Where patching occurs in a painted surface, apply primer and intermediate paint coats over patch and apply final paint coat over entire unbroken surface containing patch. Provide additional coats until patch blends with adjacent surfaces.
 - 3. Where feasible, test and inspect patched areas after completion to demonstrate integrity of installation.
- F. Ceilings: Patch, repair, or rehang existing ceilings as necessary to provide an even-plane surface of uniform appearance.

3.7 DISPOSAL OF DEMOLISHED MATERIALS

- A. Remove demolition waste materials from Project site and dispose of them in an EPA-approved construction and demolition waste landfill acceptable to authorities having jurisdiction, and recycle or dispose of them according to Section 01 74 19 "Construction Waste Management and Disposal."
 - 1. Do not allow demolished materials to accumulate on-site.
 - 2. Remove and transport debris in a manner that will prevent spillage on adjacent surfaces and areas.
 - 3. Remove debris from elevated portions of building by chute, hoist, or other device that will convey debris to grade level in a controlled descent.
 - 4. Comply with requirements specified in Section 01 74 19 "Construction Waste Management and Disposal."
- B. Burning: Do not burn demolished materials.

3.8 CLEANING

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

END OF SECTION 02 41 19

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SECTION 09 22 16 - NON-STRUCTURAL METAL FRAMING

PART 1 – GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

- A. Section Includes:
 - 1. Non-load-bearing steel framing systems for interior partitions.
 - 2. Structural stud framing systems for interior partitions.
 - 3. Suspension systems for interior ceilings and soffits.
 - 4. Grid suspension systems for gypsum board ceilings.
- B. Related Requirements:
 - 1. Section 05 40 00 "Cold-Formed Metal Framing" for exterior load-bearing and exterior non-load-bearing wall studs.

1.3 DEFINITIONS

- A. Cold Formed Sheet Metal Gages: Provide cold formed sheet metal studs, runners, furring channels, and accessories manufactured from galvanized sheet steel with design base metal thicknesses conforming to the following schedule. Actual minimum metal thickness shall not be less than 95 percent of the design metal thickness.
 - 1. 25 gage: 0.0179 inch .
 - 2. 22 gage: 0.0269 inch .
 - 3. 20 gage: 0.0329 inch for structural applications.
 - 4. 20 gage: 0.0296 inch for non-structural applications.
 - 5. 18 gage: 0.0451 inch
 - 6. 16 gage: 0.0538 inch .
 - 7. 14 gage: 0.0713 inch .

1.4 ACTION SUBMITTALS

- A. Product Data: For each type of product.

1.5 INFORMATIONAL SUBMITTALS

- A. Product Data: For each type of product.
 - 1. Studs and Runners: Provide documentation that framing members' certification is according to SFIA's "Code Compliance Certification Program for Cold-Formed Steel Structural and Non-Structural Framing Members." SFIA's program certifies that studs and runners comply with the IBC, [ASTM C 645], AISI S100 and [AISI S220 and ASTM C645, Section 10] [AISI S220]. Mechanical properties, coatings, dimensions, and labeling are checked.

- B. Product Certificates: For each type of code-compliance certification for studs and tracks.
- C. Evaluation Reports: For firestop tracks, post-installed anchors, and power-actuated fasteners, from ICC-ES or other qualified testing agency acceptable to authorities having jurisdiction.

1.6 QUALITY ASSURANCE

- A. Code-Compliance Certification of Studs and Tracks: Provide documentation that framing members are certified according to the product-certification program of the Certified Steel Stud Association, the Steel Framing Industry Association (SFIA), or the Steel Stud Manufacturers Association.

PART 2 – PRODUCTS

2.1 PERFORMANCE REQUIREMENTS

- A. Delegated Design: Engage a professional engineer, as defined in Section 01 40 00 “Quality Requirements,” to design non-structural metal framing.
 - 1. Delegated Design shall also include structural evaluation and recommendations for repair of field modifications to non-structural metal framing, such as but not limited to the cutting of holes in web members, that exceed the approved design or recognized industry standards.
- B. Structural Performance: Provide non-structural metal framing capable of withstanding design loads within limits under conditions indicated.
 - 1. Design Loads: As indicated on Structural Drawings.
 - 2. Deflection Limits: Design framing systems to withstand design loads without deflections greater than the following:
 - a. Interior Non-Load-Bearing Framing: Horizontal deflection of $1/360$ of the wall height.
 - b. Ceiling/Soffit Framing: Vertical deflection of $1/360$ of the span for live loads and $1/240$ for total loads of the span.
 - 3. Design framing system to maintain clearances at openings, to allow for construction tolerances, and to accommodate live load deflection of primary building structure as follows:
 - a. Maximum steel frame structure deflection shall be $L/360$, over spans indicated.
 - b. Maximum concrete frame structure deflection shall be $L/600$, over spans indicated.
- C. Fire-Test-Response Characteristics: For fire-resistance-rated assemblies that incorporate non-load-bearing steel framing, provide materials and construction identical to those tested in assembly indicated, according to ASTM E 119 by an independent testing agency.
- D. Stud Selection:
 - 1. General: Select stud gages from manufacture’s published design properties and load/span tables, based on the deflection limit and the following selection criteria, for the wall span indicated on the Drawings.
 - a. Stud Selection Criteria:

- 1) Stud properties shall not be less than specified for stud of depth indicated.
- 2) Furnish studs of depth indicated.
- 3) Furnish studs of yield strength, profile, gage and spacing required to meet deflection criteria at the design load.
- 4) Furnish studs with the most economical yield strength, profile, gage and spacing to meet selection criteria.
- 5) Stud spacing shall not exceed 16 inches on center.

2. Interior:

- a. General: 5 pounds per square-foot uniform load over the full height of the studs.
- b. Partial height walls acting as guardrails:
 - 1) Uniform load acting horizontally on face of wall: 50 pounds per square foot.
 - 2) Point load acting horizontally at top of wall: 200 pounds.
 - 3) Loads are not assumed to act concurrently.

2.2 FRAMING SYSTEMS

A. Framing Members, General: Comply with the IBC, [ASTM C 645], AISI S100 and [AISI S220 and ASTM C645, Section 10] [AISI S220]. or conditions indicated.

1. Steel Sheet Components: Comply with the IBC, [ASTM C 645], AISI S100 and [AISI S220 and ASTM C645, Section 10] [AISI S220]. requirements for metal unless otherwise indicated.
2. Protective Coating:
 - a. Interior: ASTM A 653/A 653M, G40, hot-dip galvanized unless otherwise indicated.
3. When provided, factory punchouts will be located along the center line of the webs of the stud members and will have a minimum center-to-center spacing of 24". Punchouts for members greater than 2-1/2" deep are a maximum of 1-1/2" wide by 4" long. Members with depths 2-1/2" and smaller are a maximum 3/4" wide by 4" long. The minimum distance between the end of the member and the near edge of the web punchout shall be 10". Any configuration or combination of holes that fit within the punchout width and length limitations mentioned above shall be permitted; other punchout configurations and locations not in compliance with limitations listed above must be approved by the Architect.

B. Studs and Tracks: ASTM C 645.

1. Steel Studs and Tracks:
 - a. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - 1) CEMCO; California Expanded Metal Products Co.
 - 2) ClarkDietrich.
 - 3) Custom Stud.
 - 4) Jaimes Industries.
 - 5) MarinoWARE.
 - 6) MBA Building Supplies.
 - 7) MRI Steel Framing, LLC.
 - 8) Phillips Manufacturing Co.
 - 9) SCAFCO Steel Stud Company.
 - 10) Steel Construction Systems.

- 11) Telling Industries.
 - 12) The Steel Network, Inc.
 - b. Minimum Base-Metal Thickness: 0.0296 inch (22 gauge) for studs and tracks.
 - 1) Provide minimum thickness of 0.0329-inch studs at walls supporting hung casework, wall receiving cementitious tile backer board, at building expansion joints, and wall control joints.
 - 2) Provide minimum thickness of 0.0451-inch structural studs at each door, window and cased opening jamb, at partition corners and at partition end walls.
 - c. Depth: As indicated on Drawings.
- C. Slip-Type Head Joints: Where indicated, provide one of the following:
 - 1. Single Long Leg Track System: ASTM C 645 top track with 2-inch deep flanges in thickness not less than indicated for studs, installed with studs friction fit into top tracks and with continuous bridging located within 12 inches of the top of studs to provide lateral bracing.
 - 2. Deflection Track: Steel sheet top track manufactured to prevent cracking of finishes applied to interior partition framing resulting from deflection of structure above; in thickness not less than indicated for studs and in width to accommodate depth of studs.
 - a. Basis-of-Design: Subject to compliance with requirements, provide the following:
 - 1) ClarkDietrich Building Systems ; MaxTrak Slotted Deflection Track.
 - b. Comparable Manufacturers/Products: Subject to compliance with requirements, the following manufacturers/products shall be considered comparable:
 - 1) Metal-Lite; The System.
 - 2) Steel Network, Inc. (The); VertiTrack VTD and/or VertiClip SLD.
 - 3) Super Stud Building Products, Inc.; Interior Top Track Clip 450.
 - c.
- D. Flat Strap and Backing Plate: Steel sheet for blocking and bracing in length and width indicated.
 - 1. Minimum Base-Metal Thickness: 0.0329 inch.
- E. Cold-Rolled Channel Bridging: Steel, 0.0538-inch minimum base-metal thickness, with minimum 1/2-inch-wide flanges.
 - 1. Basis-of-Design: Subject to compliance with requirements, provide products by the following:
 - a. ClarkDietrich Building Systems.
 - 2. Depth: 1-1/2 inches.
 - 3. Clip Angle: Not less than 1-1/2 by 1-1/2 inches, 0.068-inch-thick, galvanized steel.
- F. Hat-Shaped, Rigid Furring Channels: ASTM C 645.
 - 1. Basis-of-Design: Subject to compliance with requirements, provide the following:
 - a. ClarkDietrich Building Systems ; Furring Channel.

2. Minimum Base-Metal Thickness: 0.0179 inch.
 3. Depth: As indicated on Drawings.
- G. Resilient Furring Channels: 1/2-inch-deep, steel sheet members designed to reduce sound transmission.
1. Basis-of-Design: Subject to compliance with requirements, provide the following:
 - a. ClarkDietrich Building Systems ; RC Deluxe Series.
 2. Configuration: Asymmetrical or hat shaped.
- H. Cold-Rolled Furring Channels: 0.053-inch uncoated-steel thickness, with minimum 1/2-inch-wide flanges.
1. Depth: 1-1/2 inch and 3/4 inch.
 2. Furring Brackets: Adjustable, corrugated-edge-type steel sheet with minimum uncoated-steel thickness of 0.0329 inch.
 3. Tie Wire: ASTM A 641/A 641M, Class 1 zinc coating, soft temper, 0.062-inch-diameter wire, or double strand of 0.048-inch-diameter wire.

2.3 SUSPENSION SYSTEMS

- A. Tie Wire: ASTM A 641/A 641M, Class 1 zinc coating, soft temper, 0.062-inch-diameter wire, or double strand of 0.048-inch-diameter wire.
- B. Hanger Attachments to Concrete:
1. Post-Installed Anchors: Fastener systems with an evaluation report acceptable to authorities having jurisdiction, based on ICC-ES AC01, AC193, AC58, or AC308 as appropriate for the substrate.
 - a. Uses: Securing hangers to structure.
 - b. Type: Torque-controlled, expansion anchor, torque-controlled, adhesive anchor, or adhesive anchor.
 - c. Material for Interior Locations: Carbon-steel components zinc-plated to comply with ASTM B 633 or ASTM F 1941, Class Fe/Zn 5, unless otherwise indicated.
 - d. Material Where Stainless Steel Is Indicated: Alloy Group 1 stainless-steel bolts, ASTM F 593, and nuts, ASTM F 594.
 2. Power-Actuated Anchors: Fastener systems with an evaluation report acceptable to authorities having jurisdiction, based on ICC-ES AC70.
- C. Wire Hangers: ASTM A 641/A 641M, Class 1 zinc coating, soft temper, 0.16 inch in diameter.
- D. Flat Hangers: Steel sheet, 1 by 3/16 inch by length indicated.
- E. Carrying Channels (Main Runners): Cold-rolled, commercial-steel sheet with a base-metal thickness of 0.0538 inch and minimum 1/2-inch-wide flanges.
1. Depth: 1-1/2 inches.
- F. Furring Channels (Furring Members):

1. Cold-Rolled Channels: 0.0538-inch uncoated-steel thickness, with minimum 1/2-inch-wide flanges, 3/4 inch deep.
 2. Hat-Shaped, Rigid Furring Channels: ASTM C 645, 7/8 inch deep.
 - a. Minimum Base-Metal Thickness: 0.0179 inch.
 3. Resilient Furring Channels: 1/2-inch-deep members designed to reduce sound transmission.
 - a. Configuration: Asymmetrical or hat shaped.
- G. Grid Suspension System for Gypsum Board Ceilings: ASTM C 645, direct-hung system composed of main beams and cross-furring members that interlock.
1. Products: Subject to compliance with requirements, provide one of the following:
 - a. Armstrong World Industries, Inc; Drywall Grid Systems.
 - b. Chicago Metallic Corporation; 640/660 Drywall Ceiling Suspension and 650/670 Fire Rated Drywall Ceiling Suspension.
 - c. USG Corporation; Drywall Suspension System.
- 2.4 AUXILIARY MATERIALS
- A. General: Provide auxiliary materials that comply with referenced installation standards.
1. Fasteners for Steel Framing: Of type, material, size, corrosion resistance, holding power, and other properties required to fasten steel members to substrates.

EXECUTION

2.5 EXAMINATION

- A. Examine areas and substrates, with Installer present, and including welded hollow-metal frames, cast-in anchors, and structural framing, for compliance with requirements and other conditions affecting performance of the Work.
- B. Proceed with installation only after unsatisfactory conditions have been corrected.

2.6 PREPARATION

- A. Suspended Assemblies: Coordinate installation of suspension systems with installation of overhead structure to ensure that inserts and other provisions for anchorages to building structure have been installed to receive hangers at spacing required to support the Work and that hangers will develop their full strength.
1. Furnish concrete inserts and other devices indicated to other trades for installation in advance of time needed for coordination and construction.
- B. Coordination with Sprayed Fire-Resistive Materials:
1. Before sprayed fire-resistive materials are applied, attach offset anchor plates or ceiling tracks to surfaces indicated to receive sprayed fire-resistive materials. Where offset anchor plates are required, provide continuous plates fastened to building structure not more than 24 inches o.c.

2. After sprayed fire-resistive materials are applied, remove them only to extent necessary for installation of non-load-bearing steel framing. Do not reduce thickness of fire-resistive materials below that are required for fire-resistance ratings indicated. Protect adjacent fire-resistive materials from damage.

2.7 INSTALLATION, GENERAL

- A. Installation Standard: ASTM C 754.
 1. Gypsum Board Assemblies: Also comply with requirements in ASTM C 840 that apply to framing installation.
- B. Install framing and accessories plumb, square, and true to line, with connections securely fastened.
- C. Install supplementary framing, and blocking to support fixtures, equipment services, heavy trim, grab bars, toilet accessories, furnishings, or similar construction.
- D. Install bracing at terminations in assemblies.
- E. Do not bridge building control and expansion joints with non-load-bearing steel framing members. Frame both sides of joints independently.

2.8 INSTALLING FRAMED ASSEMBLIES

- A. Install framing system components according to spacings indicated, but not greater than spacings required by referenced installation standards for assembly types.
 1. Single-Layer Application: 16 inches o.c. unless otherwise indicated.
- B. Where studs are installed directly against exterior masonry walls or dissimilar metals at exterior walls, install isolation strip between studs and exterior wall.
- C. Install studs so flanges within framing system point in same direction.
- D. Install tracks at floors and overhead supports. Extend framing full height to structural supports or substrates above suspended ceilings except where partitions are indicated to terminate at suspended ceilings. Provide 45-degree stud bracing at 10'-0" where stud walls do not continue full height. Continue framing around ducts that penetrate partitions above ceiling.
 1. Slip-Type Head Joints: Where framing extends to overhead structural supports, install to produce joints at tops of framing systems that prevent axial loading of finished assemblies.
 2. Other Framed Openings: Frame openings other than door openings the same as required for door openings unless otherwise indicated. Install framing below sills of openings to match framing required above door heads.
 3. Control Joints:
 - a. Install double studs with 1/2-inch minimum clearance between studs at control joint locations, full height of wall.
 - b. At door jambs, install cripple stud at head adjacent to jamb stud, with a minimum 1/2-inch clearance from jamb stud, for full remaining height of wall.
 - c. At fire rated walls, provide fire-blocking consisting of two layers of 5/8 inch fire-rated drywall or a 3-inch minimum length of safing insulation the full depth of the wall, centered behind the control joint.
 - d. Locations: Where indicated, or if not indicated:

- 1) Provide where partitions of dissimilar construction meet and remain in the same plane.
 - 2) A maximum of 30 feet in any one direction.
 - 3) Except at dissimilar partitions and where walls exceed 30 feet in length without interruption, install control joints at the door jamb adjacent to the largest unbroken wall area.
 - 4) At building expansion or control joints in furred masonry walls.
4. Fire-Resistance-Rated Partitions: Install framing to comply with fire-resistance-rated assembly indicated and support closures and to make partitions continuous from floor to underside of solid structure.
 - a. Firestop Track: Where indicated, install to maintain continuity of fire-resistance-rated assembly indicated.
5. Sound-Rated Partitions: Install framing to comply with sound-rated assembly indicated.
6. Curved Partitions:
 - a. Bend track to uniform curve and locate straight lengths so they are tangent to arcs.
 - b. Begin and end each arc with a stud, and space intermediate studs equally along arcs. On straight lengths of no fewer than two studs at ends of arcs, place studs 6 inches o.c.
- E. Direct Furring:
 1. Attach to concrete or masonry with stub nails, screws designed for masonry attachment, or powder-driven fasteners spaced 24 inches o.c.
- F. Installation Tolerance: Install each framing member so fastening surfaces vary not more than 1/8 inch from the plane formed by faces of adjacent framing.

2.9 FIELD MODIFICATIONS AND REPAIRS

- A. Cutting, notching, and boring holes in nonstructural cold-formed steel wall framing: Flanges and lips of nonstructural cold-formed steel wall studs shall not be cut or notched. Holes in webs of non-structural steel wall studs shall be permitted along the centerline of the web of the framing member, shall not exceed 1-1/2 inches in width or 4 inches in length, and the holes shall not be spaced less than 24 inches center to center from another hole or less than 10 inches from the bearing end.
- B. If punch-outs are provided in a stud member, no other punch-outs or holes are allowed unless they are within the criteria noted above.
- C. If the contractor, sub-contractor, or any others modify or damage framing materials, that party is responsible for all costs necessary to analyze and, where necessary, correct the situation.
- D. Installation of holes in the webs of structural members is limited to the size, configuration, and location as specified in the approved design or recognized design standard. Any webs of structural members with holes violating the above requirements must be evaluated by the Architect. The Architect may request that the specialty designer provide recommendations on such holes, with final acceptance by the Architect.
- E. Field repairs to damaged structural members shall be made in accordance with the Architect's recommendation. The Architect may request that the specialty designer provide recommendations on field repairs, with final acceptance by the Architect.
- F. Repairs to the metallic coating, when required, shall be in accordance with ASTM A780.

2.10 INSTALLING CEILING SUSPENSION SYSTEMS

- A. Install suspension system components according to spacings indicated, but not greater than spacings required by referenced installation standards for assembly types.
 - 1. Hangers: 48 inches o.c.
 - 2. Carrying Channels (Main Runners): 48 inches o.c.
 - 3. Furring Channels (Furring Members): 16 inches o.c.
- B. Isolate suspension systems from building structure where they abut or are penetrated by building structure to prevent transfer of loading imposed by structural movement.
- C. Suspend hangers from building structure as follows:
 - 1. Install hangers plumb and free from contact with insulation or other objects within ceiling plenum that are not part of supporting structural or suspension system.
 - a. Splay hangers only where required to miss obstructions and offset resulting horizontal forces by bracing, counter splaying, or other equally effective means.
 - 2. Where width of ducts and other construction within ceiling plenum produces hanger spacings that interfere with locations of hangers required to support standard suspension system members, install supplemental suspension members and hangers in the form of trapezes or equivalent devices.
 - a. Size supplemental suspension members and hangers to support ceiling loads within performance limits established by referenced installation standards.
 - 3. Wire Hangers: Secure by looping and wire tying, either directly to structures or to inserts, eye screws, or other devices and fasteners that are secure and appropriate for substrate, and in a manner that will not cause hangers to deteriorate or otherwise fail.
 - 4. Flat Hangers: Secure to structure, including intermediate framing members, by attaching to inserts, eye screws, or other devices and fasteners that are secure and appropriate for structure and hanger, and in a manner that will not cause hangers to deteriorate or otherwise fail...
 - 5. Do not attach hangers to steel roof deck.
 - 6. Do not attach hangers to permanent metal forms. Furnish cast-in-place hanger inserts that extend through forms.
 - 7. Do not attach hangers to rolled-in hanger tabs of composite steel floor deck.
 - 8. Do not connect or suspend steel framing from ducts, pipes, or conduit.
- D. Seismic Bracing: Sway-brace suspension systems with hangers used for support.
- E. Grid Suspension Systems: Attach perimeter wall track or angle where grid suspension systems meet vertical surfaces. Mechanically join main beam and cross-furring members to each other and butt-cut to fit into wall track.
- F. Installation Tolerances: Install suspension systems that are level to within 1/8 inch in 12 feet measured lengthwise on each member that will receive finishes and transversely between parallel members that will receive finishes.

END OF SECTION 09 22 16

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SECTION 09 29 00 - GYPSUM BOARD

PART 1 – GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

- A. Section Includes:
 - 1. Interior gypsum board.
 - 2. Tile backing panels.
 - 3. Sound attenuation insulation.
- B. Related Requirements:
 - 1. Section 01 81 13 "Sustainable Design Requirements."
 - 2. Section 06 16 00 "Sheathing" for gypsum sheathing for exterior walls.
 - 3. Section 09 21 16.23 "Gypsum Board Shaft Wall Assemblies" for metal shaft-wall framing, gypsum shaft liners, and other components of shaft-wall assemblies.
 - 4. Section 09 22 16 "Non-Structural Metal Framing" for non-structural steel framing and suspension systems that support gypsum board panels.

1.3 PREINSTALLATION MEETINGS

- A. Pre-Installation Meeting: Conduct conference at Project site. Review methods and procedures related to drywall finishing including, but not limited to, the following:
 - 1. Coordination of drywall finishing work with specific wall coverings and finishes.
 - 2. Identify wall surfaces scheduled to receive gloss finishes, subject to critical lighting, or receiving finishes requiring special flatness or finishing tolerances.
 - 3. Coordinate finishing levels and tolerances with wall finish installers.
 - 4. Pre-installation meeting shall include wallcovering installers, painters, and other trades that will apply finishes to gypsum board assemblies.

1.4 ACTION SUBMITTALS

- A. Product Data: For each type of product.
 - 1. Joint treatment for finishing system, application and installation instructions, and materials data.
 - 2. Manufacturer's data on all products is to be supplied.
 - 3. Indicate stud type, size, and gage to be used, by location or wall type
 - 4. Describe method for securing studs to tracks; blocking and framing connections.
 - 5. Copy of UL or GA Design Classification indicating products to be furnished under this Section.
- B. Samples: For the following products:
 - 1. Trim Accessories: Full-size Sample in 12-inch- long length for each trim accessory indicated.

2. Textured Finishes: Manufacturer's standard size for each textured finish indicated and on same backing indicated for work.

1.5 INFORMATIONAL SUBMITTALS

- A. Sustainable Design Submittal Requirements: See Section 01 81 13 "Sustainable Design Requirements" for submittal requirements.

1.6 DELIVERY, STORAGE AND HANDLING

- A. Store materials inside under cover and keep them dry and protected against weather, condensation, direct sunlight, construction traffic, and other potential causes of damage. Stack panels flat and supported on risers on a flat platform to prevent sagging.

1.7 FIELD CONDITIONS

- A. Environmental Limitations: Comply with ASTM C 840 requirements or gypsum board manufacturer's written instructions, whichever are more stringent.
- B. Do not install paper-faced gypsum panels until installation areas are enclosed and conditioned.
- C. Do not install panels that are wet, moisture damaged, and mold damaged.
 1. Indications that panels are wet or moisture damaged include, but are not limited to, discoloration, sagging, or irregular shape.
 2. Indications that panels are mold damaged include, but are not limited to, fuzzy or splotchy surface contamination and discoloration.

PART 2 – PRODUCTS

2.1 SUSTAINABLE DESIGN MATERIAL REQUIREMENTS

- A. Materials shall comply with the requirements of Section 01 81 13 "Sustainable Design Requirements."

2.2 PERFORMANCE REQUIREMENTS

- A. Fire-Resistance-Rated Assemblies: For fire-resistance-rated assemblies, provide materials and construction identical to those tested in assembly indicated according to ASTM E 119 by an independent testing agency.
 1. Where products other than the reference standards are provided, fire-rated construction is indicated, and a specific UL or GA Design Classification is designated, provide only products listed in the Design Classification or an equivalent UL or GA Design Classification, acceptable to the Architect/Engineer.

2.3 GYPSUM BOARD, GENERAL

- A. Size: Provide maximum lengths and widths available that will minimize joints in each area and that correspond with support system indicated.

2.4 INTERIOR GYPSUM BOARD

A. Gypsum Board, Type X: ASTM C 1396/C 1396M.

1. Products: Subject to compliance with requirements, provide one of the following:
 - a. CertainTeed Corporation; CertainTeed Type X.
 - b. Continental Building Products, LLC; Firecheck Type X.
 - c. Georgia-Pacific Gypsum LLC; Tough Rock Fireguard X.
 - d. National Gypsum Company; Gold Bond Brand Fire-Shield Gypsum Board.
 - e. USG Corporation; USG Sheetrock® Brand Firecode® X Panels.
2. Thickness:
 - a. General: 5/8 inch, unless otherwise indicated.
 - b. Curved Fire-Rated Assemblies: 2 layers (one layer 3/8" thick and one layer 1/4" thick), for wall radius range 3 feet to 18 feet.
3. Long Edges: Tapered.
4. Locations: Where drywall is indicated, fire-rated assemblies and non-fire-rated assemblies.

B. Flexible Gypsum Board: ASTM C 1396/C 1396M. Manufactured to bend to fit radii and to be more flexible than standard regular-type gypsum board of same thickness.

1. Basis-of-Design: Subject to compliance with requirements, provide the following:
 - a. USG Corporation ; USG Sheetrock® Brand Flexible Gypsum Panels.
2. Comparable Manufacturer: Subject to compliance with requirements, the following manufacturers shall be considered comparable:
 - a. CertainTeed Corporation.
 - b. Continental Building Products, LLC.
 - c. Georgia-Pacific Gypsum LLC.
 - d. National Gypsum Company.
3. Thickness: One layer 3/8" thick and one layer 1/4" thick.
4. Long Edges: Tapered.
5. Locations: Interior curved and rounded walls, where noted on drawings. Apply in two layers unless noted otherwise on drawings.

C. Abuse-Resistant Gypsum Board: ASTM C 1396/C 1396M gypsum board, tested according to ASTM C 1629/C 1629M.

1. Products: Subject to compliance with requirements, provide one of the following:
 - a. Continental Building Products, LLC; Protecta AR 100 Type X with Mold Defense.
 - b. Georgia-Pacific Gypsum LLC; DensArmor Plus Abuse-Resistant Interior Panel.
 - c. National Gypsum Company; Gold Bond XP Hi-Abuse Gypsum Board..
 - d. USG Corporation; USG Sheetrock® Brand Mold Tough® Abuse-Resistant Firecode®.
2. Core: 5/8 inch, Type X.
3. Surface Abrasion: ASTM C 1629/C 1629M, meets or exceeds Level 3 requirements.
4. Indentation: ASTM C 1629/C 1629M, meets or exceeds Level 1 requirements.
5. Soft-Body Impact: ASTM C 1629/C 1629M, meets or exceeds Level 2 requirements.

6. Long Edges: Tapered.
 7. Mold Resistance: ASTM D 3273, score of 10 as rated according to ASTM D 3274.
- A. Impact-Resistant Gypsum Board: ASTM C1396/C1396M gypsum board, tested according to ASTM C1629/C1629M.
1. Products: Subject to compliance with requirements, provide one of the following:
 - a. CertainTeed; SAINT-GOBAIN; CertainTeed Extreme Impact Resistant Type X Gypsum Board with M2Tech Mold and Moisture Technology.
 - b. Continental Building Products Inc.; Protecta HIR 300 Type X with Mold Defense.
 - c. National Gypsum Company; Hi-Impact Brand XP Fire-Shield Wallboard.
 - d. USG Corporation; USG Sheetrock® Brand Mold Tough® VHI (Very High Impact) Firecode® Core.
 2. Core: 5/8 inch, Type X.
 3. Surface Abrasion: ASTM C1629/C1629M, meets or exceeds Level 3 requirements.
 4. Indentation: ASTM C1629/C1629M, meets or exceeds Level 1 requirements.
 5. Soft-Body Impact: ASTM C1629/C1629M, meets or exceeds Level 3 requirements.
 6. Hard-Body Impact: ASTM C1629/C1629M, meets or exceeds Level 3 requirements according to test in Annex A1.
 7. Long Edges: Tapered.
 8. Mold Resistance: ASTM D3273, score of 10 as rated according to ASTM D3274.

2.5 TRIM ACCESSORIES

- A. Interior Trim: ASTM C 1047.
1. Basis-of-Design: Subject to compliance with requirements, provide products by the following:
 - a. Trim-Tex, Inc.
 2. Material: Mud-set vinyl.
 3. Corner Bead (Drywall):
 - a. Outside corner.
 - b. Inside corner.
 - c. Bullnose corner.
 - d. Fillable edge trim.
 - e. Reveal trim.
 - f. Control joint.
 4. Fire-Rated Control Joint (Drywall):
 - a. Control joint. Trim-Tex; 093X-V. Composite PVC control joint with a single strip of intumescent tape factory applied to the back side of the control joint.
- B. Aluminum Trim: Extruded accessories of profiles and dimensions indicated.
1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. Fry Reglet Corporation.
 - b. Gordon, Inc.

- c. Pittcon Industries.
 - 2. Aluminum: Alloy and temper with not less than the strength and durability properties of ASTM B 221, Alloy 6063-T5.
 - 3. Finish: Corrosion-resistant primer compatible with joint compound and finish materials specified.
 - 4. Drywall Molding End Closure: Extruded aluminum.
 - a. Basis-of-Design: Subject to compliance with requirements, provide the following:
 - 1) Fry Reglet; Drywall Molding End Closures, DMEC Series.
 - b. Match profile indicated.
- C. Mullion Trim:
- 1. Basis-of-Design: Subject to compliance with requirements, provide MULL-it-OVER Products; 55 Series Mullion Trim Cap, or the following:
 - a. Gordon, Inc.; Mullion Mate Series 40 Partition Closures.
 - 2. Provide sound barrier mullion trim caps of design, basic profile, materials, and operation indicated. Provide units with capability to accommodate variations in adjacent surfaces.
 - 3. Provide units as required where no mullion exists.
 - 4. Profile: As selected by Architect from manufacturer's full range.
 - 5. Compressible Foam: Between edge of extrusion and interior face of curtain wall glass.
 - a. Fire Rating: ASTM E85, Class 1.
 - b. Fungi Resistance: Zero rating per ASTM G21.
 - c. Thickness: Standard 1/2 inch, or 1 inch to accommodate a larger mullion deflection.
 - d. Color: To Match Existing
 - 6. Fire Rating:
 - a. Standard Conditions: Assembly fire rating of 1 hour per ANSI/UL2079 and CAN/ULC S115. UL Joint System No. WW-S-1039 for 1 hour assembly. UL Joint System No. WW-S-1041 for 2-hour assembly
 - b. Unique or Non-Standard Conditions: Subject to review and engineered ruling by manufacturer.
 - 7. Thermal Movements: Allow for thermal movements from ambient and surface temperature changes.

2.6 JOINT TREATMENT MATERIALS

- A. General: Comply with ASTM C 475/C 475M.
- B. Joint Tape:
 - 1. Interior Gypsum Board: Paper, unless otherwise recommended by manufacturer for applications indicated.
 - 2. Glass-Mat Gypsum Sheathing Board: 10 by 10 glass mesh.
 - 3. Tile Backing Panels: As recommended by panel manufacturer.

- C. Joint Compound for Interior Gypsum Board: For each coat, use formulation that is compatible with other compounds applied on previous or for successive coats.
 - 1. Prefilling: At open joints and damaged surface areas, use setting-type taping compound.
 - 2. Embedding and First Coat: For embedding tape and first coat on joints, fasteners, and trim flanges, use setting-type taping compound.
 - 3. Fill Coat: For second coat, use drying-type, all-purpose compound.
 - 4. Finish Coat: For third coat, use drying-type, all-purpose compound.
 - 5. Skim Coat: For final coat of Level 5 finish, use high-build interior coating product designed for application by airless sprayer and to be used instead of skim coat to produce Level 5 finish.
 - a. Products: Provide one of the following:
 - 1) National Gypsum; ProForm Brand Surfacer/Primer.
 - 2) Porter Paints; Maxbuild High Build Drywall Surfacer/Primer.
 - 3) Sherwin-Williams; PrepRite High Build Primer/Surfacer.
 - 4) United States Gypsum Company; Tuff-Hide Primer/Sealer.

2.7 AUXILIARY MATERIALS

- A. General: Provide auxiliary materials that comply with referenced installation standards and manufacturer's written instructions.
- B. Laminating Adhesive: Adhesive or joint compound recommended for directly adhering gypsum panels to continuous substrate.
- C. Steel Drill Screws: ASTM C 1002 unless otherwise indicated.
 - 1. Use screws complying with ASTM C 954 for fastening panels to steel members from 0.033 to 0.112 inch thick.

PART 3 – EXECUTION

3.1 EXAMINATION

- A. Examine areas and substrates including welded hollow-metal frames and support framing, with Installer present, for compliance with requirements and other conditions affecting performance of the Work.
- B. Examine panels before installation. Reject panels that are wet, moisture damaged, and mold damaged.
- C. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 APPLYING AND FINISHING PANELS, GENERAL

- A. Comply with ASTM C 840.
- B. Install ceiling panels across framing to minimize the number of abutting end joints and to avoid abutting end joints in central area of each ceiling. Stagger abutting end joints of adjacent panels not less than one framing member.
- C. Install panels with face side out. Butt panels together for a light contact at edges and ends with not more than 1/16 inch of open space between panels. Do not force into place.

- D. Locate edge and end joints over supports, except in ceiling applications where intermediate supports or gypsum board back-blocking is provided behind end joints. Do not place tapered edges against cut edges or ends. Stagger vertical joints on opposite sides of partitions. Do not make joints other than control joints at corners of framed openings.
- E. Form control and expansion joints with space between edges of adjoining gypsum panels.
- F. Cover both faces of support framing with gypsum panels in concealed spaces (above ceilings, etc.), except in chases braced internally.
 - 1. Unless concealed application is indicated or required for sound, fire, air, or smoke ratings, coverage may be accomplished with scraps of not less than 8 sq. ft. in area.
 - 2. Fit gypsum panels around ducts, pipes, and conduits.
 - 3. Where partitions intersect structural members projecting below underside of floor/roof slabs and decks, cut gypsum panels to fit profile formed by structural members; allow 1/4- to 3/8-inch- wide joints to install sealant.
- G. Isolate perimeter of gypsum board applied to non-load-bearing partitions at structural abutments. Provide 1/4- to 1/2-inch- wide spaces at these locations and trim edges with edge trim where edges of panels are exposed. Seal joints between edges and abutting structural surfaces with acoustical sealant.
- H. Attachment to Steel Framing: Attach panels so leading edge or end of each panel is attached to open (unsupported) edges of stud flanges first.
- I. STC-Rated Assemblies: Seal construction at perimeters, behind control joints, and at openings and penetrations with a continuous bead of acoustical sealant. Install acoustical sealant at both faces of partitions at perimeters and through penetrations. Comply with ASTM C 919 and with manufacturer's written instructions for locating edge trim and closing off sound-flanking paths around or through assemblies, including sealing partitions above acoustical ceilings.
- J. Install sound attenuation blankets before installing gypsum panels unless blankets are readily installed after panels have been installed on one side.

3.3 APPLYING INTERIOR GYPSUM BOARD

- A. Single-Layer Application:
 - 1. On ceilings, apply gypsum panels before wall/partition board application to greatest extent possible and at right angles to framing unless otherwise indicated.
 - 2. On partitions/walls, apply gypsum panels vertically (parallel to framing) unless otherwise indicated or required by fire-resistance-rated assembly, and minimize end joints.
 - a. Stagger abutting end joints not less than one framing member in alternate courses of panels.
 - b. At stairwells and other high walls, install panels horizontally unless otherwise indicated or required by fire-resistance-rated assembly.
 - 3. On Z-shaped furring members, apply gypsum panels vertically (parallel to framing) with no end joints. Locate edge joints over furring members.
 - 4. Fastening Methods: Apply gypsum panels to supports with steel drill screws.
- B. Multilayer Application:
 - 1. On ceilings, apply gypsum board indicated for base layers before applying base layers on walls/partitions; apply face layers in same sequence. Apply base layers at right angles to framing

- members and offset face-layer joints one framing member, 16 inches minimum, from parallel base-layer joints, unless otherwise indicated or required by fire-resistance-rated assembly.
- 2. On partitions/walls, apply gypsum board indicated for base layers and face layers vertically (parallel to framing) with joints of base layers located over stud or furring member and face-layer joints offset at least one stud or furring member with base-layer joints unless otherwise indicated or required by fire-resistance-rated assembly. Stagger joints on opposite sides of partitions.
- 3. On Z-shaped furring members, apply base layer vertically (parallel to framing) and face layer either vertically (parallel to framing) or horizontally (perpendicular to framing) with vertical joints offset at least one furring member. Locate edge joints of base layer over furring members.
- 4. Fastening Methods: Fasten base layers and face layers separately to supports with screws.

3.4 INSTALLING TRIM ACCESSORIES

- A. General: For trim with back flanges intended for fasteners, attach to framing with same fasteners used for panels. Otherwise, attach trim according to manufacturer's written instructions.
- B. Control Joints: Install control joints according to ASTM C 840 and in specific locations approved by Architect/Engineer for visual effect and as follows:
 - 1. Install double studs with 1/2-inch minimum clearance between studs at control joint locations, full height of wall.
 - 2. At door jambs, install crippled stud at head adjacent to jamb stud, with a minimum of 1/2 inch clearance from jamb stud, for full remaining height of wall.
 - 3. At fire-rated walls:
 - a. Provide fire-blocking consisting of two layers of 5/8 inch fire-rated gypsum board or a 3 inch manumit length of safing insulation for full depth of wall, centered behind the control joint. Based on test WHI-647-3024, and WHI-651-0318.1.
 - b. Provide fire-rated control joint. Based on test UL-XHBN.WW-D-0172.
 - 4. Locations: Where indicated, or if not indicated:
 - a. Provide where partitions of dissimilar construction meet and remain in the same plane.
 - b. A maximum of 30 feet in any one direction.
 - c. Except at dissimilar partitions and where walls exceed 30 feet in length without interruption, install control joints at the door jamb adjacent to largest unbroken wall area.
 - d. At building expansion or control joints in furred masonry walls.
- C. Interior Trim: Install in the following locations:
 - 1. Cornerbead: Use at outside corners unless otherwise indicated.
 - 2. Bullnose Bead: Use at outside corners.
 - 3. LC-Bead: Use at exposed panel edges.
 - 4. U-Bead: Use at exposed panel edges.
 - 5. Curved-Edge Cornerbead: Use at curved openings.
- D. Aluminum Trim: Install in locations indicated on Drawings.
- E. Mullion Trim: Install in accordance with manufacturer's written instructions.

3.5 FINISHING GYPSUM BOARD

- A. General: Treat gypsum board joints, interior angles, edge trim, control joints, penetrations, fastener heads, surface defects, and elsewhere as required to prepare gypsum board surfaces for decoration. Promptly remove residual joint compound from adjacent surfaces.
- B. Prefill open joints and damaged surface areas.
- C. Apply joint tape over gypsum board joints, except for trim products specifically indicated as not intended to receive tape.
- D. Gypsum Board Finish Levels: Finish panels to levels indicated below and according to ASTM C 840:
 - 1. Level 1: Ceiling plenum areas, concealed areas, and where indicated.
 - 2. Level 2: Panels that are substrate for tile.
 - 3. Level 4: At panel surfaces that will be exposed to view unless otherwise indicated.
 - a. Primer and its application to surfaces are specified in Section 09 91 23 "Interior Painting."
 - 4. Level 5: For walls or ceilings with strong cross lighting (natural or artificial) and/or gloss sheen paint finishes and where indicated on Drawings.
 - a. Primer and its application to surfaces are specified in Section 09 91 23 "Interior Painting."

3.6 PROTECTION

- A. Protect adjacent surfaces from drywall compound and promptly remove from floors and other non-drywall surfaces. Repair surfaces stained, marred, or otherwise damaged during drywall application.
- B. Protect installed products from damage from weather, condensation, direct sunlight, construction, and other causes during remainder of the construction period.
- C. Remove and replace panels that are wet, moisture damaged, and mold damaged.
 - 1. Indications that panels are wet or moisture damaged include, but are not limited to, discoloration, sagging, or irregular shape.
 - 2. Indications that panels are mold damaged include, but are not limited to, fuzzy or splotchy surface contamination and discoloration.

END OF SECTION 09 29 00

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SECTION 09 51 13 - ACOUSTICAL PANEL CEILINGS

PART 1 – GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

- A. Section includes acoustical panels and exposed suspension systems for interior ceilings.
- B. Products furnished, but not installed under this Section, include anchors, clips, and other ceiling attachment devices to be cast in concrete.

1.3 PREINSTALLATION MEETINGS

- A. Preinstallation Conference: Conduct conference at Project site.

1.4 ACTION SUBMITTALS

- A. Product Data: For each type of product.
- B. Samples for Verification: For each component indicated and for each exposed finish required, prepared on Samples of sizes indicated below:
 - 1. Acoustical Panels Set of 6-inch- square Samples of each type, color, pattern, and texture.
- C. Delegated-Design Submittal: For seismic restraints for ceiling systems.
 - 1. Include design calculations for seismic restraints including analysis data signed and sealed by the qualified professional engineer responsible for their preparation.

1.5 INFORMATIONAL SUBMITTALS.

- A. Quality Assurance Plan:
 - 1. Furnish copies for review for conformance with requirements.
 - 2. Furnish completed record copies for project records and for distribution to authorities having jurisdiction.
 - 3. Furnish written Statement of Responsibility on Contractor's letterhead, indicating the following:
 - a. Acknowledgement of awareness of special requirements contained in the Quality Assurance Plan.
 - b. Acknowledgement that control will be exercised to obtain conformance with the Contract Documents approved by the authority having jurisdiction.
 - c. Procedures for exercising control within the Contractor's organization, the method and frequency of reporting, and the distribution of reports.

- d. Identification and qualifications of the person(s) exercising control and their position(s) within the company.
 - B. Qualification Data: For testing agency.
 - C. Product Test Reports: For each acoustical panel ceiling, for tests performed by a qualified testing agency.
 - D. Evaluation Reports: For each acoustical panel ceiling suspension system and anchor and fastener type, from ICC-ES.
- 1.6 CLOSEOUT SUBMITTALS
- A. Maintenance Data: For finishes to include in maintenance manuals.
- 1.7 MAINTENANCE MATERIAL SUBMITTALS
- A. Furnish extra materials, from the same product run, that match products installed and that are packaged with protective covering for storage and identified with labels describing contents.
- 1.8 DELIVERY, STORAGE, AND HANDLING
- A. Deliver acoustical panels, suspension-system components, and accessories to Project site and store them in a fully enclosed, conditioned space where they will be protected against damage from moisture, humidity, temperature extremes, direct sunlight, surface contamination, and other causes.
 - B. Before installing acoustical panels, permit them to reach room temperature and a stabilized moisture content.
- 1.9 FIELD CONDITIONS
- A. Environmental Limitations: Do not install acoustical panel ceilings until spaces are enclosed and weathertight, wet-work in spaces is complete and dry, work above ceilings is complete, and ambient temperature and humidity conditions are maintained at the levels indicated for Project when occupied for its intended use.
 - 1. Pressurized Plenums: Operate ventilation system for not less than 48 hours before beginning acoustical panel ceiling installation.

PART 2 – PRODUCTS

2.1 MANUFACTURERS

- A. Source Limitations: Obtain each type of acoustical ceiling panel and its supporting suspension system from single source from single manufacturer.

2.2 PERFORMANCE REQUIREMENTS

- A. Seismic Performance: Suspended ceilings shall withstand the effects of earthquake motions determined according to ASCE/SEI 7.

- B. Surface-Burning Characteristics: Comply with ASTM E 84; testing by a qualified testing agency. Identify products with appropriate markings of applicable testing agency.

1. Flame-Spread Index: Class A according to ASTM E 1264.
2. Smoke-Developed Index: 50 or less.

2.3 ACOUSTICAL PANELS

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

1. Armstrong World Industries, Inc.
2. CertainTeed Corporation.
3. National Gypsum Company
4. USG Corporation.

- B. Acoustical Panel Standard: Provide manufacturer's standard panels according to ASTM E 1264 and designated by type, form, pattern, acoustical rating, and light reflectance unless otherwise indicated.

- C. Type 3 - Unperforated: 24" x 24" lay-in panels with square edge and hold-down clips.

1. Acceptable Products:

- a. 56099, Clean Room ClimaPlus Class 100; USG Interiors, Inc.
- b. 868, Clean Room VL; Armstrong.
- c. Vinyl Shield A non-perforated; CertainTeed.
- d. GB5044, Gridstone Brand Gypsum Ceiling Panels; National Gypsum Company.

2. Acoustic Properties: STC: 40-44.

- D. Type 4 - Perforated: 24" x 24" lay-in tile with square edge.

1. Acceptable Products:

- a. 5890, Touchstone; USG Interiors, Inc.
- b. 301, Tundra; Armstrong.

2. Acoustic Properties:

- a. NRC: 0.50-0.60.
- b. STC: 35-39.

- E. Type 5 - Unperforated: 24" x 24" lay-in tile with tegular edge.

1. Acceptable Products:

- a. 76775, Eclipse; USG Interiors.
- b. 584, Cirrus Travertone; Armstrong.

2. Acoustic Properties:

- a. NRC: 0.50-0.65.
- b. STC: 35-39.

- F. Type 7 - Unperforated: 24" x 24" lay-in panels with square edge, vinyl face and hold-down clips.

1. Acceptable Products:
 - a. 3260, Sheetrock Brand ClimaPlus; USG Interiors, Inc.
 - b. 868, Clean Room VL; Armstrong.
 - c. GB5044, Gridstone Brand Gypsum Ceiling Panels; National Gypsum Company.
 - d. Vinyl Shield A non-perforated; Celotex/Capaul.
2. Acoustic Properties: STC: 40-44.

2.4 METAL SUSPENSION SYSTEM

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 1. Armstrong World Industries, Inc.
 2. CertainTeed Corporation.
 3. Chicago Metallic Corporation.
 4. USG Corporation.
- B. Metal Suspension-System Standard: Provide manufacturer's standard, direct-hung, metal suspension system and accessories according to ASTM C 635/C 635M and designated by type, structural classification, and finish indicated.
- A. Standard Grid System:
 1. Exposed grid system including main tee runners, cross tee runners, angle moldings and corner pieces, and all accessories necessary for complete installations.
 2. ASTM C 635 Heavy Duty (HD) and Intermediate Duty (ID) main tee classifications;
 3. Material: commercial quality HDG-30 steel, hot-dip galvanized body and cap
 - a. Provide grid with aluminum cap, where indicated.
 4. Height: 1-1/2 inches.
 5. Width: 15/16 inches.
 6. Color: White to Match Existing
 7. Acceptable Products:
 - a. Prelude Exposed Grid System; Armstrong Commercial Ceilings; Armstrong World Industries.
 - b. Classic Stab System; CertainTeed.
 - c. Snapgrid System 200/250 Series; Chicago Metallic Corporation.
 - d. Donn DX System; USG Interiors, Inc.

2.5 ACCESSORIES

- A. Attachment Devices: Size for five times the design load indicated in ASTM C 635/C 635M, Table 1, "Direct Hung," unless otherwise indicated. Comply with seismic design requirements.
 1. Anchors in Concrete: Anchors of type and material indicated below, with holes or loops for attaching hangers of type indicated and with capability to sustain, without failure, a load equal to five times that imposed by ceiling construction, as determined by testing according to ASTM E 488/E 488M or ASTM E 1512 as applicable, conducted by a qualified testing and inspecting agency.
 - a. Type: Postinstalled expansion anchors.

- b. Retain one of three "Corrosion Protection" subparagraphs below or, if more than one is required, indicate locations for each type on Drawings. Zinc plating of mild class indicated protects against corrosion from an indoor atmosphere with rare condensation and subject to minimum wear or abrasion; revise thickness to suit more corrosive conditions or use stainless steel. Corrosion Protection: Carbon-steel components zinc plated according to ASTM B 633, Class SC 1 (mild) service condition.
 - c. Corrosion Protection: Carbon-steel components zinc plated according to ASTM B 633, Class SC 1 (mild) service condition.
 - 2. Power-Actuated Fasteners in Concrete: Fastener system of type suitable for application indicated, fabricated from corrosion-resistant materials, with clips or other accessory devices for attaching hangers of type indicated and with capability to sustain, without failure, a load equal to 10 times that imposed by ceiling construction, as determined by testing according to ASTM E 1190, conducted by a qualified testing and inspecting agency.
- B. Wire Hangers, Braces, and Ties: Provide wires as follows:
 - 1. Zinc-Coated, Carbon-Steel Wire: ASTM A 641/A 641M, Class 1 zinc coating, soft temper.
 - 2. Size: Wire diameter sufficient for its stress at three times hanger design load (ASTM C 635/C 635M, Table 1, "Direct Hung") will be less than yield stress of wire, but not less than 0.135-inch- diameter wire.
- C. Hanger Rods: Mild steel, zinc coated or protected with rust-inhibitive paint.
- D. Flat Hangers: Mild steel, zinc coated or protected with rust-inhibitive paint.
- E. Angle Hangers: Angles with legs not less than 7/8 inch wide; formed with 0.04-inch- thick, galvanized-steel sheet complying with ASTM A 653/A 653M, G90 coating designation; with bolted connections and 5/16-inch- diameter bolts.
- F. Hold-Down Clips: Manufacturer's standard hold-down.
- G. Grid restraining clips for Seismic Category C: Provide manufactured seismic grid restraining clips tested for compliance with the design requirements of the International Building Code, Section 1621.
 - 1. Products: Provide one of the following:
 - a. Armstrong Commercial Ceilings, Armstrong World Industries; BERC or BERC-2 Clip
 - b. Chicago Metallic Corporation; 1496 Seismic Perimeter Clip
- H. Grid restraining clips for Seismic Categories D, E, F: Provide manufactured seismic grid restraining clips tested for compliance with the design requirements of the International Building Code, Section 1621.
 - 1. Products: Provide one of the following:
 - a. Armstrong Commercial Ceilings, Armstrong World Industries; BERC-2 Clip.
 - b. Chicago Metallic Corporation; 1496 Seismic Perimeter Clip.
- I. Seismic Stabilizer Bars: Manufacturer's standard perimeter stabilizers designed to accommodate seismic forces.
- J. Seismic Struts: Manufacturer's standard compression struts designed to accommodate seismic forces.
- K. Slotted Channel Strut Hanger Supports:

1. Basis-of-Design: Subject to compliance with requirements, provide Unistrut Corp.; P1000 or P1001 or one of the following:
 - a. B-Line Systems, Inc.; a division of Cooper Industries.
 - b. ERICO/Michigan Hanger Co.; ERISTRUT Div.
 - c. Power-Strut Div.; Tyco International, Ltd.
 - d. Unistrut Corp.; Tyco International, Ltd.
2. Coatings: Manufacturer's standard finish, unless bare metal surfaces are indicated.

2.6 METAL EDGE MOLDINGS AND TRIM

- A. Roll-Formed, Sheet-Metal Edge Moldings and Trim: Type and profile indicated or, if not indicated, manufacturer's standard moldings for edges and penetrations that comply with seismic design requirements; formed from sheet metal of same material, finish, and color as that used for exposed flanges of suspension-system runners.
 1. Edge moldings shall fit acoustical panel edge details and suspension systems indicated and match width and configuration of exposed runners unless otherwise indicated.
 2. For lay-in panels with reveal edge details, provide.
 3. For circular penetrations of ceiling, provide edge moldings fabricated to diameter required to fit penetration exactly.
 4. Accessories: Provide splice plates, T-bar connector clips, perimeter trim hold-down clips, alignment clips, drywall trim and other accessory items required for a complete system.
 5. Height: As scheduled.
 6. Color: Match existing
 7. Acceptable products:
 - a. Chicago Metallic Corporation; Infinity.
 - b. USG Interiors, Inc.; Compasso Fascia trim.
- B. Extruded-Aluminum Edge Moldings and Trim: Where indicated, provide manufacturer's extruded-aluminum edge moldings and trim of profile indicated or referenced by manufacturer's designations, including splice plates, corner pieces, and attachment and other clips, complying with seismic design requirements.

2.7 ACOUSTICAL SEALANT

- A. Acoustical Sealant: As specified in Section 07 92 19 "Acoustical Joint Sealants."

PART 3 – EXECUTION

3.1 EXAMINATION

- A. Examine substrates, areas, and conditions, including structural framing to which acoustical panel ceilings attach or abut, with Installer present, for compliance with requirements specified in this and other Sections that affect ceiling installation and anchorage and with requirements for installation tolerances and other conditions affecting performance of acoustical panel ceilings.
- B. Examine acoustical panels before installation. Reject acoustical panels that are wet, moisture damaged, or mold damaged.

- C. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 PREPARATION

- A. Measure each ceiling area and establish layout of acoustical panels to balance border widths at opposite edges of each ceiling. Avoid using less-than-half-width panels at borders unless otherwise indicated, and comply with layout shown on reflected ceiling plans.
- B. Layout openings for penetrations centered on the penetrating items.

3.3 INSTALLATION

- A. Install acoustical panel ceilings according to ASTM C 636/C 636M, seismic design requirements, and manufacturer's written instructions.
- B. Suspend ceiling hangers from building's structural members and as follows:
 - 1. Install hangers plumb and free from contact with insulation or other objects within ceiling plenum that are not part of supporting structure or of ceiling suspension system.
 - 2. Splay hangers only where required to miss obstructions; offset resulting horizontal forces by bracing, countersplaying, or other equally effective means.
 - 3. Where width of ducts and other construction within ceiling plenum produces hanger spacings that interfere with location of hangers at spacings required to support standard suspension-system members, install supplemental suspension members and hangers in form of trapezes or equivalent devices.
 - 4. Secure wire hangers to ceiling-suspension members and to supports above with a minimum of three tight turns. Connect hangers directly to structure or to inserts, eye screws, or other devices that are secure and appropriate for substrate and that will not deteriorate or otherwise fail due to age, corrosion, or elevated temperatures.
 - 5. Secure flat, angle, channel, and rod hangers to structure, including intermediate framing members, by attaching to inserts, eye screws, or other devices that are secure and appropriate for both the structure to which hangers are attached and the type of hanger involved. Install hangers in a manner that will not cause them to deteriorate or fail due to age, corrosion, or elevated temperatures.
 - 6. Do not support ceilings directly from permanent metal forms or floor deck. Fasten hangers to cast-in-place hanger inserts, postinstalled mechanical or adhesive anchors, or power-actuated fasteners that extend through forms into concrete.
 - 7. When steel framing does not permit installation of hanger wires at spacing required, install carrying channels or other supplemental support for attachment of hanger wires.
 - 8. Do not attach hangers to steel deck tabs.
 - 9. Do not attach hangers to steel roof deck. Attach hangers to structural members.
 - 10. Space hangers not more than 48 inches o.c. along each member supported directly from hangers unless otherwise indicated; provide hangers not more than 8 inches from ends of each member.
 - 11. Size supplemental suspension members and hangers to support ceiling loads within performance limits established by referenced standards.
- C. Secure bracing wires to ceiling suspension members and to supports with a minimum of four tight turns. Suspend bracing from building's structural members as required for hangers, without attaching to permanent metal forms, steel deck, or steel deck tabs. Fasten bracing wires into concrete with cast-in-place or postinstalled anchors.
- D. Install edge moldings and trim of type indicated at perimeter of acoustical ceiling area and where necessary to conceal edges of acoustical panels.

1. Apply acoustical sealant in a continuous ribbon concealed on back of vertical legs of moldings before they are installed.
 2. Screw attach moldings to substrate at intervals not more than 16 inches o.c. and not more than 3 inches from ends. Miter corners accurately and connect securely.
 3. Do not use exposed fasteners, including pop rivets, on moldings and trim.
- E. Install suspension-system runners so they are square and securely interlocked with one another. Remove and replace dented, bent, or kinked members.
- F. Install acoustical panels with undamaged edges and fit accurately into suspension-system runners and edge moldings. Scribe and cut panels at borders and penetrations to provide precise fit.
1. Arrange directionally patterned acoustical panels as follows:
 - a. As indicated on reflected ceiling plans.
 - b. Install panels with pattern running in one direction parallel to match exiting axis of space.
 - c. Install panels in a basket weave pattern.
 2. For square-edged panels, install panels with edges fully hidden from view by flanges of suspension-system runners and moldings.
 3. For reveal-edged panels on suspension-system runners, install panels with bottom of reveal in firm contact with top surface of runner flanges.
 4. Paint cut edges of panel remaining exposed after installation; match color of exposed panel surfaces using coating recommended in writing for this purpose by acoustical panel manufacturer.

3.4 ERECTION TOLERANCES

- A. Suspended Ceilings: Install main and cross runners level to a tolerance of 1/8 inch in 12 feet, non-cumulative.
- B. Moldings and Trim: Install moldings and trim to substrate and level with ceiling suspension system to a tolerance of 1/8 inch in 12 feet, non-cumulative.

3.5 FIELD QUALITY CONTROL.

- A. Special Inspections: Owner will engage a qualified special inspector to perform the following special inspections:
1. Periodic inspection during the installation of suspended ceiling grids according to ASCE/SEI 7.
- B. Testing Agency: Owner will engage a qualified testing agency to perform tests and inspections.
- C. Perform the following tests and inspections of completed installations of acoustical panel ceiling hangers and anchors and fasteners in successive stages and when installation of ceiling suspension systems on each floor has reached 20 percent completion, but no panels have been installed. Do not proceed with installations of acoustical panel ceiling hangers for the next area until test results for previously completed installations of acoustical panel ceiling hangers show compliance with requirements.
1. Within each test area, testing agency will select one of every 10 power-actuated fasteners and postinstalled anchors used to attach hangers to concrete and will test them for 200 lbf of tension; it will also select one of every two postinstalled anchors used to attach bracing wires to concrete and will test them for 440 lbf of tension.

- 2. When testing discovers fasteners and anchors that do not comply with requirements, testing agency will test those anchors not previously tested until 20 pass consecutively and then will resume initial testing frequency.
 - D. Acoustical panel ceiling hangers, anchors, and fasteners will be considered defective if they do not pass tests and inspections.
 - E. Prepare test and inspection reports.
- 3.6 CLEANING
- A. Clean exposed surfaces of acoustical panel ceilings, including trim, edge moldings, and suspension-system members. Comply with manufacturer's written instructions for cleaning and touchup of minor finish damage.
 - B. Remove and replace ceiling components that cannot be successfully cleaned and repaired to permanently eliminate evidence of damage.

END OF SECTION 09 51 13

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SECTION 09 65 13 - RESILIENT BASE AND ACCESSORIES

PART 1 – GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

- A. Section Includes:

- 1. Thermoset-rubber base.
- 2. Thermoplastic-rubber base.
- 3. Vinyl base.
- 4. Rubber stair accessories.
- 5. Vinyl stair accessories.
- 6. Rubber molding accessories.
- 7. Vinyl molding accessories.

- B. Related Requirements:

- 1. Section 09 05 60 “Common Work Results for Flooring Preparation.”

1.3 ACTION SUBMITTALS

- A. Product Data: For each type of product.
- B. Samples for Initial Selection: For each type of product indicated.
- C. Samples for Verification: For each type of product indicated and for each color, texture, and pattern required in manufacturer's standard-size Samples, but not less than 12 inches long.
- D. Product Schedule: For resilient base and accessory products. Use same designations indicated on Drawings.

1.4 INFORMATIONAL SUBMITTALS

1.5 MAINTENANCE MATERIAL SUBMITTALS

- A. Furnish extra materials, from the same product run, that match products installed and that are packaged with protective covering for storage and identified with labels describing contents.
 - 1. Furnish not less than 10 linear feet for every 500 linear feet or fraction thereof, of each type, color, pattern, and size of resilient product installed.

1.6 DELIVERY, STORAGE, AND HANDLING

- A. Store resilient products and installation materials in dry spaces protected from the weather, with ambient temperatures maintained within range recommended by manufacturer, but not less than 50 deg F or more than 90 deg F.

1.7 FIELD CONDITIONS

- A. Maintain ambient temperatures within range recommended by manufacturer, but not less than 70 deg F or more than 95 deg F, in spaces to receive resilient products during the following periods:
 - 1. 48 hours before installation.
 - 2. During installation.
 - 3. 48 hours after installation.
- B. After installation and until Substantial Completion, maintain ambient temperatures within range recommended by manufacturer, but not less than 55 deg F or more than 95 deg F.
- C. Install resilient products after other finishing operations, including painting, have been completed.

PART 2 – PRODUCTS

2.1 SUSTAINABLE DESIGN MATERIAL REQUIREMENTS

- A. Materials shall comply with the requirements of Section 01 81 13 "Sustainable Design Requirements."

2.2 VINYL BASE

- A. Basis-of-Design: Subject to compliance with requirements, provide products indicated on Drawings or a comparable product approved by Architect/Interior Designer by one of the following:
 - 1. Burke.
 - 2. Flexco.
 - 3. Johnsonite.
 - 4. Mannington.
 - 5. Roppe.
 - 6. VPI.
- B. Product Standard: ASTM F 1861, Type TV (vinyl, thermoplastic).
 - 1. Group: I (solid, homogeneous).
 - 2. Style and Location: As indicated on Drawings.
- C. Minimum Thickness: 0.125 inch.
- D. Height: As indicated on Drawings.
- E. Lengths: Coils in manufacturer's standard length.
- F. Outside Corners: Match Existing
- G. Inside Corners: Match Existing

- B. Colors and Patterns: As indicated on Drawings. All Colors and Patterns to match existing

2.3 INSTALLATION MATERIALS

- A. Trowelable Leveling and Patching Compounds: Latex-modified, portland-cement-based or blended hydraulic-cement-based formulation provided or approved by resilient-product manufacturer for applications indicated.
- B. Adhesives: Water-resistant type recommended by resilient-product manufacturer for resilient products and substrate conditions indicated.
- C. Floor Polish: Provide protective, liquid floor-polish products only if recommended by resilient stair-tread manufacturer.

PART 3 – EXECUTION

3.1 EXAMINATION

- A. Examine substrates, with Installer present, for compliance with requirements for maximum moisture content and other conditions affecting performance of the Work.
 - 1. Verify that finishes of substrates comply with tolerances and other requirements specified in other Sections and that substrates are free of cracks, ridges, depressions, scale, and foreign deposits that might interfere with adhesion of resilient products.
- B. Proceed with installation only after unsatisfactory conditions have been corrected.
 - 1. Installation of resilient products indicates acceptance of surfaces and conditions.

3.2 PREPARATION

- A. Prepare substrates according to manufacturer's written instructions to ensure adhesion of resilient products.
- B. Concrete Substrates for Resilient Stair Accessories: Refer to Section 09 05 60 "Common Work Results for Flooring Preparation."
- C. Fill cracks, holes, and depressions in substrates with trowelable leveling and patching compound; remove bumps and ridges to produce a uniform and smooth substrate.
- D. Do not install resilient products until materials are the same temperature as space where they are to be installed.
 - 1. At least 48 hours in advance of installation, move resilient products and installation materials into spaces where they will be installed.
- E. Immediately before installation, sweep and vacuum clean substrates to be covered by resilient products.

3.3 RESILIENT BASE INSTALLATION

- A. Comply with manufacturer's written instructions for installing resilient base.

- B. Apply resilient base to walls, columns, pilasters, casework and cabinets in toe spaces, and other permanent fixtures in rooms and areas where base is required.
- C. Install resilient base in lengths as long as practical without gaps at seams and with tops of adjacent pieces aligned.
- D. Tightly adhere resilient base to substrate throughout length of each piece, with base in continuous contact with horizontal and vertical substrates.
- E. Do not stretch resilient base during installation.

3.4 CLEANING AND PROTECTION

- A. Comply with manufacturer's written instructions for cleaning and protecting resilient products.
- B. Perform the following operations immediately after completing resilient-product installation:
 - 1. Remove adhesive and other blemishes from surfaces.
- C. Protect resilient products from mars, marks, indentations, and other damage from construction operations and placement of equipment and fixtures during remainder of construction period.
 - 1. Apply two coat(s) minimum or as recommended by Manufacturer.
- D. Cover resilient products subject to wear and foot traffic until Substantial Completion.

END OF SECTION 09 65 13

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PART 1 – GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

1.3 ACTION SUBMITTALS

- A. Product Data: For each type of product. Include preparation requirements and application instructions.
 - 1. Indicate VOC content.
 - 2. Submit Samples on rigid backing, 8 inches square.
 - 3. Label each coat of each Sample.
 - 4. Label each Sample for location and application area.

1.4 MAINTENANCE MATERIAL SUBMITTALS

- A. Furnish extra materials, from the same product run, that match products installed and that are packaged with protective covering for storage and identified with labels describing contents.

1.5 QUALITY ASSURANCE

- A. Single-source responsibility: materials selected for each coating system and type of surface shall be the product of a single manufacturer and shall be of the type recommended by that manufacturer for the particular application.

1.6 DELIVERY, STORAGE, AND HANDLING

- A. Delivery:
 - 1. Deliver all paint materials to the job site in their original unopened containers with all labels intact and legible at time of use.
- B. Storage and Handling:
 - 1. Store materials not in use in tightly covered containers in well-ventilated areas with ambient temperatures continuously maintained at not less than 45 deg F.
 - a. Maintain containers in clean condition, free of foreign materials and residue.
 - b. Remove rags and waste from storage areas daily.
 - 2. Store only the approved materials at the job site and store only in a single designated area restricted to the storage of paint materials and related equipment.
 - 3. All paints, varnishes, and volatile oil shall be stored in accordance with health, safety, and fire regulations.

4. "No Smoking" signs and covered waste receptacles shall be provided in the area.
5. Floor of storage area shall be covered and protected from spilled material.
6. Provide metal lockers for storage and provide two listed 2A:20BC rated multi-purpose dry chemical or a 10BC rated CO² fire extinguisher mounted in the immediate area.
7. Use all means necessary to protect paint materials before, during, and after application and to protect the installed Work and materials of all other trades.
8. Use fire-retardant treated drop cloths where flammable products are in use.

1.7 FIELD CONDITIONS

- A. Do not clean, prepare or paint surfaces on which condensation is evident or when environmental conditions may cause condensation to form on surfaces during finishing operations.
- B. Maintain temperature and humidity levels during finishing work at a level to prevent condensation.
- C. Apply paints and finish product within the temperature range and relative humidity acceptable to the manufacturer of the product, as listed on the product label or product data sheet.

PART 2 - PRODUCTS

Paint, general **General:**

1. Provide primer and topcoat listed by the manufacturer as compatible with the substrate indicated.
 - a. Where conflict arises between manufacturer's printed application recommendation and scheduled product listing, the manufacturer's recommendations shall prevail, maintaining carrier type and gloss level indicated.
2. Prime walls scheduled to receive wallcoverings, using primer indicated on painting schedule for substrate, unless noted otherwise.

Color standard:

1. Colors shall match existing walls, basis of design.

1.8 MANUFACTURERS

- A. Basis-of-Design Products: Subject to compliance with requirements, provide products by The Sherwin Williams Company and as listed in the Interior Painting Schedule for the paint category indicated.
- B. Manufacturers: Furnish materials from one of the following manufacturers, unless otherwise indicated:
 1. Benjamin Moore Paint. (BM)
 2. PPG Paints. (PPG)
 3. The Sherwin Williams Company. (S-W)

1.9 PAINT, GENERAL

B. General:

1. There is no attempt to define the physical properties and composition of the painting materials. Furnished product shall be the manufacturer's equivalent to those specified.
2. Provide primer and topcoat listed by the manufacturer as compatible with the substrate indicated.

- a. Where conflict arises between manufacturer's printed application recommendation and scheduled product listing, the manufacturer's recommendations shall prevail, maintaining carrier type and gloss level indicated.
 3. Prime walls scheduled to receive wallcoverings, using primer indicated on Painting Schedule for substrate, unless noted otherwise.
 4. The use of paint manufacturer names indicated on Drawings are for color selection purposes only and do not necessarily indicate selection of a particular manufacturer's products.
- A. Material Compatibility:

SYSTEMS COULD FAIL IF PAINTS USED FOR INDIVIDUAL COATS ARE INCOMPATIBLE.

1. Materials for use within each paint system shall be compatible with one another and substrates indicated, under conditions of service and application as demonstrated by manufacturer, based on testing and field experience.
2. For each coat in a paint system, products shall be recommended in writing by topcoat manufacturers for use in paint system and on substrate indicated.

1.10 PRIMING

- A. Spot prime all exposed nails and other metals that are to be painted with emulsion paints using a primer recommended by the manufacturer of the coating systems.
- B. Primer is not required at new gypsum drywall that has received primer/surfer, unless required by manufacturer of finish coating.
- C. Masonry substrates: remove efflorescence and chalk. Do not paint surfaces if moisture content or alkalinity of surfaces or mortar joints exceeds that permitted in manufacturer's written instructions.
1. Preparation of gypsum drywall ensure that dirt, dust, and other foreign matter have been removed. Ensure that all apparent deposits of spackling compound have been removed, taking care not to damage the paper cover of the gypsum drywall.
 2. Spackle and lightly sandpaper scuffs, scratches, and nicks.

1.11 PREPARATION OF GYPSUM DRYWALL AND PLASTER

- A. Coordination:
1. Ensure that dirt, dust, and other foreign matter have been removed. Ensure that all apparent deposits of spackling compound have been removed, taking care not to damage the paper cover of the gypsum drywall.
 2. Spackle and lightly sandpaper scuffs, scratches, and nicks.

1.12 FINISH APPLICATION

- A. General:

1. Paint all surfaces, except glass and similar items not finished and not called out as unfinished.
 - a. Operating Parts: Do not paint moving parts of operating units, mechanical and electrical parts, such as valve and damper operators, linkages, sinkages, sensing devices, motor and fan shafts, and sprinkler heads, unless otherwise specified.
 2. Paint all grilles and other pre-finished items where the factory finish is not in accordance with the "Painting Schedule" and color selection.
 3. Allow 48 hours drying time before recoating. Modify the periods as recommended by the material manufacturer to suit adverse weather conditions.
 4. Suction and hot spots shall be touched up after first coat has been applied.
 5. Where preceding coat is not completely covered by finish coat or does not adequately hide underlying finishes or marks, apply additional coats at no additional cost to the Owner.
 6. Finish coats shall be smooth and uniform, completely hiding undercoats.
 7. Edges adjoining different colors or materials shall be sharp and clean with no overlap.
 8. Touch-up or repainting of surfaces shall cover entire item, frame, or wall area. "Spot" touch-up work will not be permitted.
 9. Paint surfaces behind movable equipment and furniture same as similar exposed surfaces. Before final installation, paint surfaces behind permanently fixed equipment or furniture with prime coat only.
 10. Paint front and backsides of access panels, removable or hinged covers, and similar hinged items to match exposed surfaces.
 11. Do not paint over labels of independent testing agencies or equipment name, identification, performance rating, or nomenclature plates.
 12. Primers specified in painting schedules may be omitted on items that are factory primed or factory finished if acceptable to topcoat manufacturers.
 13. The Contractor shall use the primer best suited for the paint products schedule under Part 2 of this section, and for compatibility with the substrate.
- B. Environmental Conditions:
1. Do not apply paint in areas where dust is being generated.
 2. Turpentine shall not be used in closed areas.
 3. Temperature shall be maintained above 50°F at all times.
- C. Defects:
1. Repair or fill defects between coats with appropriate fill material.
 2. Sand and dust between coats to remove all defects visible to the unaided eye from a distance of five feet.
- D. Identification of fire-rated construction and smoke-barrier walls:
1. Where fire-rated wall construction or smoke barrier walls are indicated on the Plans, paint wall rating a minimum of 6-inches above the ceiling line on each side of the wall.
 2. Lettering shall be stencil applied, all capitals, level, and at a uniform height on each wall.
 3. Letter height: 3-inches, minimum
 4. Color: Black on light colored substrates, white or red on dark colored substrates.
 5. Spacing: one label every 10 feet, maximum. Not less than one label per wall section, except at offsets less than 6 feet long.
 6. Text: indicate hour rating and rating type.
 - a. Example: 2-HR. FIRE
 - b. Example: 1-HR FIRE AND SMOKE

- E. Identification of exterior wall construction with exterior applied air/moisture/vapor barrier:
1. Where exterior wall construction with applied air/moisture/vapor retarder is indicated, paint wall notice a minimum of 6-inches above the ceiling line on the interior side of the wall in each room.
 2. Lettering shall be stencil applied, all capitals, level, and at a uniform height on each wall.
 3. Letter height: 2-inches, minimum
 4. Color: Black on light colored substrates, white or red on dark colored substrates.
 5. Spacing: one label every 20 feet, maximum. Not less than one label per wall section, except at offsets less than 6 feet long.
 6. Text:

“AIR/MOISTURE/VAPOR BARRIER ON EXTERIOR
COMPLETELY SEAL SHEATHING PENETRATIONS”

1.13 CLEANING AND PROTECTION

- C. General: Prevent accidental spilling of paint materials, In the event of such spill, immediately remove all spilled material and the waste or other equipment used to clean up the spill, and wash the surface to its original undamaged condition, at no additional cost to the Owner
- A. At end of each workday, remove rubbish, empty cans, rags, and other discarded materials from Project site.
1. After completing paint application, clean spattered surfaces. Remove spattered paints by washing, scraping, or other methods. Do not scratch or damage adjacent finished surfaces.
 2. Protect work of other trades against damage from paint application. Correct damage to work of other trades by cleaning, repairing, replacing, and refinishing, as approved by Architect/Engineer, and leave in an undamaged condition.
 3. At completion of construction activities of other trades, touch up and restore damaged or defaced painted surfaces.
 4. Prior to final inspection and upon completion of this portion of the work, visually inspect all surfaces and remove all paint and traces of paint from surfaces not scheduled to be painted.

END OF SECTION 09 91 23

SECTION 230100 - HVAC GENERAL

PART 1 - GENERAL REQUIREMENTS

1.1 DEFINITIONS

- A. Piping: Pipe, fittings, flanges, valves, controls, hangers, supports, traps, drains, gauges, insulation, vents, and items customarily required in connection with the transfer of fluids.
- B. Ductwork: All air distribution, re-circulation, and exhaust ducts, whether of sheet metal or other material, and includes all connections, hanger, supports, damper controls, insulation, accessories, fire and smoke control devices, and appurtenances necessary for and incidental to a complete system.
- C. Provide: Furnish and install complete ready for use.
- D. Furnish: Purchase and deliver to the project site complete with every necessary appurtenance and for installation.
- E. Install: Unload at the delivery point and perform every operation necessary to establish secure mounting and correct operation at the proper location in the project.
- F. Concealed: Embedded in masonry or other construction, installed behind wall furring, above ceilings, in crawl spaces, in shafts or otherwise not visible.
- G. Exposed: Not concealed.
- H. By other Trades: Shall mean by persons or parties who are not anticipated to be the Subcontractor for this trade working together with the Prime Contractor. In this context the words "by other trades" shall be interpreted to mean not included in the overall contract.
- I. Contractor: As used in this Division of the specification refers to the Mechanical Contractor unless specifically noted otherwise.

1.2 INTERPRETATION OF CONTRACT DOCUMENTS

- A. This section of the specifications and related drawings describe general provisions applicable to every section of Division 23.
- B. Attention is directed to General Conditions, which is binding in its entirety, on this portion of the work and in particular to paragraphs concerning materials, workmanship, and substitutions.
- C. Mention in these specifications, indications, and reasonable implications on drawings, whereby articles, materials, operation or methods related to execution of the mechanical work are noted, specified, drawing or described, thereby requires execution of each such item of work and provision of all labor, materials, equipment and appurtenances required for execution thereof.

- D. Particular attention is directed to the drawings and other contract documents for information pertaining to required items or work which are related to and usually associated with the work of this Division of the specifications, but which are to be provided as part of the work of other Divisions of the specifications.
- E. No exclusions from, or limitations in, the language used in the drawings or specifications shall be interpreted as meaning that the appurtenance or accessories necessary to complete any required system or item of equipment are to be omitted.
- F. The drawings of necessity utilize symbols and schematic diagrams to indicate various items of work. Neither of these have any dimensional significance nor do they delineate every item required for the intended installations. The work shall be installed, in accordance with the intent diagrammatically expressed on the drawings, and in conformity with the dimensions indicated on final architectural and structural working drawings and on equipment shop drawings. No interpretation shall be made from the limitations of symbols and diagrams that any elements necessary for complete work are excluded. When abbreviations appear on the drawings or specification in lower case letter with or without periods, their meanings shall be the same as stated above.
- G. Certain details appear on the drawings which are specific with regard to the dimensioning and positioning of the work. These details are intended only for the purpose of establishing general feasibility. They do not obviate field coordination for the indicated work.
- H. Information as to the general construction shall be derived from structural and architectural drawings and specifications only.
- I. The use of words in the singular shall be considered as limited where other indications denote that more than one item is referred to.
- J. Submission of a proposal and ultimate acceptance of an agreement or contract for execution of this section of work will be construed as evidence that the Prime Contractor, Subcontractor and Vendor has carefully read and accepts all conditions set forth in each division. Insofar as such conditions may affect both the bidding for and execution of this section of work.
- K. Where compliance with drawings or specifications is in apparent conflict with the applicable building codes or applicable UL listings then contractor shall contact the engineer of record. Generally building codes and UL compliance will take precedence over the specifications and drawings.

1.3 QUALITY ASSURANCE AND WARRANTY

- A. The Contractor shall guarantee all work, materials and equipment furnished against defects, leaks, performance, and non-operation for a period of one (1) year after the date of the Owner's final acceptance, or as indicated in the General Conditions. Warranties to extend past this date are defined in individual equipment specification sections. Defects shall be interpreted as defective materials or equipment or unsatisfactory installation and are not intended to apply to ordinary wear and tear. The Contractor shall pay for any repairs or replacements caused by these defects within the period covered by the guarantee, including all incidental work required to correct the deficiency.

- B. All equipment and materials required for installation under these specifications shall be new and without blemish or defect. All equipment shall bear labels attesting to Underwriters Laboratories approval where subject to Underwriters Laboratories label service. Where no specific indication as to the type or quality of material or equipment is indicated, a first-class standard article shall be furnished. All manufacturers of equipment and materials pertinent to these items shall have been engaged in the manufacturers of said equipment a minimum of three (3) years and, if directed by the Designer, be able to furnish proof of their ability to deliver this equipment by submitting affidavits supporting their claim.
- C. Each major component of equipment shall have the manufacturer's name, address, model number and rating on a plate securely affixed in a conspicuous place. The nameplate of a distributing agent will not be acceptable. UL or other label, or other data which is die-stamped into the surface of the equipment shall be stamped in a location easily visible. Performance as delineated in schedules and in the specifications shall be interpreted as minimum performance.
- D. All equipment of one type (such as fans, pumps, valves, grilles, etc.) shall be the products of one manufacturer unless specifically stated otherwise.
- E. Where the specifications do not list a specific model number for a manufacturer, the construction of a product shall be equal to those models specifically listed.
- F. All welders shall be certified by the National Certified Pipe Welding Bureau for the appropriate service and shall perform all welding in accordance with Welding Bureau's procedures and the ASA Code for pipe welding. Welding and welder qualifications shall be in accordance with ASME Section IX.

1.4 REQUIREMENTS OF REGULATORY AGENCIES

- A. Contractors shall submit to the appropriate Regulatory Agencies all items necessary to obtain all required permits obtain such required permits and pay all required fees.
- B. All work shall conform to the following Standards and Codes (applicable edition):
 - 1. North Carolina State Building Code.
 - 2. National Fire Protection Association.
 - 3. Uniform Boiler and Pressure Vessel Act of N.C. (Boiler Code).
- C. Where applicable, all fixtures, equipment, and materials shall be as approved or listed by the following:
 - 1. Factory Mutual Laboratories (FM).
 - 2. Underwriters Laboratories, Inc. (UL).
 - 3. CSA.
 - 4. ETL.
 - 5. AGA.
 - 6. AWWA.
- D. All fuel fired equipment shall meet the requirements of the agencies listed and also meet the Owner's insurer requirements.

1.5 STANDARDS AND PROCEDURES

- A. ADC: Air Diffusion Council.
- B. AMCA: Air Moving and Conditioning Association, Inc.
- C. ANSI: American National Standards Institute.
- D. API: American Petroleum Institute.
- E. ARI: American Refrigeration Institute.
- F. ASHRAE: American Society of Heating, Refrigeration and Air Conditioning Engineers.
- G. ASME: American Society of Mechanical Engineers.
- H. ASTM: American Society of Testing and Materials.
- I. IBR: Institute of Boiler and Radiator Manufacturers.
- J. MSS: Manufacturers Standardization Society.
- K. NEMA: National Electrical Manufacturer's Association.
- L. OSHA: Occupational Safety and Health Administration.
- M. SMACNA: Sheet Metal and Air Conditioning Contractors National Association, Inc.
 - 1. Where reference is made to ASA Standards it shall be understood that this reference is to the standards published by ANSI.
 - 2. Include all items of labor and materials required to comply with such standards and codes. Where quantity, sizes or other requirements indicated on the drawings or herein specified are in excess of the standard or code requirements, the specifications or drawings, respectively, shall govern.

1.6 EQUIVALENT PRODUCTS

- A. Notwithstanding any reference in the specifications to any article, device, product, materials, fixture, form or type of construction by name, make, or catalog number, such references shall be interpreted as establishing a standard of quality and shall not be construed as limiting competition and the Contractor, in such cases may, at his option, use any article, device, product, material, fixture, form or type of construction which, in the judgment of the Designer, expressed in writing, is equal to that specified.
- B. Requests for written approval to substitute materials or equipment considered by the contractor as equal to those specified shall be submitted for approval, to the Engineer, in accordance with SUBSTITUTIONS section.

1.7 VERIFICATION OF DIMENSIONS AND LOCATIONS

- A. The Contractor shall visit the premises and thoroughly familiarize himself with all details of the work, working conditions, verify all dimensions in the field, advise the Designer of any discrepancy, and submit shop drawings of any changes he proposes to make, in quadruplicate for approval, before starting the work. Contractor shall install all equipment in a manner to avoid building interference.
- B. The location of duct, pipe, fixture, equipment, and appurtenances for existing facilities are shown on plans to indicate the extent of work required. Exact condition shall be field verified.

1.8 COORDINATION WITH OTHER TRADES

- A. Coordinate all work of each section with work of other sections to avoid interference. Bidders are cautioned to check their equipment against space available as indicated on drawings and shall make sure that proposed equipment can be accommodated. If interferences occur and clearances cannot be maintained as recommended by manufacturer and as required for maintenance and inspection of equipment, Contractor shall bring them to the attention of Designer, in writing, prior to signing of contract; or Contractor shall, at his own expense, provide proper materials, equipment, and labor to correct any damage due to defects in his work caused by such interferences.
- B. Prepare composite coordination drawings at a scale of $\frac{1}{4}" = 1'-0"$ or larger, detailing major elements, components, and systems of mechanical equipment and materials in relationship with other systems, installations, and building components (For all floor levels including all mechanical areas, penthouses, and roof plans. Indicate locations where space is limited for installation and access and where sequencing and coordination of installations are of importance to the efficient flow of the work. The Mechanical Contractor will administer the effort of coordination between various trades. The coordination drawings will be prepared and reviewed approved by Engineer of Record and CxA before installation of any plumbing, sprinkler, mechanical or electrical work and will be shown as a task on the Project Schedule to be prepared by the General Contractor.

1.9 WORKMANSHIP

- A. Workmen to be thoroughly experienced and fully capable of installing assigned work. Work to be in accordance with the best standard practice of the trade. Work that is not of good quality will require removal and reinstallation at no additional expense to Owner and as approved.
- B. All material and equipment to be installed in accordance with manufacturer's printed recommendations (using recommended accessories) and/or as approved by the Designer. Retain a copy on job site and submit others for approval when required.

PART 2 - PRODUCTS

This Part Not Used.

PART 3 - EXECUTION

3.1 SURFACE CONDITIONS

A. Inspection:

1. Prior to any work, the Contractor shall carefully inspect the installed Work of all other Trades and verify that all such Work is complete to the point where his installation may properly commence.
2. Verify that all equipment may be installed in accordance with all pertinent codes and regulations, the original design, and the referenced standards.

3.2 INSTALLATION

- A.** Install all equipment and appurtenances in strict accordance with the manufacturer's recommendations.

3.3 FUNCTIONAL TESTING REQUIREMENTS

- A.** This project will require functional testing support from the contractor to assist the Engineer in verifying control sequences and test and balance data. Include minimum of 5 days for controls technician and test and balance technician support. Additional support required beyond this time shall be at no additional cost.

3.4 REQUIREMENTS FOR OPERATING HVAC EQUIPMENT DURING CONSTRUCTION

- A.** Building must be fully enclosed, including installation of all doors, windows, etc.
- B.** Set air handler to use 100% outside if construction is still generating dust and when conditions will not allow the coil to freeze.
- C.** If return air is to be used then all exhaust and return ducts/grilles shall be covered with temporary filter media, minimum MERV 8, to prevent dust infiltration into the ducting.
- D.** All chilled water piping shall be insulated.
- E.** Pump and fans shafts shall be aligned prior to operation. Laser alignment shall be provided for pumps, and reports shall be furnished prior to operation.
- F.** Supply and outside air connections of ductwork to AHUs shall be complete.
- G.** All manual dampers, fire dampers and combination fire/smoke dampers shall be open.
- H.** All main supply ductwork shall be insulated.
- I.** All safety circuits and basic control functions shall be active and fully functional. If the equipment may operate without a fully functional BAS, then means to prevent damage to ducting due to closed dampers and means to prevent damage to freezing coils shall be provided. Blow-out doors may be used to protect ducting. Until TAB activities commence, fans and pumps shall operate at no more than 70% of estimated design capacity.

- J. Conditioning (cooling & dehumidifying) of the building shall remain once started.
- K. Final approval of Engineer and Owner are required prior to starting AHUs for temporary operation.
- L. Cover outside air intakes with 1" roll filter media.
- M. The contractor shall perform all required preventative maintenance on mechanical equipment operated during construction and provide documentation in the operation and maintenance manuals of preventative maintenance activities completed during this period.
- N. At the end of the construction period and prior to occupancy, clean the inside of AHUs and if more than 50% loaded, then install new pre and final filters.
- O. AHU UV lights shall be operational, and all specified filters installed during all AHU operation.

3.5 PROTECTION AND CLEANING OF SYSTEMS AND EQUIPMENT

- A. Protect all materials and equipment from damage during storage at the Site and throughout the construction period. In the event of damage prior to final inspections, the Contractor shall repair or replace damaged items as determined by the Architect/Engineer, at no cost to the Owner.
- B. Damage from rain, dirt, sun, and ground water shall be prevented by storing the equipment on elevated supports and covering them on all sides with securely fastened protective rigid or flexible waterproof coverings.
- C. Piping shall be protected by storing it on elevated supports and capping the ends with suitable closure material to prevent dirt accumulation in the piping.
- D. During construction cap the top of all ductwork and piping installed vertically.
- E. Periodically during construction and prior to Owner acceptance of the building, Contractor shall remove from the premises and dispose of all packing material and debris. All adjacent occupied areas shall be cleaned daily to remove dirt and debris resulting from this work.

3.6 WELDING AND PIPING PRESSURE TESTS

- A. All welded piping shall be installed by Contractor using NCPWB or ASME Certified Welding Procedures. Welding shall comply with ANSI/ASME B31.1 and Section IX of the ASME Boiler and Pressure Code.
- B. All piping shall be hydrostatically tested for pressure of 1-1/2 times the working pressure of the line, but not less than 150 psig. This hydrostatic test shall be witnessed by the Designer.
- C. Ten days before any welded work is to start, the Contractor shall furnish the Designer copies of the welding procedures approved for the Contractor.
- D. Before any welder is put to work in welding any piping for this job, the Designer shall be furnished with duplicate copies of the certification of each welder. If, in the opinion of the

Designer, the welding is not done properly, a coupon shall be cut from field welds for inspection and/or the welder may be required to pass a recertification test. Costs of cutting the coupon shall be the responsibility of the Contractor. Also, all welds shall be subject to non-destructive x-ray examination by Owner. Contractor will be responsible for all costs of non-destructive x-ray examination, including all remedial repair work and retesting of welding that is determined to be unsatisfactory.

- E. No welding is to be covered with insulation or concealed until the welding has been approved by the Designer as outlined above.
- F. All welding operations shall be approved by the Designer prior to beginning work. Extreme care shall be exercised to prevent damage to the existing buildings or building or surrounding contents during welding operations.
- G. During welding of all piping, contractor shall use fire resistant or equal pad protection to prevent scorching or burning of existing floor and wall finishes, etc. Also, care shall be taken to eliminate sparks from dropping on existing furniture, equipment, and flooring material. All damages created by welding flame or sparks shall be repaired to owner's satisfaction at contractor's expense.
- H. All welding shall be done in such a manner as to prevent welding fumes to enter other areas of the building and shall be coordinated with the owner to assure that it does not interfere with normal building operations while the building is occupied.

3.7 SUBSTITUTION OF EQUIPMENT

- A. Requests for substitutions of products may be made during the bidding period by submitting completed substitution request accompanied by information sufficient for the Engineer to make a determination as to the equivalency of a product.
- B. The Engineer will consider requests utilizing this section for substitution of products in place of those specified.
- C. Submit 14 calendar days prior to Bid Date. No substitutions will be reviewed or accepted after this date unless there is an obvious advantage to the Owner.
- D. Substitution requests may be submitted by U.S. Postal Service.
- E. Prime Bidders shall request a substitution on the letterhead stationery of the Prime Bidder submitting the request. Requests from individual manufacturers will not be accepted.
- F. Submit separate request for each substitution. Support each request with the following information. All items must be addressed.
- G. Complete data substantiating compliance of proposed substitutions with requirements stated in Contract Documents:
 - 1. Product identification, including manufacturer's name and address.
 - 2. Manufacturer's literature, identifying:

- a. Product description
 - b. Reference standards.
 - c. Performance and test data.
 3. Name and address of similar projects on which product has been used and date of each installation.
 4. Itemized comparison of the proposed substitution with product specified, listing significant variations.
 5. Data relating to changes in construction schedule, if any.
 6. All effects of substitution on separate contracts.
 7. List of changes required in other work or products.
 8. Designation of availability of maintenance services and sources of replacement parts.
- H. Substitutions will not be considered for acceptance when:
1. Acceptance will require substantial revision of Contract Documents.
 2. In judgment of Engineer, substitution request does not include adequate information for a complete evaluation.
 3. Requests for substitutions not submitted by a Prime Bidder.
 4. Where the effect on the schedule will be negative.
- I. In making formal request for substitution, the Prime Bidder represents that:
1. The Prime Bidder has investigated proposed product and has determined that it is equivalent to or superior in all respects to that specified.
 2. The Prime Bidder will provide the same warranties or bonds for substitution as for product specified.
 3. The Prime Bidder will coordinate installation of accepted substitution into the Work and will make such changes as may be required for the Work to be complete in all respects.

3.8 SUBMITTALS

- A. Refer to Division 1, as available, for information on submittal requirements. When conflicts exist, Division 1 shall apply.
- B. The terms "Submittals" can generally be used to indicate any information which is required to be reviewed by the A/E before further action on that product can be taken by the Contractor. This may include product data sheets, shop drawings, and schedules.
- C. Submittals generally not required when equipment is purchased exactly as specified and scheduled. Submit list of such equipment only. Equipment data sheets must be included in project manual prepared for Owner.
- D. Submittals shall be searchable format, preferably pdf.

3.9 PRODUCT SUBMITTALS

- A. The following product data information shall be submitted:

Section	Title
230100	MECHANICAL GENERAL
230200	MECHANICAL RELATED WORK
230300	ELECTRICAL WORK FOR MECHANICAL SYSTEMS
230500	FIRESTOPPING AND WATERPROOFING
230510	GAGES AND METERS
230513	ADJUSTABLE FREQUENCY DRIVES
230529	SUPPORTS AND ANCHORS
230548	VIBRATION ISOLATION AND SEISMIC RESTRAINTS
230553	MECHANICAL IDENTIFICATION
230593	TESTING, ADJUSTING, AND BALANCING
230700	INSULATION
230013	INSTRUMENTATION AND CONTROL DEVICES
230923	BUILDING AUTOMATION SYSTEM
230900	BUILDING AUTOMATION SYSTEM
230910	BAS FIELD DEVICES
230920	BAS COMMUNICATION AND WIRING
230930	BAS I&C DEVICES FOR HVAC
230940	BAS SOFTWARE AND GRAPHICAL USER INTERFACE
230950	BAS ALARMING AND REPORTING
230960	BAS POINT STRUCTURING AND NAMING
230970	BAS TRENDING
230990	BAS FAULT DETECTION / DIAGNOSTICS AND UTILITY ANALYSIS
232113	HYDRONIC PIPING
232116	HYDRONIC SPECIALTIES
232123	PUMPS
232213	STEAM AND CONDENSATE PIPING
232216	STEAM AND CONDENSATE SPECIALTIES
232300	REFRIGERANT AND CONDENSATE PIPING AND FITTINGS
232310	PIPING SPECIALTIES – REFRIGERATION
232500	CHEMICAL WATER TREATMENT
233100	DUCTWORK
233300	DUCTWORK ACCESSORIES
233400	POWER VENTILATORS
233600	AIR TERMINAL UNITS
233700	AIR OUTLETS AND INLETS
235234	CONDENSING BOILERS
235235	VERTICAL TUBELESS STEAM BOILERS
236412	WATER COOLED CHILLER
236413	CHILLER EQUIPMENT ROOM
236500	INDUCED DRAFT COOLING TOWERS
236510	CENTRIFUGAL SOLID SEPARATOR
237300	MODULAR AIR HANDLING UNITS
237313	MEDIUM PRESSURE CUSTOM AIR HANDLING
238113	TERMINAL HEAT TRANSFER UNITS
238123	COMPUTER ROOM AIR CONDITIONING UNITS
238126	SPLIT SYSTEM UNITS

3.10 TEST AND REPORT SUBMITTALS

- A. The following list may be used as a checklist for the contractor and A/E. All tests may not be listed:
 - 1. Test:
 - a. Underground and Aboveground HVAC piping
 - b. Duct pressure test.
 - c. System start up.
 - d. Test and Balance Agency Construction Report.
 - e. All required test reports.
 - f. Boiler inspection.
 - g. Gas piping pressure test.
 - h. Required Pressurization Systems.

3.11 FIRE PENETRATION SYSTEMS SUBMITTAL

- A. Each type of system penetrating a fire rated assembly shall be identified by the Contractor. The Contractor shall demonstrate his understanding of fire stop systems by the following.
- B. Submit 3/4-inch scale drawings of each assembly indicating type penetrations, slab, floor, wall or roof system, fire stop materials used, thickness and all other pertinent details. Submittal shall be neatly and accurately drafted.
- C. Each type of system penetrating a fire rated assembly shall be identified by the Contractor. Provide approved installation details with agency approval indicated thereon.

3.12 RECORD DRAWINGS

- A. The Contractor shall keep a record set of drawings on the job and, as construction progresses, shall show the actual installed location of all items, material, and equipment of these job drawings.
- B. At the time of final inspection, two corrected sets of prints and sepias shall be delivered to the Designer. All drawing costs to be paid by the Contractor.
- C. Sepias shall be corrected deleting incorrect locations and showing installed locations in accordance with information transferred from job drawing.
- D. Qualified draftsmen shall perform this task.

3.13 OPERATION AND MAINTENANCE MANUALS

- A. The Contractor shall compile and bind three (3) sets of all manufacturer's instructions and descriptive literature on all items of equipment furnished under this work. An electronic PDF copy of the O&M manuals shall also be provided and shall have searchable text.

- B. The manuals shall comply with specifications in this section in addition to specifications in other mechanical specifications as well.
- C. Binder shall be hard cover, three-ring notebook, 11" x 8-1/2" with heavy duty rings. Maximum binder size shall be 2-1/2".
- D. The front of the binder shall be titled "Mechanical Operating and Maintenance Instructions," with the name of the job and documents date under the title.
- E. Operating and Maintenance Instructions shall include the following:
 - 1. A sheet in each binder listing the architect, engineer, and all contractors. List addresses and phone numbers.
 - 2. List name, address, and phone number of organization responsible for warranty work if other than contractor and the specific work for which he is responsible.
 - 3. List name, address and phone number of the nearest sales and the nearest service organization for each product.
 - 4. Schedules of all equipment indicating identification number shown on plans cross referenced to field applied identification tag number.
 - 5. Performance Curves: For pumps, balance valves and similar equipment at the operating conditions.
 - 6. Lubrication Schedule: Indicating type and frequency of lubrication required.
 - 7. List of Spare Parts: Recommended for normal service requirements. Each piece of equipment shall have this list clearly marked or attached to this submittal.
 - 8. Parts List: Identifying the various parts of the equipment for repair and replacement purposes.
 - 9. Instruction Books: May be standard booklets but shall be clearly marked to indicate applicable equipment and characteristics.
 - 10. Wiring Diagrams: Generalized diagrams are not acceptable; submittal shall be specifically prepared for this Project.
 - 11. Automatic Controls: Diagrams and functional descriptions.
 - 12. Test and Balance Reports.
 - 13. Valve tag list: Identifying valve type, size, service, and general location.
 - 14. Filter schedule: Identifying filter type, size efficiency, manufacturer, and equipment number.
 - 15. Ceiling marker schedule.
- F. The following diagrams, schematics and lists shall be framed under glass and hung adjacent to equipment, in mechanical rooms, or where directed by Owner:
 - 1. Automatic control diagrams.
 - 2. Sequence of operation.
 - 3. Valve Tag List.

3.14 OPERATIONAL AND MAINTENANCE INSTRUCTION

- A. After all final tests and adjustments have been complete, a competent employee of the Contractor shall be provided to instruct the Owner's Representative in all details of operation and maintenance for equipment installed. Supply qualified personnel to operate equipment for sufficient length of time after instructions to assure that Owner's Representative is qualified to

take over operation and maintenance procedures. Instruction periods shall be as designated by the Owner and shall not necessarily be consecutive. Minimum instruction periods shall be as follows:

1. Air handling units, Chilled Water, Hot Water, and Steam Systems (1 working day).
2. Air distribution system and Exhaust Systems (1/2 working day).
3. Split Systems (1/2 working day).

- B. Instruction period shall be performed during the forty-five (45) days following substantial completion at time periods as approved by Owner.

3.15 CONTROLS OPERATION AND MAINTENANCE INSTRUCCION

- A. Upon completion of Operation and Maintenance instructions, competent employees of the Control Contractor shall be provided to instruct the Owner's representative in all details of operation and maintenance for the controls installed. Supply qualified personnel to operate system for sufficient length of time after instructions to assure the Owner's Representative is qualified to take over operation and maintenance procedures.
- B. Controls Operation and Maintenance Instruction shall include the entire control system including control sequences that are inherent to equipment provided by the Equipment Manufacturer including economizer cycles, burner operation, low ambient operation, freezstats and similar sequences. Contractor shall provide sufficient personnel equipment walkie-talkies, gauges, and other accessories for this work.
- C. Instruction periods shall be as designated by the Owner and shall not necessarily be consecutive. Minimum instruction periods shall be one (1) working day for on-site training.
- D. Instructional period shall be performed during the forty-five (45) days following substantial completion at time periods as approved by Owner. One (1) day of instructions shall be in a formal classroom setting as determined by the owner.
- E. Classroom instructions shall be videotaped by the Contractor. A copy of each tape shall be provided to the Owner. Contractor shall be responsible for all equipment, tapes, and accessories required.

3.16 GENERAL COMPLETION AND DEMONSTRATION

- A. Results Expected:
1. All systems and controls shall be complete, tested, and operational.
 2. All start-up and testing and balancing shall be complete.
 3. All equipment shall be thoroughly cleaned. All excess materials and all debris shall be removed from the site.
 4. All walls, floors, ceilings, and other surfaces marred or otherwise damaged as a result of execution of this contract shall be cleaned and repaired to the satisfaction of the Designer and Owner.

END OF SECTION 230100

SECTION 230200 - MECHANICAL RELATED WORK

PART 1 - GENERAL REQUIREMENTS

1.1 DRAWINGS AND SPECIFICATIONS

- A. Provide all materials called for in these specifications and accompanying drawings and provide the apparatus complete in every respect. Anything called for in the specifications and not shown on the drawings or shown on the drawings and not called for in the specifications must be provided.
- B. Where there is a discrepancy between drawings and specifications, the worst case shall be assumed.
- C. Drawings show arrangements of system desired and shall be followed as closely as practical. Because of the small scale of the drawings not all offsets and bends can be shown, and these shall be provided as required, to fully complete the intent of plans. Should conditions and substitutions of equipment necessitate a rearrangement, prepare, and submit for review scaled drawings of such rearrangement, before beginning work.
- D. Verify and check all measurements in the field.
- E. Review architectural, structural, and electrical plans, and cooperate and coordinate work with other trades to the extent that interference shall be avoided. Discrepancies shown on different plans, or between plans and specifications, shall promptly be brought to the attention of the Designer.

1.2 CONCEALMENT OF PIPE AND DUCTS

- A. Chases and Holes: Unless otherwise indicated, all piping and ductwork shall be run in concealed spaces between floor and ceilings or in chases. Ductwork and piping areas without ceilings shall be installed, exposed and as high as practical. This Contractor shall be responsible for the location and size of holes required for pipe, ducts and other equipment and shall advise of chase spaces and holes required as building progresses. Failure to do so shall require this Contractor to provide or cut same.

1.3 CUTTING AND PATCHING

- A. This Contractor must have an experienced Mechanic upon the job before concrete floors, concrete or masonry walls are set in place, whose duty it shall be to locate the exact position of any and all sleeves and holes for the future installation of his pipe or duct work. This Contractor shall locate and size all openings required for his equipment in time to not delay the building construction.
- B. If it becomes necessary to cut holes in concrete floors or concrete or other masonry walls, this Contractor shall call the General Contractor or his superintendent of Construction and inform

him of the position and size of the hole or other opening to be provided and the General Contractor shall determine how this will be done. Under no condition shall this Contractor make any cuts without permission from the General Contractor, nor shall he cut any green floors or walls.

- C. This Contractor shall arrange proper openings in the building to admit his equipment. If it becomes necessary to cut any portion of the building to admit any equipment or install mechanical systems, this Contractor shall be responsible for cutting and patching. The portions cut must be restored to their former condition by this Contractor.
- D. All cutting of structure shall be done using best method to minimize noise and cracking of structure. The method of cutting shall be approved by the Project Expediter (Prime Contractor) before work is started.
- E. All drilled holes required for equipment or supports shall be done by this Contractor. Holes for piping shall be core drilled only.

1.4 EQUIPMENT STANDS, FOUNDATIONS AND MISCELLANEOUS STEEL FOR HANGERS AND SUPPORTS

- A. Provide all equipment stands and supports for equipment as shown or required. Provide miscellaneous steel for hanging piping, ducts or other items of equipment as shown as required.
- B. All concrete foundations, curbs and pads for equipment, ductwork, piping, etc. shall be provided by this Contractor, unless otherwise indicated. Pads shall be provided for all floor standing equipment.
- C. All stands shall be adequately cross braced to provide rigid supporting foundation. All stands shall be adequately anchored to wall or floor as required. All miscellaneous steel shall have one coat of shop paint and two finished coats of rust resistant paint.

1.5 SITE EXAMINATION

- A. Contractor, prior to submitting a bid, shall visit the site and thoroughly acquaint himself with the conditions under which the work will be performed.

1.6 PAINTING

- A. Work to be Painted:
 - 1. All piping, ductwork, conduit, steel supports, hangers, and other mechanical items exposed to view in occupied areas shall be painted under Division 09 by General Contractor.
 - 2. All insulated piping as noted in Section 230700, uninsulated piping, ductwork, supporting steel and hangers for piping, ductwork and equipment (except made of galvanized steel) shall be shop coated with rust proof primer and shall be field painted by Mechanical Contractor except where installed above ceilings or where concealed in building construction. Concealed supports and hangers do not require painting.

3. All exposed insulated and uninsulated piping and ductwork in Mechanical Room shall be painted by Mechanical Contractor with (2) coats of paint.
 4. All areas where cutting and patching are required the mechanical contractor shall paint to match adjacent surfaces.
- B. Work not requiring Painting:
1. Piping and ductwork above solid (lay-in, gypsum board, etc.) ceilings do not require painting.
 2. All exposed items specified to be finished by manufacturer will not be painted. See "Manufacturers' Finished Products".
- C. Manufacturers' Finished Products:
1. All manufacturer finished products, such as water pumps, fans, air handling units, control panels, etc., shall have factory standard finish except where otherwise specified on the drawings or in other sections of this specification.
 2. Contractor providing finished products shall be required to touch up any minor damages or scratches due to shipment, installation, or exposure to weather on all equipment with baked enamel or equivalent finish, Prime coated equipment shall be cleaned and touched up. Large areas of damaged finish shall be painted to match factory painting.
- D. Refer to Division 09 for painting requirements

PART 2 - PRODUCTS

2.1 ROOF CURBS AND EQUIPMENT SUPPORTS

- A. See notes on plans for supports provided by others.
- B. Manufactured Equipment: Furnish all rooftop type manufactured equipment with a prefabricated roof curb designed to support the equipment. The equipment base shall overhang the curb and act as a cap flashing. Where required, curb shall be designed for sloping roof.
- C. Curbs: Curbs shall be prefabricated metal roof curbs constructed using minimum 18 gage thick galvanized steel minimum 14 gage galvanized steel with any side longer than 48", with fully mitered and welded corners, integral base plate with minimum 3/4" exterior flange and unobstructing interior edge, 1 1/2" thick 3 lbs/sq. ft. density rigid interior fiber glass insulation and pressure treated wood nailers.
1. Roof curbs shall have 45-degree cant.
 2. Minimum height of curbs shall be 12" above the finished roof.
 3. Roof curbs shall be constructed to match roof deck slope to create a level top surface.
 4. Roof curbs shall have an internal flange suitable for damper installation, where applicable.
 5. Roof curbs shall have an ABS thermoplastic cap with integral graduated step boots for pipe and round duct penetrations. Include adjustable stainless-steel clamps, 2 per boot. Refer to drawings for pipe sizes and quantities.

- D. Equipment Supports: Supports shall be prefabricated metal curb supports constructed of minimum 1.9 mm (14 gage) thick galvanized steel with fully mitered and welded corners, integral base plate with minimum $\frac{3}{4}$ " flange, pressure treated top wood nailer, and 18 gage thick galvanized steel counterflashing cap.
1. Supports shall be 45-degree cant.
 2. Minimum height shall be 12" above the finished roof.
 3. Supports shall be constructed to match roof deck slope to create a level top surface.

PART 3 - EXECUTION

3.1 FORMWORK

- A. General: Design, construct and maintain formwork to support vertical and lateral loads including pressure of cast-in-place concrete. Construct formwork so that formed concrete will be required size and shape and in required location. Construct with joints which will not leak cement paste. Form side and bottoms of concrete work, except where clearly indicated to be cast directly in excavation or against other construction, or on grade or prepared subgrade. Design and construct forms for easy removal without damage to concrete and other work.
- B. Form Coating: Coat concrete-contact surfaces of forms to be removed. Apply form-coating compound before reinforcement is placed. Apply in accordance with manufacturer's instructions and remove excess compound and spillage.
- C. Deposit concrete continuously or in layers of thickness which will result in no concrete being placed on concrete which has hardened sufficiently to cause formation of seams or planes of weakness within section. If section cannot be placed continuously, provide construction joints. Deposit concrete as nearly as practicable in its final location, so as to avoid segregation due to rehandling or flowing.
- D. Consolidate placed concrete by mechanical vibrating equipment supplemented by hand-spading, rodding, or tamping. Use equipment and procedures complying with recommended practices of ACI 309; eliminate voids in work.
- E. Bring horizontal surfaces to correct level with straightedge and strike off. Use bull floats or darbies to smooth surface, free of humps and hollows.
- F. Cold Weather Placement: Comply with ACI 306. Do not use frozen materials or materials containing ice and snow. Do not place concrete on frozen subgrade or on subgrade containing frozen materials. When air temperature has fallen or is expected to fall below 40 degrees F, heat water and aggregates uniformly before mixing, as required to obtain concrete mixture temperature of not less than 50 degrees F, and not more than 80 degrees F, at time of placement. Protect concrete work from physical damage and reduced strength resulting from frost, freezing actions, or low temperatures.

END OF SECTION 230200

SECTION 230300 - ELECTRICAL WORK FOR MECHANICAL SYSTEMS

PART 1 - GENERAL

1.1 SECTION INCLUDES:

- A. 120V and 24V control Wiring.
- B. Electrical wiring.
- C. Starters and controllers.

1.2 CODES, STANDARDS, AND QUALIFICATIONS

- A. All work shall conform to all sections of the most current North Carolina State Building Codes.
- B. All work shall conform to all North Carolina Department of Administration State Construction Office Guidelines.
- C. Electrical equipment shall be listed and/or labeled by an independent testing agency approved by the State Building Code.
- D. Enclosure for electrical equipment and enclosed switches shall meet NEMA standards.

PART 2 - PRODUCTS

2.1 WIRING

- A. All wiring and conduit shall be in accordance with the requirements of Division 26. This includes wiring requirements from variable frequency drives to equipment motors (refer to VFD cable requirements in Division 26).
- B. Low voltage control wiring shall be not less than #18-gauge copper wire run in metallic conduit.
- C. Low voltage shall be defined as a circuit operating at less than 30 volts and meeting the requirements of NEC Section 720 for Class I, power limited circuits.

2.2 MOTORS

- A. Allowable manufacturers:
 - 1. Baldor Super-E EM/XE (general purpose family) with optional cast iron frame.
 - 2. TECO/Westinghouse ASHH or Max-PE, WEG W22.
 - 3. Toshiba.

- B. Substitutions:
1. Must be pre-approved in compliance with procedures outlined in 23 01 00 Mechanical General Specification.
- C. Motors shall be built in accordance with the latest standards of NEMA and as specified. Motors shall be tested in accordance with standards of ASA C50 and conform thereto for insulation resistance and dielectric strength. Motors shall be provided with conduit terminal box, adequate starting and protective equipment as specified or required. Size shall be sufficient to operate associated driven devices under all conditions of operation and load and without overload, and at least shall be the horsepower indicated or specified. Motors shall be selected for quiet operation.
- D. Motors less than 3/4 HP shall be single phase, PSC/capacitor start-induction run, open type, splashproof. Motors 3/4 HP and larger shall be induction, open 3-phase multi tap unless otherwise indicated. Voltage for 3-phase motors is noted in schedules. Coordinate electrical service requirements with Electrical Contractor.
- E. Motors shall be provided with overload protection. On 3-phase motors overload protection shall be in the starters. Single-phase motors shall have built-in thermal overload protection.
- F. Motors shall be sufficient size for the duty to be performed, not less than that indicated on the drawings, and shall not exceed their full rated load when the driven equipment is operating at specified capacity under the most severe conditions likely to be encountered. All motors shall be for continuous duty classification based on 40 degrees C ambient temperature unless otherwise indicated.
- G. Motors less than 1 HP shall have efficiencies that comply with the current N.C. Building Code. Efficiency shall be determined in accordance with IEEE Standard 112, method B.
- H. Motors 1 HP and larger shall have efficiencies that comply with NEMA Premium Efficiency ratings.
- I. All vertically mounted motors shall be provided with thrust bearings.
- J. Motors shall be open drip proof (ODP) for indoor use where satisfactorily housed, guarded drip proof when exposed to contact by employees or building occupants, TEFC (totally enclosed fan cooled) for outdoor use.
- K. Motors that are specified to cycle on and off automatically under control of a device shall be capable of making starts as frequently as the device may demand. Other motors shall be capable of being started 4 times per hour without damage.
- L. Motors that are to be used with adjustable frequency drives shall be approved by the motor manufacturer for that service.
- M. All 3-phase motors shall be provided with lugs.
- N. Motor Construction: NEMA Standard MG 1, general purpose, continuous duty, Design "B", except "C" where required for high starting torque. Class "B" insulation shall be provided.

1. Frames: NEMA Standard No. 48 or 54; use driven equipment manufacturer's standards to suit specific application.
 2. Nameplate: Indicate the full identification of manufacturer, ratings, characteristics, construction, special features and similar information.
 3. Service Factor: The service factor shall be at least 1.15 for polyphase motors and 1.35 for single phase motors.
 4. Provide solid shaft grounding rings (Aegis SGR or approved equal). Soft carbon brushes and split shaft grounding rings shall not be accepted.
- O. All motors 40 hp and larger not provided with VFD shall be provided with reduced voltage starters.
- P. Provide armored AFD power cables for all motors served by AFD.
- Q. For frames 284 or larger, bearing shall be capable of lubrication. Extend grease lines to an accessible location. For frames 140T-280T, bearings shall be capable of lubrication unless specifically reviewed and approved otherwise with Engineer and Owner.
- R. The opposite shaft end bearing shall be clamped to secure the bearing in the housing. Electrical characteristics and horsepower shall be as specified on the project schedule.
- S. For air handler fan motors, in a direct drive application, motors shall be capable of running continuously from 0 to 120Hz and deliver full rated horsepower at 60 to 120Hz operating frequencies. All motors shall maintain a minimum service factor of 1.15 throughout a 60 to 120HZ operating range. Motors shall conform to a G2.0 balance per NEMA S2.19.

2.3 STARTERS AND CONTROLLERS

- A. Controllers and Control: Where controllers and controls are specified to be provided by the Contractor, they shall conform to the requirements specified below:
1. Controllers shall conform to adopted standards and recommended practices of the Industrial Control Standards of National Electrical Manufacturer's Association and the standard for Industrial Control Equipment of the Underwriters' Laboratories, Inc. Motors 93 W (1/8 hp) or larger and shall be provided with thermal overload protection. Manually reset type. Overload protective device shall be provided, mounted in separate enclosure. Single or double-pole tumbler heavy duty switches may be used as manual controllers for motors of 186 W (1/4 hp) or less in rating. Manual controllers for motors larger than 186 W (1/4 hp) shall be designed for purpose and shall have horsepower rating adequate for motor. Two speed motors shall have 2 winding type controllers unless otherwise specified.
 2. Combination magnetic starter shall be full voltage, across the line type with under-voltage release for manual or automatic operation and shall break all phases on 3 phase starters for motors up to 40 hp. Starters shall be provided with start-stop pushbuttons mounted on cover unless controlled by hand-off-automatic (HOA) device. Hand-off-automatic device shall not be wired to override safety device interlocks on starter and shall be mounted on the starter or if adjacent mounted remotely, provide test start pushbutton on starter. All auxiliary contacts required for interlocking purposes shall be furnished and installed by the Contractor furnishing the starter. All starters not included in motor control centers shall be provided by Division 23.

3. Manual starters shall be provided with a manually operated trip free switch, horsepower rated with a separate fused disconnect.
4. Contractor providing the starters shall be responsible for all motors to be protected with proper size heater or thermal elements. All starters and enclosures shall be NEMA Standard, Type 1 unless otherwise specified. In wet locations, enclosures shall be NEMA 3R.
5. All starters and pushbutton stations shall be provided with labels as specified under identification designating service for which starter is used. Plate shall be firmly attached to starter or wall mounted adjacent to the starter.
6. All cabinets provided for the installation of motor starters, control transformers, relays, and appurtenant items shall be provided with gravity or forced ventilation at the option of the manufacturer. Openings shall be placed at bottom and top of the cabinet or high-low in the door if recessed and of sufficient size to limit the temperature rise through the enclosure or ambient compensated heater elements shall be provided.
7. All controllers and starters shall be rated for the same voltage as the motor which it serves. If the voltage is not indicated on the HVAC drawings, the Contractor shall provide the units at the voltage listed on the electrical drawings.
8. Provide interlocks, pneumatic switches and similar devices as required for coordination with control requirements of Division 23 Controls sections.
9. Provide built-in 120 volts control circuit transformer, fused from line side, where service voltage exceeds 240 volts.
10. Provide externally operated manual reset.
11. Motor connections shall be in waterproofed sealtite flexible conduit, maximum length of 457 mm (18"), except where plug-in electrical cords are specifically indicated.

2.4 SAFETY SWITCHES

- A. All safety switches specified in Division 23 or on mechanical plans shall be heavy-duty type, NEMA 1 for indoor and NEMA 3R for outdoor use unless specifically stated specifically otherwise on plans. They shall be fused type unless specifically indicated otherwise on plans. Fused type shall be equipped with the following: Service Entrance and Feeder Circuits over 600A – Class L, UL Listed, current limiting with 200K interrupting rating; Service Entrance and Feeder Circuits 600A and less – Class RK1 or J, UL Listed, current limiting with 200K interrupting rating; Motor, Motor Controller and Transformer Circuits – Class RK5, UL Listed, current limiting time delay with 200K interrupting rating; and Individual Equipment where fault current does not exceed 50kA – Class K5, UL Listed, with 50K interrupting rating. Fusible safety switches with short circuit withstand rating of 100K or 200K shall include Class R or Class J rejection fuse block feature. Switches shall be equipped with defeatable door interlocks and padlocking provisions in the on and off positions. Padlocks shall be provided for switches located in public areas. Switches shall be by Square D, Cutler-Hammer, General Electric Co., or equivalent by others.
- B. Contractor shall furnish one spare set of fuses for each piece of equipment.
- C. All safety switches, motor starters, or other boxes or panels, designated as NEMA 3R or otherwise intended for outdoor use or use in wet areas, shall use raintight conduit hub fittings with bonding screw.
- D. Control wiring shall not be installed in the same raceways as power wiring.

PART 3 - EXECUTION

3.1 WIRING

- A. Regardless of voltage, furnish and install all temperature control wiring, and all interlock wiring and equipment control wiring for the equipment furnished.
- B. Electrical Contractor will furnish and install all power wiring to line side of starters (see details on plans). The mechanical contractor shall furnish disconnects for equipment. Mechanical contractor shall provide all load side power wiring (see details on plans) and temperature control and interlock wiring. Controllers and controls shall be provided by the Mechanical Contractor.
- C. Check with Electrical Contractor on service outlets provided to determine that service, circuit protection, switches and wiring provided are of adequate size to meet Code requirements for equipment provided. Discrepancies shall be brought to the attention of the Designer before work is installed. Cost for changes not so noted shall be at the expense of this Contractor. Electrical cost increase due to equipment substitution of different electrical characteristics shall be this Contractor's expense.
- D. Provide necessary electrical data for all equipment to the Electrical Contractor for proper coordination.
- E. Control and interlock wiring shall be run in conduit. Conduit shall be minimum 3/4" in size.
- F. Provide control circuit disconnect for all motor starters as required by Section 430-74 of NEC.
- G. Unless otherwise noted or specified, all low voltage and line voltage control and instrumentation wiring and devices for equipment furnished under Division 23 shall be provided as part of this Division 23. Control wiring is considered to be the portion of the wiring which carries the electric signal directing or indicating the performance of a starter, relay, or contactor generally installed between starters, indicators, and remote-control devices. All wiring from indicated or available electrical source in the electrical room and/or mechanical room to direct digital control panels shall be provided as part of this Division.
- H. Examine the drawings, and in cooperation with the Electrical Contractor, confirm the final location of all electrical equipment to be installed in the vicinity of piping. Plan and arrange all overhead piping to be no closer than 24" from the vertical line to electric motor controllers, switchboards, panelboards, or similar equipment. If the vertical line is less than 24", the installation of piping shall be relocated.

END OF SECTION 230300

SECTION 230500 - FIRESTOPPING

PART 1 - GENERAL REQUIREMENTS

1.1 SCOPE OF WORK

A. General:

1. Furnish all labor, materials, tools, and equipment and perform all operations in connection with the patching and repair of building structure, finishes and building assemblies as specified hereinafter.
2. Furnish all labor, materials, tools, and equipment and perform all penetrations in connection with the installation of fire stopping and smoke stopping systems required to seal all penetrations of required rated partitions, walls, or assemblies for Division 23 work.

B. Descriptions:

1. Patch and repair all building finishes, structural components, or other appurtenances that are removed or damaged as a result of the performance of this contract. Patch and repair work shall include finishes, components, substructure, and materials required for the installation of such work in accordance with standard practices.
2. All penetrations through exterior walls, floors, and roof systems shall be sealed watertight.
3. Firestop all existing openings in walls, roofs, slabs, and similar assemblies remaining as a result of removing existing pipes, ducts, conduit, equipment appurtenances.
4. Firestop and Smokestop as required for assembly type all new openings in walls, roofs, slabs and similar assemblies at pipe, duct, conduits, equipment, and appurtenances.
5. Patched and repaired work shall be finished to match existing or adjacent construction and conditions.

1.2 QUALITY ASSURANCE

A. Materials:

1. Materials shall be new, unused, properly stored and matching existing in colors, texture, finish, appearance, and function.
2. Fire stopping and smoke stopping materials shall be delivered to the job site ready to install and require no critical mixing procedures or precise installation time constraints.
3. Materials shall be delivered to the site in sealed containers, fully identified with manufacturer's name, brand, type, grade and U.L. and FM labels. Store materials in a dry space under cover and off the ground.
4. Products shall be applied in strict accordance with their listing and manufacturers' application requirements.

B. Code and Standards: All work shall meet or exceed the standards and procedures (latest editions) of the following:

1. ASTM E814, Fire Tests of Through-Penetration Firestop Systems.
 2. UL 1479, Through-Penetration Firestop Systems.
- C. Manufacturer: The following firestopping and waterproofing sealant manufacturers are acceptable:
1. Nelson.
 2. Thomas & Betts.
 3. 3M.
 4. Hilti.
 5. GE.
 6. Frye Putty.
- D. The following smoke stopping manufacturers are acceptable:
1. Nelson.
 2. Thomas & Betts.
 3. 3M.

PART 2 - PRODUCTS

2.1 FIRESTOPPING

- A. Firestopping material shall maintain its dimension and integrity while preventing the passage of flame, smoke, and gases under conditions of installation and use when exposed to the ASTM E119 time-temperature rating of the assembly penetrated.
- B. All material shall be listed by U.L.

2.2 SMOKESTOPPING

- A. Smoke-stop shall provide an effective barrier against the spread of smoke.
- B. All material shall be listed by U.L.

2.3 WATERPROOFING

- A. Sealant materials shall be as follows:
1. Penetrations of Fire Rated assemblies shall meet the requirements of 2.1 FIRESTOPPING specified hereinbefore.
 2. Exterior joint sealant shall be Polyurethane base, multi-component; self-leveling type for application in vertical joints; capable of withstanding movement of up to 50% of joint width and satisfactorily handled throughout temperature of 4 to 27 degrees C.; uniform, homogeneous, and free from lumps, skins and coarse particles when mixed; Shore "A"

hardness of minimum 15 and maximum 50; non-staining; non-bleeding; colors selected by Architect/Engineer.

2.4 SUBMITTAL

- A. Provide U.L. approval assembly detail for specific application of the product.
- B. Provide installation detail of the product.

PART 3 - EXECUTION

3.1 GENERAL

- A. Exercise care in the performance of this contract so as not to damage any existing building components and finishes, outside components, shrubs, or other appurtenances.
- B. Clean and prepare joints for sealant application in accordance with manufacturer's recommendations. Ensure that joint forming materials are compatible with sealant.
- C. Openings larger than required for proper installation of pipe or duct shall be patched or repaired.
- D. Protect the roof at all times. Provide planking, plywood, supports, and other materials and means to ensure damage is not incurred.
- E. Firestopping and smoke stopping will meet the U.L. approved assembly detail for the product used.

3.2 EQUIPMENT PENETRATIONS:

- A. Seal all openings into equipment resulting from installation of equipment such as piping and conduit.
- B. Repair all insulation damaged during installation of equipment.

END OF SECTION 230500

SECTION 230510 - GAUGES AND METERS

PART 1 - GENERAL

1.1 SECTION INCLUDES

- A. Pressure gauges and Pressure Gauge taps.
- B. Thermometers and thermometer wells.

1.2 ENVIRONMENTAL REQUIREMENTS

- A. Do not install instrumentation when areas are under construction, except for required rough-in, taps, supports and test plugs.

PART 2 - PRODUCTS

2.1 PRESSURE GAUGES

- A. Glycerin-Filled Pressure Gauge: 4-1/2" dial with snubber and stainless steel or cast aluminum case, gasketed Plexiglas Lens, stainless steel movement, Polypropylene blow-out back plate, White scale with black divisions and numerals, Plastic lens, Manufactured in accordance with ASME specification B40.1, Grade 2A.
- B. Acceptable Manufacturers:
 - 1. Dwyer.
 - 2. Weiss.
 - 3. Weksler.
 - 4. Terice.
- C. All gauges shall have brass valve. Graduation in feet.

2.2 PRESSURE GAUGE TAPPINGS

- A. Gauge Valve: Brass 1/4" ball valve.
- B. 1/4-inch NPT for minimum 150 psig.

2.3 STEM TYPE THERMOMETERS

- A. Acceptable manufacturers:
 - 1. Terice.

2. Weksler.
3. Weiss.

- B. Thermometer: ASTM E1, adjustable angle, lens front tube, cast aluminum case with enamel finish, cast aluminum adjustable joint with positive locking device. Temperature ranges shall be appropriate for water service type and shall be submitted to Engineer for approval prior to installation.

1. Size: 9-inch scale.
2. Window: Clear glass.
3. Stem: 3/4-inch NPT brass.
4. Accuracy: 1 percent.
5. Calibration: Degrees F., 2 degrees per graduation.

- C. Thermometers shall be solar powered digital readout able to operate with lighting levels of 10 Lux (1 foot Candle). Casing shall be of high impact ABS. Range shall read from 0 °F to 250 °F with a 1% or 1 °F accuracy whichever is greater. Resolution shall be to 1/10th °F. Recalibration shall be via an internal potentiometer and the display shall update once every 10 seconds. The thermometer shall be able to operate in relative humidity up to 100%. The sensor shall be a glass passivated thermistor. The stem assembly shall be bi-metallic and fully conform to standard ASME B40.3-1990 and be fully interchangeable with bi-metallic dial thermometers.

2.4 THERMOMETER SUPPORTS

- A. Pipe Socket: Brass separable sockets with insulation extensions as required.

2.5 TEST PLUGS

- A. Test Plug: 1/4 inch or 1/2-inch brass or stainless-steel fitting and cap for receiving 1/8 inch outside diameter pressure or temperature probe with neoprene core for temperatures up to 200 degrees F.

PART 3 - EXECUTION

3.1 INSTALLATION

- A. Install in accordance with manufacturer's instructions.
- B. Provide one pressure Gauge per pump, installing taps on suction and discharge of pump. Pipe to Gauge. Provide pressure Gauge at inlet, outlet connection to condenser and evaporator of chiller, coils.
- C. Install pressure gauges with pulsation dampers. Provide valves to isolate each Gauge. Extend nipples to allow clearance from insulation.
- D. Install thermometers in piping systems in sockets in short couplings. Enlarge pipes smaller than 2-1/2 inch for installation of thermometer sockets. Ensure sockets allow clearance from

insulation. Dip thermometer stems in heat conducting paste before installing in wells. Provide thermometers at each inlet, outlet of coils, condenser and evaporator connections to each chiller, boiler.

- E. Install thermometer sockets adjacent to controls systems transmitter.
- F. Provide instruments with scale ranges selected according to service.
- G. Install gauges and thermometers in locations where they are easily read from normal operating level.
- H. Adjust gauges and thermometers to final angle, clean windows and lenses, and calibrate to zero.
- I. Locate test plugs adjacent thermometers and thermometer sockets adjacent to pressure gauges and pressure Gauge taps adjacent to control device sockets.

END OF SECTION 230510

SECTION 230513 – ADJUSTABLE FREQUENCY DRIVES

PART 1 - GENERAL

1.1 WORK INCLUDED

- A. Adjustable frequency drive units for pumps and fans.

1.2 QUALITY ASSURANCE

- A. The complete unit shall be listed by a testing agency approved in North Carolina.
- B. All wiring to conform to the NEMA Standards.
- C. All enclosures to be NEMA rated.
- D. All units shall conform to Part 23 of the FCC regulations on RFI/EMI emissions.
- E. The inverter and any associated hardware are to be "run in" at rated ambient temperature and rated load on variable speeds at the manufacturer's plant prior to shipment.
- F. The VFD and options shall be tested to ANSI/UL Standard 508. The complete VFD including all specified options, shall be assembled by the manufacturer, which shall be UL-508 certified for the building and assembly of option panels. Local representative panel shop assembly for option control panels is not acceptable. The appropriate UL stickers shall be applied to both the drive and option panel. Both drive and option panel shall be manufactured in ISO 9001 certified facilities.
- G. All adjustable frequency drives for mechanical equipment shall be furnished by the same manufacturer.

PART 2 - PRODUCTS

2.1 ACCEPTABLE MANUFACTURERS

- A. Square D.
- B. ABB.
- C. Alan Bradley.
- D. Cutler Hammer.
- E. Danfoss Graham.

2.2 EQUIPMENT REQUIREMENTS

- A. The seller shall, with the aid of the buyer's electrical power single line diagram, perform an analysis to initially demonstrate that the supplied equipment will meet the IEEE standards after installation. If, as results of the analysis, it is determined that additional filter equipment is required to meet the IEEE recommendations, the cost of such equipment shall be included in the bid.
- B. A harmonic analysis shall be submitted with the approval drawings to verify compliance with IEEE-519 1992 voltage and current distortion limits as shown in Tables 10.2 and 10.3 at the point of common coupling (PCC). The PCC shall be defined as the consumer-utility interface or metering point.

Table 10.2 Low-Voltage System Classification and Distribution Limits		
	Special Applications (1)	General Systems (2)
Notch Depth	10%	20%
THD (Voltage)	3%	5%

NOTES:

1. Airports and medical facilities having patient monitoring equipment.
2. In volt-microseconds at rated voltage and current.

Table 10.3 Current Distortion Limits for General Distribution Systems (120V Through 69,000V)						
Maximum Harmonic Current Distortion in Percent of IL						
	Individual Harmonic Order (Odd Harmonics)					
Iso/IL	<11	11 ≤ sn <17	17 ≤ sn <23	23 ≤ sn <35	35 ≤ sn	TDD
<20 (1)	4.0	2.0	1.5	0.6	0.3	5.0
20<50	7.0	3.5	2.5	1.0	0.5	8.0
50<100	10.0	4.5	4.0	1.5	0.7	12.0
100<1000	12.0	5.5	5.0	2.0	1.0	15.0
>1000	15.0	7.0	6.0	2.5	1.4	20.0

NOTES:

1. Even harmonics are limited to 25% of the odd harmonic limits above.
 2. Current distortion that results in a dc offset, e.g., half-wave converters, are not allowed.
 3. All power generation equipment is limited to these values of current distortion, regardless of actual Iso/IL.
- C. The VFD shall convert incoming fixed frequency three-phase AC power into variable frequency and voltage for controlling the speed of three phase AC motors (note: all motors provided for VFD equipment shall be inverter duty rated). The motor current shall closely approximate a sine wave. Motor voltage shall be varied with frequency to maintain desired motor magnetization current suitable for centrifugal pump and fan control. An advanced sine wave approximation and voltage vector control shall be used to allow operation at rated motor shaft output at nominal speed with no derating. This voltage vector control shall minimize harmonics to the motor to increase motor efficiency and life. The VFD shall include a full-wave diode bridge rectifier and maintain a fundamental power factor near unity regardless of speed or load. The VFD, including the options listed below, shall be tested to ANSI/UL Standard 508.
1. The VFD shall have a DC link reactor on both positive and negative rails of the DC bus to minimize power line harmonics. VFD's without a DC link reactor shall have a 5% impedance input AC line reactor.
 2. An automatic energy optimization selection feature shall be provided standard in the drive. This feature shall reduce voltages when lightly loaded and provide a 3% to 10% additional energy savings.
 3. Galvanic and/or optical isolation shall be provided between the drive's power circuitry and control circuitry to ensure operator safety and to protect connected electronic control equipment from damage caused by voltage spikes, current surges, and ground loop currents. Drives not including isolation on both analog I/O and discrete I/O shall include additional isolation modules.
 4. Drive shall include current sensors on all three output phases to detect and report phase loss to the motor. The VFD will identify which of the output phases is low or lost.
 5. Input and output power circuit switching can be done without interlocks or damage to the VFD.
 6. Class 20 I2t electronic motor overload protection for single motor applications and thermal-mechanical overloads for multiple motor applications.
 7. Protection against input transients, loss of AC line phase, short circuit, ground fault, overvoltage, undervoltage, drive overtemperature and motor overtemperature.
 8. Display all faults in English language. Codes are not acceptable.
 9. If the temperature of the drive's heat sink rises to 80o C, the drive shall automatically reduce the carrier frequency to reduce the heat sink temperature. If the temperature of the heat sink continues to rise the drive shall automatically reduce its output frequency to the motor. As the drive's heat sink temperature returns to normal, the drive shall automatically increase the output frequency to the motor and return the carrier frequency to its normal switching speed.
 10. Fully range minimum and maximum speed adjustment with ability to automatically.
 11. Select speeds as defined in controls sequence.
 12. Separately adjustable linear acceleration and deceleration.
 13. Field adjustable or automatic current limit.
 14. Four short circuit current settings protection.
 15. All units shall operate on a 4-20 ma signal in automatic mode.

16. Drive shall communicate with building automation system via BACnet protocol.
17. Be rated to provide 100% of rated current, minimum 110% break away current.
18. Inverter is to be rated for an input line voltage variation of + 10% and -10%.
19. Provide a manual 3 contactor bypass consisting of a door interlocked main fused disconnect padlockable in the off position, a built-in motor starter and a four position DRIVE/OFF/LINE/TEST switch controlling three contactors. In the DRIVE position, the motor is operated at an adjustable speed from the drive. in the OFF position, the motor and drive are disconnected. In the LINE position, the motor is operated at full speed from the AC power line and power is disconnected from the drive, so that service can be performed. In the TEST position, the motor is operated at full speed from the AC line power. This allows the drive to be given an operational test while continuing to run the motor at full speed in bypass. Customer supplied normally closed dry contact shall be interlocked with the drives safety trip circuitry to stop the motor whether in DRIVE or BYPASS mode in case of an external safety fault. The use of microprocessor-based bypass control shall not be allowed.
20. Provide circuit breaker for main power disconnect. Service personnel shall be able to defeat the main power disconnect and open the bypass enclosure without disconnecting power. This shall be accomplished through the use of a specially designed tool and mechanism while meeting all local and national code requirements for safety.
21. The drive and bypass circuits shall operate independently of each other and have completely separate switch mode power supplies operating off AC line Voltage.
22. The bypass shall provide motor functionality with the drive removed. The bypass shall automatically respond to the BAS for start and stop while operating in bypass.
23. The bypass shall include a service switch or line isolation contactor to disconnect power to the drive, but not the bypass.
24. The drive and bypass package shall be UL listed and have a labeled, short circuit current rating (SCCR) of 100,000 amps.
25. Smoke purge circuitry shall be interconnected such that an external dry contact can be used in both drive and bypass modes.

PART 3 - EXECUTION

3.1 INSTALLATION AND START UP

- A. Install in accordance with manufacturer's written installation instructions.
- B. The contractor shall assume the responsibility for coordinating the purchased equipment with the motor served and with the automatic temperature control system, paying specific attention to the signal sent and received, the ground source and the required speed range.
- C. Contractor to verify that job site conditions for installation meet factory recommended and code-required conditions for VFD installation prior to start-up, including clearance spacing, temperature, contamination, dust, and moisture of the environment. All power and control wiring shall (including from VFD to motor) be installed in conduit. Separate conduit installation of the motor wiring, power wiring, and control wiring, and installation per the manufacturer's recommendations shall be verified.
- D. VFD shall be installed a maximum distance of 100' away from associated motor.

- E. The VFD is to be covered and protected from installation dust and contamination until the environment is cleaned and ready for operation. The VFD shall not be operated while the unit is covered.
- F. The manufacturer shall provide start-up commissioning of the variable frequency drive and its optional circuits by a factory certified service technician who is experienced in start-up and repair services. The commissioning personnel shall be the same personnel that will provide the factory service and warranty repairs at the customer's site. Sales personnel and other agents who are not factory certified technicians for VFD field repair are not acceptable as commissioning agents. Start-up services shall include checking for verification of proper operation and installation for the VFD, its options and its interface wiring to the building automation system. Start-up shall include customer operator training at the time of the equipment commissioning.

3.2 WARRANTY

- A. The VFD shall be warranted by the manufacturer for a period of 36 months from date of shipment. The warranty shall include parts, labor, travel costs and living expenses incurred by the manufacturer to provide factory authorized on-site service.

END OF SECTION 230513

SECTION 230529 - SUPPORTS AND ANCHORS

PART 1 - GENERAL

1.1 SECTION INCLUDES

- A. Pipe and equipment hangers and supports.
- B. Equipment bases and supports.
- C. Sleeves and seals.
- D. Flashing and sealing equipment and pipe stacks

1.2 PRODUCTS FURNISHED BUT NOT INSTALLED UNDER THIS SECTION

- A. Placement of inserts sleeves in existing walls and slabs.
- B. Placement of roofing duct supports.
- C. Placement of equipment roof supports.
- D. Placement of roof sleeves, vents, and curbs.

1.3 REFERENCES

- A. ASME B31.1 - Power Piping.
- B. ASME B31.2 - Fuel Gas Piping.
- C. ASME B31.5 - Refrigeration Piping.
- D. ASME B31.9 - Building Services Piping.
- E. ASTM F708 - Design and Installation of Rigid Pipe Hangers.
- F. MSS SP58 - Pipe Hangers and Supports - Materials, Design and Manufacturer.
- G. MSS SP69 - Pipe Hangers and Supports - Selection and Application.
- H. MSS SP89 - Pipe Hangers and Supports - Fabrication and Installation Practices.
- I. NFPA 13 - Installation of Sprinkler Systems.
- J. NFPA 14 - Installation of Standpipe and Hose Systems.
- K. UL 203 - Pipe Hanger Equipment for Fire Protection Service.

1.4 SUBMITTALS

- A. Submit under provisions of Division 1.
- B. Product Data: Provide manufacturers catalog data including load capacity.
- C. Design Data: Indicate load carrying capacity of trapeze, multiple pipe, and riser support hangers.
- D. Manufacturer's Installation Instructions: Indicate special procedures and assembly of components.

1.5 REGULATORY REQUIREMENTS

- A. Conform to applicable code for support of hydronic piping.

PART 2 - PRODUCTS

2.1 PIPE HANGERS AND SUPPORTS

- A. Pipe hangers for insulated piping shall be sized to fit around the pipe covering. Contractor shall provide at each hanger a galvanized insulation protection shield formed to fit the outside of the covering. Shield shall extend above center line on both sides. Shield to be #18 gauge up to 3" pipe, #16 gauge up to 6" pipe and #14 gauge for 8" and larger. Provide rigid insulation under all hangers. See Section 23 07 00, Insulation.
- B. Hydronic Piping:
 - 1. Conform to MSS SP58.
 - 2. Hangers for Pipe Sizes 1/2 to 1 1/2 Inch (13 to 38 mm): Carbon steel, adjustable swivel, split ring.
 - 3. Hangers for Cold Pipe Sizes 2 Inches (50 mm) and Over: Carbon steel, adjustable, clevis.
 - 4. Hangers for Hot Pipe Sizes 2 to 4 Inches (50 to 100 mm): Carbon steel, adjustable, clevis.
 - 5. Hangers for Hot Pipe Sizes 6 Inches (150 mm) and Over: Adjustable steel yoke, cast iron roll, double hanger.
 - 6. Multiple or Trapeze Hangers: Steel channels with welded spacers and hanger rods.
 - 7. Multiple or Trapeze Hangers for Hot Pipe Sizes 6 Inches (150 mm) and Over: Steel channels with welded spacers and hanger rods, cast iron roll.
 - 8. Wall Support for Pipe Sizes to 3 Inches (76 mm): Cast iron hook.
 - 9. Wall Support for Pipe Sizes 4 Inches (100 mm) and Over: Welded steel bracket and wrought steel clamp.
 - 10. Wall Support for Hot Pipe Sizes 6 Inches (150 mm) and Over: Welded steel bracket and wrought steel clamp with adjustable steel yoke and cast-iron roll.
 - 11. Vertical Support: Steel riser clamp.
 - 12. Floor Support for Cold Pipe: Cast iron adjustable pipe saddle, lock nut, nipple, floor flange, and concrete pier or steel support.
 - 13. Floor Support for Hot Pipe Sizes to 4 Inches (100 mm): Cast iron adjustable pipe saddle, lock nut, nipple, floor flange, and concrete pier or steel support.

14. Floor Support for Hot Pipe Sizes 6 Inches (150 mm) and Over: Adjustable cast iron roll and stand, steel screws, and concrete pier or steel support.
15. Copper Pipe Support: Carbon steel ring, adjustable, copper plated.

2.2 ACCESSORIES

- A. Hanger Rods: Mild steel threaded both ends, threaded one end, or continuous threaded.

2.3 FLASHING

- A. Metal Flashing: 26 gage galvanized steel.
- B. Metal Counterflashing: 22 gage galvanized steel.
- C. Lead Flashing:
 1. Waterproofing: 5 lb/sq ft (24.5 kg/sq m) sheet lead.
 2. Soundproofing: 1 lb/sq ft (5 kg/sq m) sheet lead.
- D. Flexible Flashing: 47mil thick sheet compatible with roofing.
- E. Caps: Steel, 22 gage (0.8 mm) minimum; 16 gage (1.5 mm) at fire resistant elements.

2.4 EQUIPMENT CURBS

- A. Fabrication: Welded 18 gage (1.2 mm) galvanized steel shell and base, mitered 3 inch (75 mm) cant, variable step to match root insulation, 1-1/2 inch thick insulation, factory installed wood nailer, sloping base to match sloping roof where required.

2.5 SLEEVES

- A. Sleeves for Pipes Through Non-Fire Rated Floors: 18 gage (1.2 mm thick) galvanized steel.
- B. Sleeves for Pipes Through Non-Fire Rated Beams, Walls, Footings, and Potentially Wet Floors: Steel pipe or 18 gage galvanized steel.
- C. Sleeves for Pipes Through Fire Rated and Fire Resistive Floors and Walls, and Fire Proofing: Prefabricated fire rated sleeves including seals, UL listed.
- D. Sleeves for Round Ductwork: Galvanized steel.
- E. Sleeves for Rectangular Ductwork: Galvanized steel.

PART 3 - EXECUTION

3.1 INSTALLATION

- A. Install in accordance with manufacturer's instructions.

3.2 INSERTS

- A. Provide inserts for placement in concrete walls and slabs as noted on plans.
- B. Provide inserts for suspending hangers from reinforced concrete slabs and sides of reinforced concrete beams.

3.3 PIPE HANGERS AND SUPPORTS

- A. Support horizontal piping as scheduled.
- B. Install hangers to provide minimum 1/2-inch (13 mm) space between finished covering and adjacent work.
- C. Place hangers within 12 inches (300 mm) of each horizontal elbow.
- D. Use hangers with 1 1/2 inch (38 mm) minimum vertical adjustment.
- E. Support vertical piping at every floor.
- F. Where several pipes can be installed in parallel and at same elevation, provide multiple or trapeze hangers.
- G. Support riser piping independently of connected horizontal piping.
- H. Provide copper plated hangers and supports for copper piping.
- I. Design hangers for pipe movement without disengagement of supported pipe.
- J. Prime coat exposed steel hangers and supports. Refer to Division 9. Hangers and supports located in crawl spaces, pipe shafts, and suspended ceiling spaces are not considered exposed.

3.4 EQUIPMENT BASES AND SUPPORTS

- A. Provide housekeeping pads of concrete, minimum 6 inches thick and extending 6 inches (150 mm) beyond supported equipment. Refer to Division 3.
- B. Provide templates, anchor bolts, and accessories for mounting and anchoring equipment.
- C. Construct supports of steel members. Brace and fasten with flanges bolted to structure.
- D. Provide rigid anchors for pipes after vibration isolation components are installed.

3.5 FLASHING

- A. Provide flexible flashing and metal counterflashing where piping and ductwork penetrate weather or waterproofed walls, floors, and roofs.
- B. Flash vent and soil pipes projecting 3 inches (75 mm) minimum above finished roof surface with lead worked one inch (25 mm) minimum into hub, 8 inches (200 mm) minimum clear on sides with 24 x 24 inches (600 x 600 mm) sheet size. For pipes through outside walls, turn flanges back into wall and calk, metal counter flash, and seal.
- C. Provide acoustical lead flashing around ducts and pipes penetrating equipment rooms, installed in accordance with manufacturer's instructions for sound control.
- D. Provide curbs for mechanical roof installations 8 inches minimum high above roofing surface. Flash and counterflash with sheet metal; seal watertight. Attach counterflashing mechanical equipment and lap base flashing on roof curbs. Flatten and solder joints. Roof curbs shall be constructed to match the roof slope so the equipment will be installed level with the ground.
- E. Adjust storm collars tight to pipe with bolts, calk around top edge. Use storm collars above roof jacks. Screw vertical flange section to face of curb.

3.6 SLEEVES

- A. Set sleeves in position in formwork. Provide reinforcing around sleeves.
- B. Size sleeves large enough to allow for movement due to expansion and contraction. Provide for continuous insulation wrapping.
- C. Extend sleeves through floors one inch above finished floor level. Calk sleeves.
- D. Where piping or ductwork penetrates floor, ceiling, or wall, close off space between pipe or duct and adjacent work with fire stopping material and calk as per UL approved detail. Provide close fitting metal collar or escutcheon covers at both sides of penetration.
- E. Install chrome plated steel escutcheons at finished surfaces.

3.7 SCHEDULES

	Pipe Size Inches	Max Hanger Spacing Feet (m)	Hanger Rod Diameter Inches (mm)
1.	1/2 to 1-1/4	6.5 (2)	3/8 (9)
2.	1-1/2 to 2	10 (3)	3/8 (9)
3.	2-1/2 to 3	10 (3)	1/2 (13)
4.	4 to 6	10 (3)	5/8 (15)
5.	8 to 12	12 (3.7)	7/8 (22)

END OF SECTION 230529

SECTION 230553 - MECH IDENTIFICATION

PART 1 - GENERAL

1.1 SECTION INCLUDES:

- A. Nameplates.
- B. Tags.
- C. Stencils.
- D. Ceiling Tacks.

1.2 REFERENCES

- A. ASME A13.1 Scheme for the Identification of Piping Systems.

PART 2 - PRODUCTS

2.1 NAMEPLATES

- A. Description: Laminated three-layer plastic with engraved black letters on light contrasting background color.

2.2 TAGS

- A. Metal Tags: Brass with stamped letters; tag size minimum 1 1/2-inch diameter.
- B. Chart: Typewritten letter size list in 3-ring notebook.

2.3 STENCILS

- A. Stencils: With clean cut symbols and letters of following size:
 - 1. 3/4 to 1 1/4 inch Outside Diameter of Insulation or Pipe: 8-inch-long color field, 1/2-inch-high letters.
 - 2. 1 1/2 to 2 inch Outside Diameter of Insulation or Pipe: 8-inch-long color field, 3/4-inch-high letters.
 - 3. 2 1/2 to 6 inch Outside Diameter of Insulation or Pipe: 12-inch-long color field, 1 1/4-inch-high letters.
 - 4. 8 to 10 inch Outside Diameter of Insulation or Pipe: 24-inch-long color field, 2 1/2-inch-high letters.

5. Over 10 inch Outside Diameter of Insulation or Pipe: 32-inch-long color field, 3 1/2-inch-high letters.
6. Ductwork and Equipment: 2 1/2-inch-high letters.

B. Stencil Paint: Semi-gloss enamel, black on white background conforming to ASME A13.1.

2.4 CEILING TACKS

A. Description: Steel with 3/4-inch diameter color coded head; In addition, provide clear plastic label adjacent to ceiling tack indicating specific equipment identification tag.

B. Color code as follows:

1. Yellow - HVAC equipment.
2. Red - Fire dampers/smoke dampers.
3. Green - Plumbing valves.
4. Blue - Heating/cooling valves.

PART 3 - EXECUTION

3.1 PREPARATION

- A. Degrease and clean surfaces to receive adhesive for identification materials.
- B. Reference division 9 for surface preparation.

3.2 INSTALLATION

- A. All equipment requiring periodic maintenance or testing located in concealed spaces shall be clearly identified on an adjacent finished surface to identify the location of equipment. For equipment mounted above ceilings, provide an ID label on the ceiling below the equipment. Typical concealed equipment includes air terminals, air valves, PRVs, mixing valves, duct and pipe differential pressure sensors, steam traps, fire smoke dampers, etc. Labels shall be clear or white with 0.375" high black letters.
- B. Install plastic nameplates with corrosive resistant mechanical fasteners, or adhesive. Apply with sufficient adhesive to ensure permanent adhesion and seal with clear lacquer.
- C. Install tags with corrosion resistant chain.
- D. Reference division 9 for surface preparation. Black on white background or color as coordinated with Engineer and Owner prior to beginning work.
- E. Install underground plastic pipe markers 6 to 8 inches below finished grade, directly above buried pipe.

- F. Identify air handling units, pumps, heat transfer equipment, tanks, and water treatment devices with plastic nameplates. Small devices, such as in line pumps, may be identified with tags.
- G. Identify control panels and major control components outside panels with plastic nameplates.
- H. Identify thermostats relating to terminal boxes or valves with nameplates.
- I. Identify valves in main and branch piping with tags.
- J. Identify air terminal units and associated valves with numbered tags.
- K. Tag automatic controls, instruments, and relays. Key to control schematic.
- L. Identify piping, concealed, or exposed, with stencils. Identify service, flow direction, and pressure. Install in clear view and align with axis of piping. Locate identification not to exceed 20 feet on straight runs including risers and drops, adjacent to each valve and Tee, at each side of penetration of structure or enclosure, and at each obstruction.
- M. Identify ductwork with stenciled painting. Identify with air handling unit identification number and area served. Locate identification at air handling unit, at each side of penetration of structure or enclosure, and at each obstruction.
- N. Provide ceiling tacks to locate valves or dampers above T-bar type panel ceilings. Locate in corner of panel closest to equipment.

END OF SECTION 230553

SECTION 230593 – TESTING, ADJUSTING AND BALANCING

PART 1 - GENERAL

1.1 SECTION INCLUDES

- A. Testing, adjustment, and balancing of air systems.
- B. Testing, adjustment, and balancing of hydronic steam systems.
- C. Measurement of final operating condition of HVAC systems.

1.2 ALLOWANCES

- A. Work is included in this section and is part of the Contract Sum/Price.

1.3 REFERENCES

- A. AABC - National Standards for Total System Balance.
- B. ADC - Test Code for Grilles, Registers, and Diffusers.
- C. ASHRAE 111 - Practices for Measurement, Testing, Adjusting, and Balancing of Building Heating, Ventilation, Air-conditioning, and Refrigeration Systems.
- D. NEBB - Procedural Standards for Testing, Adjusting, and Balancing of Environmental Systems.
- E. SMACNA - HVAC Systems Testing, Adjusting, and Balancing.

1.4 PROJECT RECORD DOCUMENTS

- A. Record actual locations of flow and pressure measuring stations and balancing valves.

1.5 QUALIFICATIONS

- A. Agency: Company specializing in the testing, adjusting, and balancing of systems specified in this Section with minimum five years documented experience certified by AABC.
- B. Perform Work under supervision of AABC Certified Test and Balance Engineer, NEBB Certified Testing, Balancing and Adjusting Supervisor, or registered Professional Engineer experienced in performance of this Work and licensed in the State of North Carolina.

1.6 PRE-BALANCE CONFERENCE

- A. Convene one month prior to commencing work. Include all pertinent contractors and designers.

1.7 SEQUENCING

- A. Sequence work to commence after completion of systems and schedule completion of work before Substantial Completion of Project.
- B. The test and balance report shall be completed, reviewed, and approved by project engineer prior to final inspection and occupancy. Preliminary/rough draft reports are not acceptable.

1.8 SCHEDULING

- A. Schedule and provide assistance in final adjustment and test of life safety and lab exhaust system.

PART 2 - PRODUCTS – This Part Not Used.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Verify that systems are complete and operable before commencing work. Ensure the following conditions:
 - 1. Systems are started and operating in a safe and normal condition.
 - 2. Temperature control systems are installed complete and operable.
 - 3. Proper thermal overload protection is in place for electrical equipment.
 - 4. Final filters are clean and in place. If required, install temporary media in addition to final filters.
 - 5. Duct systems are clean of debris.
 - 6. Fans are rotating correctly.
 - 7. Fire and volume dampers are in place and open.
 - 8. Air coil fins are cleaned and combed.
 - 9. Access doors are closed, and duct end caps are in place.
 - 10. Air outlets are installed and connected.
 - 11. Duct system leakage is minimized.
 - 12. Hydronic systems are flushed, filled, and vented.
 - 13. Pumps are rotating correctly.
 - 14. Proper strainer baskets are clean and in place.
 - 15. Service and balance valves are open.
- B. Submit field reports. Report defects and deficiencies noted.
- C. Beginning of work means acceptance of existing conditions.

3.2 PREPARATION

- A. Provide instruments required for testing, adjusting, and balancing operations. Make technician and instruments available to Designer to facilitate spot checks during testing.
- B. Provide additional balancing devices as required.

3.3 INSTALLATION TOLERANCES – CHECK AND SELECT APPROPRIATE TAB TOLERANCES HERE.

- A. Air Handling Systems: Adjust to within plus or minus 5 percent of design for air conditioning systems and plus or minus 5 percent of design for exhaust systems.
- B. Hydronic Systems: Adjust to within plus or minus 10 percent of design.
- C. Where pressure relationship between adjacent spaces is called for, document compliance.

3.4 ADJUSTING

- A. Ensure recorded data represents actual measured or observed conditions.
- B. Permanently mark settings of valves, dampers, and other adjustment devices allowing settings to be restored. Set and lock memory stops.
- C. After adjustment, take measurements to verify balance has not been disrupted or that such disruption has been rectified.
- D. Leave systems in proper working order, replacing belt guards, closing access doors, closing doors to electrical switch boxes, and restoring thermostats to specified settings.
- E. At final inspection, recheck random selections of data recorded in report. Recheck points or areas as selected and witnessed by the Owner.
- F. Check and adjust systems approximately six months after final acceptance and submit report.

3.5 AIR SYSTEM PROCEDURE

- A. For laboratory spaces, the transfer airflow rates listed on the plans are preliminary values. The Contractor shall adjust as necessary such that laboratory spaces are pressurized (either positive or negative) according to the intent shown on the drawings.
- B. Adjust air handling and distribution systems to provide required air quantities.
- C. Make air quantity measurements in ducts by Pitot tube traverse of entire cross-sectional area of duct.
- D. Measure air quantities at air inlets and outlets.
- E. Adjust distribution system to obtain uniform space temperatures control.

- F. Use volume control devices to regulate air quantities only to the extent that adjustments do not create objectionable air motion or sound levels. Effect volume control by duct mounted devices.
- G. Vary total system air quantities by adjustment of fan speeds. Provide drive changes required. Vary branch air quantities by damper regulation.
- H. Provide system schematic with required and actual air quantities recorded at each outlet or inlet. Provide summary report with all test and equipment data included.
- I. Measure static air pressure conditions on air supply units, including filter and coil pressure drops, and total pressure across the fan. Make allowances for 50 percent loading of filters.
- J. Adjust automatic, outside air, return air, and exhaust dampers for design conditions.
- K. Measure temperature conditions across outside air, return air, and exhaust dampers to check leakage.
- L. Where modulating dampers are provided, take measurements and balance at extreme conditions. Balance variable volume systems at maximum air flow rate, full cooling, and at minimum air flow rate, full heating.
- M. Measure building and/or system static pressure and adjust supply, return, and exhaust air systems to provide required relationship between each to maintain approximate positive static pressure called for.
- N. Check all motorized dampers for leakage. Adjust air quantities with mixing dampers set first for cooling, then heating, then modulating.
- O. For variable air volume system powered units set volume controller to air flow setting indicated. Confirm connections properly made and confirm proper operation for automatic variable air volume temperature control.

3.6 WATER SYSTEM PROCEDURE

- A. Adjust water systems to provide required or design quantities.
- B. Use calibrated fittings and pressure gages to determine flow rates for system balance. Where flow metering devices are not installed, base flow balance on suitable temperature difference.
- C. Adjust systems to provide specified pressure drops and flows through heat transfer elements prior to thermal testing. Perform balancing by measurement of temperature differential in conjunction with air balancing.
- D. Effect system balance with automatic control valves fully open to heat transfer elements.
- E. Effect adjustment of water distribution systems by means of balancing cocks, valves, and fittings. Do not use service or shut-off valves for balancing unless indexed for balance point.
- F. Where available pump capacity is less than total flow requirements or individual system parts, full flow in one part may be simulated by temporary restriction of flow to other parts.

3.7 SCHEDULES

A. Equipment Requiring Testing, Adjusting, and Balancing:

1. Chillers.
2. Boilers.
3. Heat Exchangers.
4. Pumps.
5. Air Coils.
6. Terminal Heat Transfer Units.
7. Air Handling System.
8. Airflow Measuring Stations.
9. Fans.
10. Air filters.
11. Air Terminal Units.
12. Air Inlets and Outlets.
13. Duct Leakage Testing.

B. Report Forms:

1. Title Page:

- a. Name of Testing, Adjusting, and Balancing Agency.
- b. Address of Testing, Adjusting, and Balancing Agency.
- c. Telephone number of Testing, Adjusting, and Balancing Agency.
- d. Project name.
- e. Project location.
- f. Project Architect.
- g. Project Engineer.
- h. Project Contractor.
- i. Project altitude.
- j. Report Date.

2. Summary Comments:

- a. Design versus final performance.
- b. Notable characteristics of system.
- c. Description of systems operation sequence.
- d. Summary of outdoor and exhaust flows to indicate amount of building pressurization.
- e. Nomenclature used throughout report.
- f. Test conditions.

3. Instrument List:

- a. Instrument.
- b. Manufacturer.
- c. Model number.
- d. Serial number.
- e. Range.

- f. Calibration date.
- 4. Electric Motors:
 - a. Manufacturer.
 - b. Model / Frame.
 - c. HP / BHP.
 - d. Phase, voltage, amperage, nameplate, actual, no load.
 - e. RPM.
 - f. Service factor.
 - g. Starter size, rating, heater elements.
 - h. Sheave Make/Size/Bore.
- 5. V-Belt Drive:
 - a. Identification/Location.
 - b. Required driven RPM.
 - c. Driven sheave, diameter, and RPM.
 - d. Belt, size, and quantity.
 - e. Motor sheave diameter and RPM.
 - f. Center to center distance, maximum, minimum, and actual.
- 6. Pump Data:
 - a. Identification number.
 - b. Manufacturer.
 - c. Size/Model.
 - d. Impeller.
 - e. Service.
 - f. Design flow rate, pressure drop, BHP.
 - g. Actual flow rate, pressure drop, BHP.
 - h. Discharge pressure.
 - i. Suction pressure.
 - j. Total operating head pressure.
 - k. Shut off, discharge, and suction pressure.
 - l. Shut off, total head pressure.
- 7. Chillers, Boilers, and Heat Exchangers:
 - a. Identification number.
 - b. Location.
 - c. Service.
 - d. Manufacturer.
 - e. Model number.
 - f. Serial number.
 - g. Steam pressure, design and actual (Only for steam heat exchangers and boiler).
 - h. Primary water entering temperature, design and actual.
 - i. Primary water leaving temperature, design and actual.
 - j. Primary water flow, design and actual.
 - k. Primary water pressure drop, design and actual.

- l. Secondary water leaving temperature, design and actual.
 - m. Secondary water leaving temperature, design and actual.
 - n. Secondary water flow, design and actual.
 - o. Secondary water pressure drop, design and actual.
- 8. Cooling Coil Data:
 - a. Identification number.
 - b. Location.
 - c. Service.
 - d. Manufacturer.
 - e. Air flow, design, and actual.
 - f. Entering air DB temperature, design and actual.
 - g. Entering air WB temperature, design and actual.
 - h. Leaving air DB temperature, design and actual.
 - i. Leaving air WB temperature, design and actual.
 - j. Water flow, design, and actual.
 - k. Water pressure drop, design, and actual.
 - l. Entering water temperature, design and actual.
 - m. Leaving water temperature, design and actual.
 - n. Saturated suction temperature, design and actual.
 - o. Air pressure drop, design and actual.
- 9. Heating Coil Data:
 - a. Identification number.
 - b. Location.
 - c. Service.
 - d. Manufacturer.
 - e. Air flow, design, and actual.
 - f. Water flow, design and actual.
 - g. Water pressure drop, design and actual.
 - h. Entering water temperature, design and actual.
 - i. Leaving water temperature, design and actual.
 - j. Entering air temperature, design and actual.
 - k. Leaving air temperature, design and actual.
 - l. Air pressure drop, design and actual.
- 10. Air Moving Equipment:
 - a. Location.
 - b. Manufacturer.
 - c. Model number.
 - d. Serial number.
 - e. Arrangement / Class / Discharge.
 - f. Air flow - specified and actual.
 - g. Return air flow - specified and actual.
 - h. Outside air flow - specified and actual.
 - i. Total static pressure (total external) - specified and actual.
 - j. Inlet pressure.

- k. Discharge pressure.
 - l. Sheave Make /Size / Bore.
 - m. Number of Belts / Make / Size.
 - n. Fan RPM.
11. Outside Air Data:
- a. Identification/Location.
 - b. Design air flow.
 - c. Actual air flow.
 - d. Design return air flow.
 - e. Actual return air flow.
 - f. Design outside air flow.
 - g. Actual outside air flow.
 - h. Return air temperature.
 - i. Outside air temperature.
 - j. Required mixed air temperature.
 - k. Actual mixed air temperature.
 - l. Design outside/return air ratio.
 - m. Actual outside/return air ratio.
12. Exhaust Fan Data:
- a. Location.
 - b. Manufacturer.
 - c. Model number.
 - d. Serial number.
 - e. Air Flow – specified and actual.
 - f. Total static pressure (total external), specified and actual.
 - g. Inlet pressure.
 - h. Discharge pressure.
 - i. Sheave Make / Size/ Bore.
 - j. Number of Belts / Make / Size.
 - k. Fan RPM.
13. Duct Traverse:
- a. System zone / branch.
 - b. Duct size.
 - c. Area.
 - d. Design velocity.
 - e. Design air flow.
 - f. Test velocity.
 - g. Test air flow.
 - h. Duct static pressure.
 - i. Air temperature.
 - j. Air correction factor.
14. Duct Leak Test:

- a. Description of ductwork under test.
 - b. Duct design operating pressure.
 - c. Duct design test static pressure.
 - d. Duct capacity, air flow.
 - e. Maximum allowable leakage duct capacity times leak factor.
 - f. Test apparatus:
 - 1) Blower.
 - 2) Orifice, tube size.
 - 3) Orifice size.
 - 4) Calibrated.
 - g. Test static pressure.
 - h. Test orifice differential pressure.
 - i. Leakage.
15. Air Monitoring Station Data:
- a. Identification/location.
 - b. System.
 - c. Size.
 - d. Area.
 - e. Design velocity.
 - f. Design air flow.
 - g. Test velocity.
 - h. Test air flow.
16. Flow Measuring Station:
- a. Identification/number.
 - b. Location.
 - c. Size.
 - d. Manufacturer.
 - e. Model number.
 - f. Serial number.
 - g. Design flow rate.
 - h. Design pressure drop.
 - i. Actual / final pressure drop.
 - j. Actual / final flow rate.
 - k. Station calibrated setting.
17. Terminal Unit Data:
- a. Manufacturer.
 - b. Type, constant, variable, single, dual duct.
 - c. Identification/number.
 - d. Location.
 - e. Model number.
 - f. Size.
 - g. Minimum static pressure.

- h. Minimum design air flow.
- i. Maximum design air flow.
- j. Maximum actual air flow.
- k. Inlet static pressure.

18. Air Distribution Test Sheet:

- a. Air terminal number.
- b. Room number/location.
- c. Terminal type.
- d. Terminal size.
- e. Area factor.
- f. Design velocity.
- g. Design air flow.
- h. Test (final) velocity.
- i. Test (final) air flow.
- j. Percent of design air flow.

END OF SECTION 230593

SECTION 230700 - INSULATION

PART 1 - GENERAL

1.1 WORK INCLUDED

- A. Work required under this section consists of insulation for piping and duct system and equipment specified in Division 23.
- B. Provide all necessary labor, materials, tools, and equipment to perform work required on the drawings and specified herein.
- C. All pipe fittings, valves, and strainers to be insulated.
- D. Certain equipment and/or systems to be factory insulated by manufacturer. Factory insulation materials to be as specified in applicable sections of the specifications.

1.2 DEFINITIONS

- A. Thermal resistance "R" values are expressed in units of "Hour-Degrees F-sq. ft./Btu per inch of Thickness" on a flat surface at a mean temperature of 75 degrees F unless noted otherwise.
- B. Thermal conductivity (K), the reciprocal of "R", btu per inch thickness/hr/ft²/degree.
- C. Insulation to consist of insulating material, jacket, mastic, and adhesive, either as a "system" or as an individual component when used separately.

1.3 QUALITY ASSURANCE / CERTIFICATION

- A. Unless noted otherwise, all insulation, adhesives, coatings, sealers, and tapes to have a flamespread rating of 25 or less and smoke development of 50 or less when tested in accordance with ASTM E-84, NFPA 225 AND UL 723.
- B. Apply insulation in a workmanlike manner using experienced, qualified tradesmen.
- C. Do not apply insulation until all pressure testing has been completed, inspected, and released or insulation application.
- D. Clean and dry surfaces prior to insulation application.
- E. Butt insulation joints firmly together; smoothly and securely install all jackets and tapes.
- F. Insulation jacket for duct, pipe, and equipment exposed to weather to be certified as self-extinguishing in less than 53 seconds when tested in accordance with ASTM D1692.
- G. Certify that all duct and piping insulation meets the minimum requirements of the current State Energy Code for New Building Construction.

PART 2 - PRODUCTS

2.1 MATERIALS FOR PIPE AND EQUIPMENT

- A. Provide factory premolded or shop mitered segment type insulation for pipe, fittings, and valves, unless otherwise noted.
- B. Fitting insulation to be of same thickness and material as adjoining pipe insulation.
- C. Cellular Glass (Foamglass):
 - 1. Product to be guaranteed by manufacturer to have continuous operational temperature limit of not less than 90 degrees F and minimum "R" value of 2.63.
 - 2. Provide Pittsburgh Corning "Foamglass" noncombustible factory-molded material.
 - 3. Provide factory applied pre-sized glass cloth jacket having an inside vapor barrier and white exterior color equivalent to Johns-Manville "Flame-Safe type "GVB".
 - 4. Provide for the following services:
 - a. Under pipe saddles where compressible piping insulation is used (Fiberglass, flexible elastomeric).
 - b. At all penetrations of rated walls and floors with insulated piping services.
- D. Flexible Elastomeric:
 - 1. Provide AP Armaflex manufactured by Armstrong or equivalent.
 - 2. Provide 2-pound density, fire-retardant polyolefin, flexible type insulation, pre-formed tubular for piping and sheet for equipment.
 - 3. Maximum water vapor transmission rate of 0.03 perms per inch and UV stabilized with a guaranteed outdoor life of 10 years.
 - 4. Product to have continuous operational temperature limit of not less than 210 degrees F and a minimum "R" value of 3.71.
 - 5. Provide white, self-seal Armaflex 2000 manufactured by Armstrong for 1/2-inch application thickness.
 - 6. Provide insulation for the following services:
 - a. Copper or steel moisture condensate drains: 1/2-inch thick.
 - b. Pump casings below 60o service: 1-1/2" thick.
 - c. Run-outs to terminal units and split systems: 1-1/2" thick.
- E. Glass Fiber:
 - 1. Provide factory-formed, factory-jacketed "system" type fiberglass insulation.
 - 2. Jacket to be fiberglass reinforced, white kraft paper with aluminum foil vapor barrier.
 - 3. Insulation density to be not less than 3.5 pounds per cubic foot.
 - 4. Product to have continuous operational temperature limit of no less than 650 degrees F and a minimum "R" value of 4.00.
 - 5. Product to be equivalent to Manville "Micro-Lok 650" with Type AP jacketing. Applicable products manufactured by Certainteed, Knauf, Owens Corning or Blue Trymer 2000 are acceptable.
 - 6. Provide insulation for following services:

- a. Heating hot water and low-pressure steam piping.
 - 1) 1-1/2-inch diameter and smaller hot water and steam piping: 1-1/2" thick.
 - 2) Above 1-1/2-inch hot water piping: 2" thick.
 - 3) Above 1-1/2-inch steam piping: 3" thick.
- b. Domestic cold water make-up piping (inside building): 1/2- inch thick
- c. Tanks: 2".

F. Rigid Foam Insulation:

- 1. Insulation shall be polyisocyanurate foam or Styrafoam with a K value (90 days aged) of .20 at a mean temperature of 75 degrees F. Density shall be 2#/cu. ft., flame spread less than 30 and smoke density less than 150 in 4" thickness. Insulation shall not be used in plenums. All joints and seams shall be neatly sealed in place with Foster 95-50 vapor barrier adhesive.
- 2. Valves and fittings shall be insulated with same material and to the same thickness as adjoining pipe. When insulating flanges and valve bodies, insulation shall extend a minimum of 1" beyond the end of the flange bolts and the bolt area shall be filled with fiberglass before molded insulation is applied.
- 3. Fill small voids with approved sealer before finish is applied.
- 4. Provide a one-piece Zeston type fitting jacket as recommended by the manufacturer for the applicable design conditions.
- 5. Clean and apply bitumen coating prior to applying rigid foam insulation.
- 6. Apply on:
 - a. Chilled Water piping: 1-1/2" thick.
 - b. Chilled water specialties, except those insulated with flexible foam: 1-1/2" thick.
 - c. Condenser Water Piping (Outside, above ground): 1" thick.
 - d. Make-up water and drain piping subject to freezing at cooling tower: 1" thick.

2.2 MATERIALS FOR DUCTS

A. Blanket Type Insulation:

- 1. Provide minimum 1 pound per cubic foot density, flexible, factory reinforced glass fiber blanket with foil-faced, glass-fiber reinforced kraft vapor barrier jacket. Provide 1.5 pcf with vinyl jacket where noted.
- 2. Insulation to have a minimum installed "R" value of 3.92.
- 3. Product to be manufactured by Manville, or equivalent by Certainteed, Knoff, or Owens-Corning.
- 4. Provide glass fiber blanket insulation for the following:
 - a. Unlined hot air or cold air supply ducts concealed from view (except where noted otherwise): 2 inch thick.

B. Glass fiber Board Type Insulation:

1. Provide minimum 3 pound per cubic foot density semi-rigid insulation with factory applied reinforced foil faced kraft vapor barrier glass fiber board "system" type insulation.
2. Insulating board to have a minimum "R" value of 4.34.
3. Product to be manufactured by Manville, or equivalent by Certainteed, Knoff, or Owens Corning.
4. Provide glass fiber board insulation for the following:
 - a. Ducts within equipment rooms and exposed to view: 1-1/2 inch thick.
 - b. Ductwork located outside of building or outside of building insulation system: 2-inch thick.
 - c. Unlined apparatus casing: 1-1/2 inch thick.

C. Exhaust ductwork shall not be insulated.

2.3 ELECTRICAL HEAT TAPE

- A. Furnish and install electrical, self-regulating heat tape at locations indicated on drawings.
- B. Unless otherwise noted, provide the following minimum heat densities:
 1. Outdoor condenser water piping (including centrifugal separator piping): 4 watts per linear foot.
 2. Outdoor chilled water, hot water, and domestic cold water makeup piping: 4 watts per linear foot.
 3. Outdoor cooling tower drain piping: 4 watts per linear foot.
- C. Install heat tape underneath insulation and jackets specified in this section.
- D. Provide ambient air sensing thermostat to switch the heat tape off when ambient conditions rise above setpoint. Provide one thermostat for each circuit.

2.4 MATERIALS FOR FITTINGS AND VALVES

- A. Premolded or mitered and fitted insulation and one-piece PVC insulated fitting covers.
- B. Provide factory pre-molded one-piece PVC insulated fitting covers, precut insulation inserts and installation materials for the following services.
 1. All pipe fittings and valves.
 2. All grooved coupling installations.
- C. Materials to be equal to Foster Seaglass PVC fitting cover, UNI-Fit inserts and accessories, or equivalent by Molded Acoustical Products, Inc., Hamfab, Zeston division of Mansfield; or Armstrong Products.

2.5 COATINGS, FINISHES, AND JACKETS

A. Piping and Equipment:

1. Prior to application of all pipe insulation, pipe surfaces shall be cleaned of rust and debris and painted. Prior to starting painting, Engineer and/or CM shall approve pipe when cleaned and painted.
2. All chill water piping and all piping in Mechanical Rooms shall be painted with one coat of rust proof paint after cleaning and prior to application of insulation. Paint on hot water, steam and condensate piping shall be high temperature.
3. For pipe, fittings, and valves through 1-1/2-inch size in systems exposed-to-view inside building or in equipment rooms, finish to be PVC factory jacket.
4. For tanks, heat exchangers, insulated equipment and pipes 2" and larger in systems exposed inside building or in equipment rooms, cover insulation with one layer of 8 oz. canvas and finish with fire retardant logging adhesive ready for painting.
5. Fitting Jackets: Inside use PVC molded one-piece or matching 2-piece jacket:
 - a. Hot surfaces; apply with stainless steel tacks or staples.
 - b. Cold surface; use 2" wide, 10 mil vinyl tape furnished by manufacturer of jacket. Where vapor barrier is required, apply tape to jacket and vapor barrier on pipe before canvas is applied.
6. For any service when above grade and exposed to the weather outside building, cover pipe insulation with 0.016-inch-thick aluminum jacket.
7. Do not insulate valves in systems operating above 60 degrees F. Paint valves with a rust-resistant product equivalent to Rustoleum.
8. For flexible tubular elastomeric pipe and fitting insulation when exposed-to-view inside building or exposed to the weather, finish with two coats of fire-retardant self-extinguishing vinyl lacquer type flexible coating equivalent to Armstrong "Armaflex Finish".

B. Ducts

1. In Equipment Rooms and where exposed to view: 8 oz canvas treated with fire retardant lagging adhesive. Seal joints and seams with 3" aluminum tape. Reinforce corners.

PART 3 - EXECUTION

3.1 GENERAL

- A. All surfaces to be clean and dry (and painted where noted above) when covering is applied. Covering to be dry when installed and during application of any finish.
- B. All adhesives, cements, and mastics to be compatible with materials applied without attacking materials in either wet or dry state.
- C. Insulation Exposed to view to have a well-tailored appearance.
- D. Do not insulate expansion tanks or heads of hot water pumps.
- E. Install all insulation in accordance with manufacturer's instructions.

3.2 PENETRATION OF RATED WALLS, PARTITIONS, AND FLOORS

- A. Do not pass pipe insulation through fire rated partitions or floors unless firestopping system is listed for insulated pipe. Stop and properly terminate insulation at each side of partition.
- B. Install foamglass insulation on chilled water piping where lines pass through rated partitions.
- C. Stop all duct coverings including jacket and insulation at all penetrations of rated walls. Flare-out or extend insulation jacket at least 2-inches beyond angle frames of fire dampers and seal to structure.
- D. Maintain vapor barrier.
- E. Install covering over damper and smoke detector access doors readily removable and identifiable.

3.3 INSTALLATION OF DUCT INSULATION

- A. Install in accordance with TIMA National Insulation Standards.
- B. Insulated ductwork conveying air below ambient temperature:
 - 1. Provide insulation with vapor barrier jacket.
 - 2. Finish with tape and vapor barrier jacket.
 - 3. Continue insulation through walls, sleeves, hangers, and other duct penetrations.
 - 4. Insulate entire system including fittings, joints, flanges, fire dampers, flexible connections, and expansion joints.
- C. Insulated ductwork conveying air above ambient temperature:
 - 1. Provide with or without standard vapor barrier jacket.
 - 2. Insulate fittings and joints. Where service access is required, bevel and seal ends of insulation.
- D. Blanket type insulation:
 - 1. Apply jacketed blanket type glass fiber pulled snug to ducts but not more than 1/2-inch compression at corners.
 - 2. Use insulation having 2-inch tab or cut insulation long enough to allow for "peel-off" of insulation from jacket to affect a minimum overlap tab of 2-inch.
 - 3. Staple lap with flare type staples on 1-inch centers.
 - 4. Cover standing seams, stiffeners, and braces with an insulation blanket, using 2-inch jacket lap and staple lap.
 - 5. Cover and seal all staples and attachment pins with foster 30-35 reinforced with glass cloth or FSK tape.
 - 6. Apply insulation with approved adhesive and weld pins at 18" o.c. on the bottom of ducts 16" or wider. Provide pins at 18" o.c. on sides of ducts 20" or more. Vertical ducts that are larger than 16" shall have weld pins on all sides. Overlap facing 3" and seal with approved adhesive or apply reinforced aluminum tape. Seal punctures and breaks with aluminum tape.

E. Jacketed Board Type Insulation:

1. Apply jacketed board type insulation to ducts using adhesive and weld pins or nylon "Stick-clip" plates having self-locking, coated metal or nylon discs.
2. If insulation is grooved for corners, pin as required to hold insulation tight to duct.
3. Seal pins and joints with Foster 30-56 reinforced with glass cloth or FSK tape.
4. Insulation shall be applied to the ductwork using approved adhesive and mechanical fasteners such as weld pins or stick clips located not less than 3" from each edge or corner of the board. Pin spacing along the duct not greater than 12" o.c. Additional fasteners used on the sides and bottom of all ducts at a maximum spacing of approximately 18" o.c. All edges and joints sealed with 5" wide aluminum vapor barrier tape applied with Foster 85-20 adhesive. All punctures in the vapor barrier facing likewise sealed.
5. Cover all joints, rips, tears, punctures, disc heads, staples, or breaks in vapor barrier jacket with 4-inch-wide woven glass fabric tape embedded in equivalent of Childers CP-82 or Benjamin-Foster No. 85-20 "Sparkfast" vapor barrier fire resistant adhesive. Pressure sensitive tape permitted if recommended by manufacturer.
6. Cover all board type insulation with 8 oz. canvas jacket applied with fire retardant logging adhesive.

F. Rigid Foam Insulation:

1. Apply with adhesive as recommended and weld pins or "Stock-clips" having self-locking metal or nylon discs.
2. Place pins 3" from edges and not more than 18" O.C.
3. Seal all joints and pin penetrations with 3" wide aluminum tape or as recommended by the manufacturer.
4. Finish insulation with 2 coats of Armaflex white paint.

3.4 INSTALLATION OF PIPE INSULATION

- A. Install in accordance with TIMA National Insulation Standards.
- B. Exposed Piping: Cover insulation with 8 oz canvas or factory jacket as noted above. Locate seams in least visible locations. Size canvas for painting. Paint (color as noted herein or as required by owner) canvas and PVC fitting covers.
- C. Insulate entire system including fittings, valves, unions, flanges, strainers, flexible connections, pump bodies, and expansion joints.
- D. Glass fiber insulated pipes conveying fluids below ambient temperature:
1. Provide vapor barrier jackets, factory-applied or field-applied. Secure with self-sealing longitudinal laps and butt strips with pressure sensitive adhesive. Secure with outward clinch expanding staples and vapor barrier mastic.
 2. Insulate fittings, joints, and valves with molded insulation of like material and thickness as adjacent pipe and PVC fitting covers.
- E. Glass fiber insulated pipes conveying fluids above ambient temperature:

1. Provide standard jackets, with or without vapor barrier, factory-applied or field-applied. Secure with self-sealing longitudinal laps and butt strips with pressure sensitive adhesive. Secure with outward clinch expanding staples.
 2. Insulate fittings, joints, and valves with insulation of like material and thickness as adjoining pipe. Finish with glass cloth and adhesive or PVC fitting covers.
- F. Insulation above furred ceiling and in chases requires no finish beyond factory jacket.
- G. Inserts and Shields:
1. Shields: Galvanized steel between pipe hangers or hanger rolls and insulation.
 2. Insert location: Between support shield and piping and under the finish jacket.
 3. Insert configuration: Minimum 12" inches long, of same thickness and contour as adjoining insulation; may be factory fabricated.
 4. Insert material: Hydrous calcium silicate or foamglas insulation material suitable for the planned temperature range.
- H. Continue insulation through walls, sleeves, pipe hangers, and other pipe penetrations. Finish at supports, protrusions, and interruptions. At fire and smoke separations, refer to Section 23 05 00.

3.5 INSTALLATION OF EQUIPMENT COVERING

- A. Factory Insulated Equipment: Do not insulate, except as otherwise noted.
- B. Apply insulation close to equipment by grooving, scoring, and beveling insulation. Fasten insulation to equipment with studs, pins, clips, adhesive, wires, or bands as appropriate.
- C. Fill joints, cracks, seams, and depressions with bedding compound to form smooth surface. On cold equipment, use vapor barrier cement.
- D. Insulated equipment containing fluids below ambient temperature: Insulate entire system.
- E. Fiber glass insulated equipment containing fluids below ambient temperature: Provide vapor barrier jackets, factory-applied or field-applied. Finish with glass cloth and vapor barrier adhesive.
- F. For hot equipment containing fluids 140 degrees F or less, do not insulate flanges and unions, but bevel and seal ends of insulation.
- G. Fiber glass insulated equipment containing fluids above ambient temperature: Provide standard jackets, with or without vapor barrier, factory-applied or field-applied. Finish with glass cloth and adhesive.
- H. Finish insulation at supports, protrusions, and interruptions.
- I. Equipment in Mechanical Equipment Rooms or Finished Spaces: Finish with canvas jacket sized for finish painting.

- J. Exterior Applications: Provide vapor barrier jacket or finish with glass mesh reinforced vapor barrier cement. Cover with aluminum jacket with seams located on bottom side of horizontal equipment.
- K. Nameplates and ASME Stamps: Bevel and seal insulation around; do not insulate over.
- L. Equipment Requiring Access for Maintenance, Repair, or Cleaning: Install insulation so it can be easily removed for inspection.

3.6 INSTALLATION OF ONE-PIECE PVC INSULATED FITTING COVERES

- A. Premolded fitting covers to be precisely cut or mitered to fit or be tucked snugly into the throat of fitting and edges adjacent to pipe covering and taped to form a fully insulated pipe covering.
- B. Use adhesive and/or tape specified for type of insulation to insure a thorough vapor barrier.
- C. Tape ends securely to adjacent pipe covering. Tape to extend over adjacent pipe insulation with an overlap of at least 2-inch on both sides.

END OF SECTION 230700

SECTION 230923 - ENTERPRISE BUILDING AUTOMATION SYSTEM

PART 1 - GENERAL

1.1 SECTION INCLUDES

- A. Building Automation System (BAS) Requirements.

1.2 REFERENCES

- A. ASME MC85.1 - Terminology for Automatic Control.
- B. NEMA EMC1 - Energy Management Systems Definitions.
- C. NEMA 250 - Enclosures for Electrical Equipment (1000 Volts Maximum).
- D. NFPA 70 - National Electrical Code.
- E. NFPA 90A - Installation of Air Conditioning and Ventilation Systems, where applicable to controls and control sequences.
- F. NFPA 92 – Standard for Smoke Control Systems, where applicable to controls and control sequences.
- G. UL 916: Energy Management Systems.
- H. UUKL 864: UL Supervised Smoke Control, where applicable to controls and control sequences.
- I. ANSI/ASHRAE Standard 135, BACnet - A Data Communication Protocol for Building Automation and Control Systems.

1.3 REGULATORY REQUIREMENTS

- A. The BAS shall comply with all governing codes, ordinances, and regulations, including UL, NFPA, State and local Building Code, and NEC.
- B. Products Requiring Electrical Connection: Listed and classified by Underwriters Laboratories Inc.
- C. All electronic equipment shall conform to the requirements of FCC Regulation, Part 15, Governing Radio Frequency Electromagnetic Interference, and be so labeled.
- D. The BAS and components shall be listed by Underwriters Laboratories (UL 916) as an Energy Management System.
- E. Portions of the BAS utilized for fire/smoke management controls and monitoring shall be listed by Underwriters Laboratories (UUKL 864).

1.4 RELATED WORK SPECIFIED IN OTHER SECTIONS

- A. Where work specified under other Sections of these specifications connects to equipment or systems which are a part of this Section provide proper connections to such equipment including trade coordination (including commissioning specifications).

1.5 PRODUCTS FURNISHED BUT NOT INSTALLED UNDER THIS SECTION

- A. Sensors and Transmitters:
 - 1. Flow switches, etc.

1.6 PRODUCTS INSTALLED BUT NOT FURNISHED UNDER THIS SECTION

- A. Fire Detection and Alarm:
 - 1. Smoke Detectors/Fire Stats

1.7 PRODUCTS NOT FURNISHED OR INSTALLED UNDER, BUT INTEGRATED WITH THE WORK OF THIS SECTION

- A. Section – General:
 - 1. Integration Meeting: The Installer furnishing the BAS system shall meet with the Installer(s) furnishing each of the following products to coordinate details of the interface between these products and the BAS system. The Owner or his designated representative shall be invited to this meeting. Each Installer shall provide the Owner and all other Installers with details of the proposed interface including PICS for BACnet equipment, hardware and software identifiers for the interface points, network identifiers, wiring requirements, communication speeds, and required network accessories. The purpose of this meeting shall be to insure there are no unresolved issues regarding the integration of these products into the BAS system. Submittals for these products shall not be approved prior to the completion of this meeting.
- B. Low-Voltage Controllers:
 - 1. Variable frequency drives: The variable frequency drive (VFD) vendor shall furnish VFDs with an interface to the control and specified monitoring points specified. These specified points shall be the minimum acceptable interface to the VFD. The connection to these points shall be by one of the following methods: (a) Hardwired connection such as relay, 0-10VDC, or 4-20mA. (b) BACnet/IP network connection. (c) BACnet over ARCNET network connection. (d) BACnet MS/TP network connection.
- C. Heating Boilers:
 - 1. Boiler controls: The boiler vendor shall furnish boilers with an interface to the control and monitoring points specified. These specified points shall be the minimum acceptable interface to the boiler. The connection to these points shall be by one of the following methods: (a) Hardwired connection such as relay, 0-10VDC, or 4-20mA. (b) BACnet/IP network connection. (c) BACnet over ARCNET network connection. (d) BACnet MS/TP network connection.
- D. Central Cooling Equipment:

1. Chiller controls: The chiller vendor shall furnish chillers with an interface to the control and monitoring points specified. These specified points shall be the minimum acceptable interface to the chiller. The connection to these points shall be by one of the following methods: (a) Hardwired connection such as relay, 0-10VDC, or 4-20mA. (b) BACnet/IP network connection. (c) BACnet over ARCNET network connection. (d) BACnet MS/TP network connection.

E. Central HVAC Equipment:

1. Packaged AHU or evaporative cooler controls: Unit shall be furnished configured to accept control inputs from an external building automation system controller as specified. Factory mounted safeties and other controls shall not interfere with this controller.

1.8 PRE-INSTALLATION MEETING

- A. BAS contractor shall initiate a meeting two weeks following submittal date to review engineer and owner comments and to finalize the submittal. If the engineer does not feel the submittal can be approved yet, then this meeting may occur after resubmittal. The meeting shall include the owner, the engineer, and all parties directly affecting the work of this section.
- B. Reference integration meeting requirements defined above.

1.9 SCOPE OF WORK

- A. Adjust the following as necessary to adequately describe the general scope of work for the BAS contractor.
- B. Furnish and install a Building Automation System (BAS) as detailed within these specifications. This system shall be provided, erected, assembled, and installed by the control system manufacturer or the manufacturer's authorized representative and utilizing technicians and mechanics regularly employed by the control manufacturer or the manufacturer's authorized representative. The Building Automation System of this defined project, as specified, will be capable of complete stand-alone operation and must include, but are not limited to the required features, options, and functions. The system shall be connected to the campus computer network. One network switch and network data connection to the campus network will be provided by others, however all other necessary equipment, connections, programming, etc. required to make the system fully functional per this specification shall be provided by the controls contractor as part of this contract.

1.10 QUALITY ASSURANCE

- A. Manufacturer Qualifications: Company specializing in manufacturing the Products specified in this section with minimum five years' experience.
 1. Design system software under direct supervision of a Professional Engineer experienced in design of this Work and licensed in the State of North Carolina.
 2. Installer must provide a description of their quality assurance operations from contract award through final delivery. The description shall include organizational responsibilities for each department represented within the execution of this document from installers to engineers, service technicians and management.

1.11 SYSTEM DESCRIPTION

- A. Automatic temperature controls field monitoring and control system using field programmable microprocessor-based units.
- B. BAS is based on distributed system of fully intelligent, stand-alone controllers, operating in a multi-tasking, multi-user environment on token passing network, with central and remote hardware, software, and interconnecting wire and conduit communicating via BACnet communication protocols or Ethernet / IP.
- C. Include computer software and hardware, operator input/output devices, control units, sensors, control devices, electronic actuators as necessary for a fully functional controls system.
- D. Provide operating software including central system software.
- E. Provide control systems consisting of thermostats, interface equipment and other apparatus and accessories required to operate mechanical systems, and to perform functions specified.
- F. Include installation and calibration, supervision, and fine-tuning necessary for complete and fully operational system.
- G. The failure of any single component or network connection shall not interrupt the execution of control strategies at other operational devices.

1.12 SYSTEM PERFORMANCE

- A. Performance Standards. System shall conform to the following minimum standards over network connections. Systems shall be tested using manufacturer's recommended hardware and software for operator workstation (server and browser for web-based systems).
- B. Graphic Display. A graphic with 20 dynamic points shall display with current data within 10 seconds.
- C. Graphic Refresh. A graphic with 20 dynamic points shall update with current data within 8 sec. and shall automatically refresh every 15 seconds.
- D. Configuration and Tuning Screens. Screens used for configuring, calibrating, or tuning points, PID loops, and similar control logic shall automatically refresh within 6 seconds.
- E. Object Command. Devices shall react to command of a binary object within 2 sec. Devices shall begin reacting to command of an analog object within 2 seconds.
- F. Alarm Response Time. An object that goes into alarm shall be annunciated at the workstation within 45 seconds.
- G. Program Execution Frequency. Custom and standard applications shall be capable of running as often as once every 5 sec. Select execution times consistent with the mechanical process under control,

- H. Performance. Programmable controllers shall be able to completely execute PID control loops at a frequency adjustable down to once per second. Select execution times consistent with the mechanical process under control.
- I. Multiple Alarm Annunciation. Each workstation on the network shall receive alarms within 5 sec of other workstations.

1.13 SUBMITTALS FOR REVIEW

- A. BAS Contractor shall not order material or begin fabrication or field installation until receiving authorization to proceed in the form of an approved submittal. BAS Contractor shall be solely responsible for the removal and replacement of any item not approved by submittal at no cost to the Owner.
- B. Proposed project team:
 - 1. Resumes of key personnel such as leadmen, superintendent and managers. Include relevant project experience, certifications, licenses, education, role, qualifications, recent training on submitted technology and years with the firm.
 - 2. Any substitutions from the proposed project team during the project shall be identified and approved prior to beginning of construction.
- C. Product Data: When manufacturer's cutsheets apply to a product series rather than a specific product, the data specifically applicable to the project shall be highlighted or clearly indicated by other means. Each submitted piece of literature and drawing shall clearly reference the specification and/or drawing that the submittal is to cover. General catalogs shall not be accepted as cutsheets to fulfill submittal requirements. Select and show submittal quantities appropriate to scope of work. Submittal approval does not relieve Contractor of responsibility to supply sufficient quantities to complete work. Submittals shall be provided within 8 weeks of contract award. Submittals shall include:
 - 1. Each submittal shall have a cover sheet with the following information provided: submittal ID number; date; project name, address, and title; BAS Contractor name, address, and phone number; BAS Contractor project manager, quality control manager, and project engineer names and phone numbers.
 - 2. BAS System Hardware:
 - a. A complete bill of materials to be used indicating quantity, manufacturer, model number, and relevant technical data of equipment to be used.
 - b. Manufacturer's description and technical data such as performance curves, product specifications, and installation and maintenance instructions for items listed below and for relevant items not listed below.
 - 1) Direct digital controllers (controller panels).
 - 2) Transducers and transmitters.
 - 3) Uninterruptable power supplies.
 - 4) Sensors (including accuracy data).
 - 5) Actuators.
 - 6) Valves.
 - 7) Relays and switches.
 - 8) Control panels.
 - 9) Power supplies.
 - 10) Batteries.
 - 11) Operator interface equipment.

- 12) Wiring.
 - c. Wiring diagrams and layouts for each control panel. Show termination numbers.
 - d. Schematic diagrams for all field sensors and controllers. Provide floor plans of all sensor locations and control hardware. Riser diagrams showing control network layout, communication protocol, and wire types.
3. Central System Hardware and Software:
 - a. A complete bill of material of equipment used indicating quantity, manufacturer, model number, and relevant technical
 - b. Manufacturer's description and technical data such as product specifications and installation and maintenance instructions for items listed below and for relevant items furnished under this contract not listed below
 - 1) Central Processing Unit (CPU) or web server.
 - 2) Monitors.
 - 3) Keyboards.
 - 4) Power supplies.
 - 5) Battery backups.
 - 6) Interface equipment between CPU or server and control panels.
 - 7) Operating System software.
 - 8) Operator interface software.
 - 9) Device configuration software.
 - 10) Color graphic software.
 - 11) Third-party software.
 - c. Schematic diagrams for all control, communication, and power wiring. Provide a schematic drawing of the central system installation. Label all cables and ports with computer manufacturers' model numbers and functions. Show interface wiring to control system.
 - d. Network riser diagrams of wiring between central control unit and control panels.
4. Controlled Systems:
 - a. Riser diagrams showing control network layout, communication protocol, and wire types.
 - b. A schematic diagram of each controlled system. The schematics shall have all control points labeled with point names shown or listed. The schematics shall graphically show the location of all control elements in the system.
 - c. A schematic wiring diagram of each controlled system. Label control elements and terminals. Where a control element is also shown on control system schematic, use the same name.
 - d. An instrumentation list (Bill of Materials) for each controlled system. List each control system element in a table. Show element name, type of device, manufacturer, model number, and product data sheet number.
 - e. A mounting, wiring, and routing plan-view drawing. The design shall consider HVAC, electrical, and other systems' design, and elevation requirements. The drawing shall show the specific location of all concrete pads and bases and any special wall bracing for panels to accommodate this work.
 - f. A complete description of the operation of the control system, including sequences of operation. The description shall include and reference a schematic diagram of the controlled system.
 - g. A point list for each control system. List I/O points and software points. Indicate alarmed and trended points.

- D. Provide a training agenda including course descriptions, course durations, location, and target audience. Include resume of videographer along with list of intended equipment to be used.

1.14 SUBMITTALS AT PROJECT CLOSEOUT

- A. Submittal Requirement: The O&M manuals shall be submitted prior to the start of functional testing and prior to the start of any Owner's training.
- B. While all requirements for hard copy submittal apply, control submittals and O&M information shall also be provided in electronic format as follows.
- C. BAS contractor checkout sheets indicating calibration of each device include initial BAS reading, field measured value, calibration offset, final BAS value and final field measured value.
- D. Drawings and Diagrams: Shop drawings shall be provided on electronic media as an AutoCAD or in Visio format. During the initial submittal approval process the drawings can be submitted in PDF format. All 'x reference' and font files must be provided with AutoCAD files.
- E. Drawings shall include individual floor plans with controller locations with all interconnecting wiring routing including space sensors, LAN wiring, power wiring, low voltage power wiring.
- F. Provide final riser diagram showing the location of all controllers.
- G. Other Submittals: All other submittals shall be provided in Adobe Portable Document Format.
- H. Controller databases.
- I. Operation and Maintenance Materials:
 - 1. Documents shall be provided electronically as described for electronic submittals and shall be text searchable.
 - 2. Submit maintenance instructions, including frequency, and spare parts lists for each type of control device, control unit, and accessory.
 - 3. Include all submittals (product data, shop drawings, control logic documentation, hardware manuals, software manuals, installation guides or manuals, maintenance instructions and spare parts lists) in maintenance manual. Only include sections for equipment and software used on this project. Do not provide entire catalog of product data with extraneous information.
 - 4. Submit BAS User's Guides (Operating Manuals) for each controller type and for all workstation hardware and software and workstation peripherals.
 - 5. Submit BAS advanced Programming Manuals for each controller type and for all workstation software.
 - 6. Controls contractor shall provide Owner with all product line technical manuals and technical bulletins, to include new and upgraded products, by the same distribution channel as to dealers or branches throughout the warranty period of the project.
 - 7. Manufacturers Certificates: For all listed and/or labeled products, provide certificate of conformance.
 - 8. Product Warranty Certificates: Coordinate and submit manufacturers product warranty certificates covering the hardware provided once approved by PU. Provide a written one-

- year guarantee showing the starting and ending dates. List the local offices and the representatives to perform routine and emergency maintenance on system components.
9. Accurately record actual setpoints and settings of controls, final sequence of operation, including changes to programs made after submission and approval of shop drawings and including changes to programs made during specified testing.
 10. Warranty: Submit manufacturer's warranty and ensure forms have been filled out in Owner's name and registered with manufacturer.
- J. Framed Control Drawings:
1. Laminated control drawings including system control schematics, sequences of operation and panel termination drawings, shall be provided in panels and mounted in a suitable frame with a .125" Lexan polycarbonate cover for major pieces of equipment. Drawings should be of sufficient size to be easily read. Terminal unit drawings shall be in the central plant equipment panel or mechanical room panel.
 2. Product Data: Submit manufacturer's technical product data for each control device, panel, and accessory furnished, indicating dimensions, capacities, performance and electrical characteristics, and material finishes. Also include installation and start-up instructions.
- 1.15 WARRANTY
- A. Contractor shall provide all software upgrades, patches, and other manufacturer recommended upgrades through the duration of the project.
 - B. Contractor shall warrant all products and labor for a period of 18 months after Final Acceptance of each fiscal year package by Owner.
 - C. Owner reserves the right to make changes to the BAS during the warranty period. Such changes do not constitute a waiver of warranty. The Contractor shall warrant parts and installation work regardless of any such changes made by the Owner unless the Contractor provides clear and convincing evidence that a specific problem is the result of such changes to the BAS. Any disagreement between Owner and the Contractor on such matters shall be subject to resolution through the contract 'Disputes' clause.
 - D. During the warranty period, the Contractor shall provide maintenance services for software and hardware components as specified below, at no additional cost to Owner.
 1. Maintenance services shall be provided for all devices, database systems and hardware installed with this project. Service all equipment per the manufacturer's recommendations. All devices shall be calibrated within the last month of the warranty period. A label indicating the date of calibration and initials of the technician performing calibration shall be affixed to the device at that time.
 2. Emergency Service: Any malfunction, failure, or defect in any hardware component or failure of any control programming that would result in property damage or loss of comfort control shall be corrected and repaired following notification by Owner to the Contractor.
 3. Response by telephone to any request for service shall be provided within one (1) hour of Owner's initial telephone request for service.
 4. If the malfunction, failure, or defect is not corrected through the telephonic communication, at least one (1) hardware and software technician, trained in the system

- to be serviced, shall be dispatched to Owner's site within two (2) hours of Owner's initial telephone request for such services, as specified.
5. Normal Service: Any malfunction, failure, or defect in any hardware component or failure of any control programming that would not result in property damage or loss of comfort control shall be corrected and repaired following telephonic notification by Owner to the Contractor.
 6. Response by telephone to any request for service shall be provided within two (2) working hours (contractor specified 40 hr. per week normal working period) of Owner's initial telephone request for service.
 7. If the malfunction, failure, or defect is not corrected through the telephonic communication, at least one (1) hardware and software technician, trained in the system to be serviced, shall be dispatched to Owner's site within three (3) working days of Owner's initial telephone request for such services, as specified.
 8. Telephonic Request for Service: Contractor shall specify a maximum of three telephone numbers for the Owner to call in the event of a need for service. At least one of the lines shall be attended at any given time. Once contacted, a technician shall respond to calls within 1 hour.
 9. Technical Support: Contractor shall provide technical support by telephone throughout the warranty period.
 10. Preventive maintenance shall be provided throughout the warranty period in accordance with the hardware component manufacturer's requirements.

1.16 PROTECTION OF SOFTWARE RIGHTS

- A. Prior to delivery of software, the Owner and the party providing the software will enter into a software license agreement with provisions for the following:
 1. Limiting use of software to equipment provided under these specifications.
 2. Limiting copying.
 3. Preserving confidentiality.
 4. Prohibiting transfer to a third party.

PART 2 - MATERIALS

2.1 MANUFACTURERS

- A. Schneider Electric.
- B. Johnson Controls, Inc.
- C. Automated Logic.
- D. Substitutions: None.

2.2 OPEN, INTEROPERABLE, INTEGRATED ARCHITECTURES

- A. The intent of this specification is to provide a peer-to-peer networked, campus control system with the capability to integrate with existing ANSI/ASHRAE Standard 135-2001 BACnet,

MODBUS, OPC, and other open and proprietary communication protocols in one open, interoperable system. New installations shall utilize MODBUS, BACnet, OPC or Ethernet/IP communication protocols.

- B. The supplied computer software shall employ object-oriented technology (OOT) for representation of all data and control devices within the system. In addition, adherence to industry standards including ANSI / ASHRAE™ Standard 135-2001 BACnet to assure interoperability between all system components is required. For each BACnet device, the device supplier must provide a PICS document showing the installed device's compliance level. Minimum compliance is Level 3; with the ability to support data read and write functionality. Physical connection of BACnet devices shall be via Ethernet (BACnet Ethernet/IP,) and/or RS-485 (BACnet MSTP) as specified.
- C. All components and controllers supplied under this Division shall be true "peer-to-peer" communicating devices. Components or controllers requiring "polling" by a host to pass data shall not be acceptable.
- D. The supplied system must incorporate the ability to access all data using standard Web browsers without requiring proprietary operator interface and configuration programs. An Open Database Connectivity (ODBC) or Structured Query Language (SQL) compliant server database is required for all system database parameter storage. This data shall reside on a supplier-installed server for all database access. Systems requiring proprietary database and user interface programs shall not be acceptable.
- E. A hierarchical topology is required to assure reasonable system response times and to manage the flow and sharing of data without unduly burdening the customer's internal Intranet network. Systems employing a "flat" single tiered architecture shall not be acceptable.
 - 1. Maximum acceptable response time from any alarm occurrence (at the point of origin) to the point of annunciation shall not exceed 5 seconds for network connected user interfaces.
 - 2. Maximum acceptable response time from any alarm occurrence (at the point of origin) to the point of annunciation shall not exceed 60 seconds for remote or dial-up connected user interfaces.

2.3 NETWORKS

- A. The Local Area Network (LAN) shall be a 100 Megabits/sec Ethernet network supporting BACnet, Java, XML, HTTP, and SOAP for maximum flexibility for integration of building data with enterprise information systems and providing support for multiple Network Area Controllers (NACs), user workstations and, if specified, a local server.
- B. Local area network minimum physical and media access requirements:
 - 1. Ethernet; IEEE standard 802.3.
 - 2. Cable: 100 Base-T, UTP-8 wire, category 5.
 - 3. Minimum throughput; 100 Mbps.

2.4 REMOTE DATA ACCESS

- A. Coordinate remote access connectivity with Owner and Engineer. The system shall support the following methods of remote access to the building data.
 - 1. Browser-based access: A remote user using a standard browser shall be able access all control system facilities and graphics with proper password. Owner shall provide the required server-side internet connection. The following paradigms are acceptable for browser-based access.
 - a. Native Internet-based user interfaces (HTML 5, Java, XML, etc.) that do not require a plug-in. The user interface must be compatible with the most current stable version of the supporting software (Java, etc.) without requiring the user to downgrade to a lesser version.
 - b. Terminal emulation software that works across the Internet and requires licensing and an installed program on the remote machine. Licenses shall be provided for at least 10 simultaneous remote connections.

2.5 COMMUNICATION SPEED

- A. The communication speed between the controllers, LAN interface devices, and operator interface devices shall be sufficient to ensure fast system response time under any loading condition. In no case shall delay times between an event, request, or command initiation and its completion be greater than those listed herein. Contractor shall reconfigure LAN as necessary to accomplish these performance requirements.
 - 1. 5 seconds between a Priority 1 (critical) alarm occurrence and enunciation at operator workstation.
 - 2. 10 seconds between a Priority 2 alarm occurrence and enunciation at operator workstation.
 - 3. 10 seconds between an operator command via an operator interface to change a setpoint and the subsequent change in the controller.
 - 4. 5 seconds between an operator command via an operator interface to start/stop a device and the subsequent command to be received at the controller.
 - 5. 10 seconds between a change of value or state of an input and it being updated on an operator interface.
 - 6. 10 seconds between an operator selection of a graphic and it completely painting the screen and updating at least 10 points.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Verify that conditioned power supply is available to the control units. Verify that field end devices and wiring are installed prior to installation proceeding.

3.2 COMMISSIONING REQUIREMENTS

- A. Controls system technician responsible for onsite programming checkout shall also provide commissioning support services. Refer to commissioning specifications for additional information.

3.3 WORKMANSHIP

- A. Install equipment, piping, and wiring/raceway parallel to building lines (i.e., horizontal, vertical, and parallel to walls) wherever possible.
- B. Provide sufficient slack and flexible connections to allow for vibration of piping and equipment.
- C. Install equipment in readily accessible locations as defined by Chapter 1 Article 100 Part A of the National Electrical Code (NEC).
- D. Verify integrity of all wiring to ensure continuity and freedom from shorts and grounds.
- E. All equipment, installation, and wiring shall comply with industry specifications and standards for performance, reliability, and compatibility and be executed in strict adherence to local codes and standard practices.

3.4 COORDINATION

- A. Coordination with controls specified in other sections or divisions. Other sections and/or divisions of this specification include controls and control devices that are to be part of or interfaced to the control system specified in this section. These controls shall be integrated into the system and coordinated by the contractor as follows:
 - 1. The contractor shall coordinate and resolve any incompatibility issues that arise between control products provided under this section and those provided under other sections or divisions of this specification.
 - 2. The contractor is responsible for providing all controls described in the contract documents regardless of where within the contract documents these controls are described.
 - 3. The contractor is responsible for the interface of control products provided by multiple suppliers regardless of where this interface is described within the contract documents.

3.5 INSTALLATION

- A. HVAC Control System Wiring:
 - 1. Routing of wiring in existing walls does not require conduit, unless required by the building code. Where used, conduit shall be EMT and the use of set screw connectors is not permitted.
 - 2. All conduit, wiring, accessories and wiring connections required for the installation of the BAS, as herein specified, shall be provided by the BAS Contractor or his subcontractors. All wiring shall comply with the requirements of local and national electric codes, unless specified otherwise in this section.
 - 3. All system input wiring shall be twisted shielded pair, minimum 18-gauge wire. All system analog output wiring shall be twisted shielded pair/3-wire as required, minimum 18-gauge wire. Preconfigured cables between Terminal Unit Controllers and Thermostats are acceptable, minimum 24 gauge.
 - 4. All internal panel device wiring for binary outputs and pilot relay shall be minimum 16-gauge wire.
 - 5. Low voltage control wiring and 24VAC can be run in the same conduit. Power wiring 120VAC and greater must be in a separate conduit.

6. Minimum control wiring conduit size $\frac{3}{4}$ ".
 - B. Digital Controller Systems:
 1. Each system will be provided with its own dedicated BAS controller or application specific controller. Mechanical systems such as AHUs, VAVs or Packaged system shall not be controlled from more than 1 application specific controller.
 2. Systems that use second tier controllers as point expansion for system controllers shall only be allowed under when the I/O points are directly controlled by the CPU of the local application specific controller.
 - C. Input Devices:
 1. All Input devices shall be installed per the manufacturer's recommendation. The contractor shall install all in-line devices such as temperature wells, pressure taps, duct smoke detectors, air flow stations, etc.
 - D. Output Devices:
 1. All output devices shall be installed per the manufacturer's recommendation. The contractor shall install all in-line devices such as control valves, dampers, etc.
 - E. Install control units and other hardware in position on permanent walls where not subject to excessive vibration.
 - F. Install software in control units and in operator workstation. Implement all features of programs to specified requirements and appropriate to sequence of operation.
 - G. Test and Balance:
 1. The contractor shall furnish a single set of all tools necessary to interface to the control system for test and balance purposes.
 2. The contractor shall provide training in the use of these tools. This training will be planned for a minimum of 4 hours.
 3. In addition, the contractor shall provide a qualified technician to assist in the test and balance process, until the first 20 terminal units are balanced.
 4. The tools used during the test and balance process will be returned at the completion of the testing and balancing.
- 3.6 IDENTIFICATION OF HARDWARE AND WIRING
- A. All wiring and cabling, including that within factory-fabricated panels shall be labeled at each end within 5 cm (2 in.) of termination with control system address or termination number.
 - B. All pneumatic tubing shall be labeled at each end within 5 cm (2 in.) of termination with a descriptive identifier.
 - C. Permanently label or code each point of field terminal strips to show the instrument or item served.
 - D. Identify control panels with minimum 1 cm ($\frac{1}{2}$ in.) letters on laminated plastic nameplates.
 - E. Identify all other control components with permanent labels. All plug-in components shall be labeled such that label removal of the component does not remove the label.

- F. Identify room sensors related to terminal boxes or valves with nameplates.
- G. Manufacturers' nameplates and UL or CSA labels shall be visible and legible after equipment is installed.
- H. Identifiers shall match record documents.
- I. Field Devices. All field devices shall be identified by a typed (not handwritten) securely attached tag label.
- J. Panel Devices. All panel devices shall be identified by a typed label securely fastened to the backplane of the local control panel.

3.7 EXISTING EQUIPMENT

- A. Wiring. Interconnecting control wiring shall be removed and shall become the property of the contractor unless specifically noted or shown to be reused.
- B. Local Control Panels. Remove and deliver existing control panels to Owner.
- C. Repair. Unless otherwise directed, the contractor is not responsible for repair or replacement of existing energy equipment and systems, valves, dampers, or actuators. Should the contractor find existing equipment that requires maintenance, the engineer is to be notified immediately.
- D. Indicator Gauges. Where these devices remain and are not removed, they must be made operational and recalibrated to ensure reasonable accuracy.
- E. Room Thermostats. Remove and deliver existing room thermostats to Owner unless otherwise noted. Patch and finish holes and marks left by removal to match existing walls.
- F. Electronic Sensors and Transmitters. Remove and deliver existing sensors and transmitters to Owner.
- G. Controllers and Auxiliary Electronic Devices. Remove and deliver existing controllers and auxiliary electronic devices to Owner.
- H. Damper Actuators, Linkages, and Appurtenances. Remove and deliver existing damper actuators, linkages, and appurtenances to Owner.
- I. Control Valves. Replace existing control valves with new. Deliver removed control valves to Owner.
- J. Control Compressed Air Systems. Replace existing control compressed air systems with new unless otherwise noted. Deliver removed systems to Owner.
- K. Existing System Operating Schedule. Existing mechanical system may be disabled during this work.
- L. The scheduling of fans through existing or temporary time clocks or control system shall be maintained throughout the DDC system installation.

- M. Install control panels where shown.
- N. Modify existing starter control circuits, if necessary, to provide hand-off-auto control of each controlled starter. If new starters or starter control packages are required, these shall be included as part of this contract.
- O. Patch holes and finish to match existing walls.

3.8 SOFTWARE LICENSE

- A. The Owner shall be the named license holder of all software associated with any and all incremental work on the project(s).
- B. The owner, or his appointed agent, shall receive ownership of all job specific software configuration documentation, data files, and application-level software developed for the project. This shall include all custom, job specific software code and documentation for all configurations and programming that is generated for a given project. Any and all required Ids and passwords for access to any component or software program shall be provided to the owner.

3.9 MANUFACTURER'S FIELD SERVICES

- A. Commissioning. Commissioning the BAS is a mandatory documented performance requirement of the selected BAS Contractor for all control systems detailed in this Specification and sequence of operations. Commissioning shall include verification of proper installation practices by the BAS Contractor and subcontractors under the BAS Contractor, point verification and calibration, system/sequence of operation verification with respect to specified operation, and network/workstation verification. Documentation shall be presented upon completion of each commissioning step and final completion to ensure proper operation of the BAS. Refer to the Commissioning Specification for more information.
- B. Noncompliant Items:
 - 1. The Contractor shall remove and replace, at its expense, all items that are not in compliance with the Specification requirements.

3.10 CONTROL SYSTEM CHECKOUT AND TESTING

- A. Startup Testing. All testing listed in this article shall be performed by the contractor and shall make up part of the necessary verification of an operating control system. This testing shall be completed before the owner's representative is notified of the system demonstration.
 - 1. The contractor shall furnish all labor and test apparatus required to calibrate and prepare for service of all instruments, controls, and accessory equipment furnished under this specification.
 - 2. Verify that all control wiring is properly connected and free of all shorts and ground faults. Verify that terminations are tight.
 - 3. Enable the control systems and verify calibration of all input devices individually. Perform calibration procedures according to manufacturers' recommendations.

4. Verify that all binary output devices (relays, solenoid valves, two-position actuators and control valves, magnetic starters, etc.) operate properly and that the normal positions are correct.
5. Verify that all analog output devices (I/Ps, actuators, etc.) are functional, that start and span are correct, and that direction and normal positions are correct. The contractor shall check all control valves and automatic dampers to ensure proper action and closure. The contractor shall make any necessary adjustments to valve stem and damper blade travel.
6. Verify that the system operation adheres to the sequences of operation. Simulate and observe all modes of operation by overriding and varying inputs and schedules. Tune all DDC loops.
7. Alarms and Interlocks:
 - a. Check each alarm separately by including an appropriate signal at a value that will trip the alarm.
 - b. Interlocks shall be tripped using field contacts to check the logic, as well as to ensure that the fail-safe condition for all actuators is in the proper direction.
 - c. Interlock actions shall be tested by simulating alarm conditions to check the initiating value of the variable and interlock action.

3.11 CONTROL SYSTEM DEMONSTRATION AND ACCEPTANCE

A. Demonstration:

1. Prior to acceptance, the control system shall undergo a series of performance tests to verify operation and compliance with this specification. These tests shall occur after the Contractor has completed the installation, started up the system, and performed his/her own tests.
2. The tests described in this section are to be performed in addition to the tests that the contractor performs as a necessary part of the installation, start-up, and debugging process and as specified in the "Control System Checkout and Testing" article in Part 3 of this specification. The engineer will be present to observe and review these tests. The engineer shall be notified at least 10 days in advance of the start of the testing procedures.
3. The demonstration process shall follow that approved in Part 1, "Submittals." The approved checklists and forms shall be completed for all systems as part of the demonstration.
4. The contractor shall provide at least two persons equipped with two-way communication and shall demonstrate actual field operation of each control and sensing point for all modes of operation including day, night, occupied, unoccupied, fire/smoke alarm, seasonal changeover, and power failure modes. The purpose is to demonstrate the calibration, response, and action of every point and system. Any test equipment required to prove the proper operation shall be provided by and operated by the contractor.
5. As each control input and output is checked, a log shall be completed showing the date, technician's initials, and any corrective action taken or needed.
6. Demonstrate compliance with Part 1, "System Performance".
7. Demonstrate compliance with sequences of operation through all modes of operation.
8. Demonstrate complete operation of operator interface.
9. Additionally, the following items shall be demonstrated:
 - a. DDC loop response. The contractor shall supply trend data output in a graphical form showing the step response of each DDC loop. The test shall show the loop's response to a change in set point, which represents a change of actuator position of at least 25% of its full range. The sampling rate of the trend shall be from 10 seconds to 3 minutes, depending on the speed of the loop. The trend data shall

- show for each sample the set point, actuator position, and controlled variable values. Any loop that yields unreasonably under-damped or over-damped control shall require further tuning by the Contractor.
- b. Demand limiting. The contractor shall supply a trend data output showing the action of the demand limiting algorithm. The data shall document the action on a minute-by-minute basis over at least a 30-minute period. Included in the trend shall be building kW, demand limiting set point, and the status of sheddable equipment outputs.
 - c. Optimum start/stop. The contractor shall supply a trend data output showing the capability of the algorithm. The change-of-value or change-of-state trends shall include the output status of all optimally started and stopped equipment, as well as temperature sensor inputs of affected areas.
 - d. Interface to the building fire alarm system.
 - e. Operational logs for each system that indicate all set points, operating points, valve positions, mode, and equipment status shall be submitted to the architect/engineer. These logs shall cover three 48-hour periods and have a sample frequency of not more than 10 minutes. The logs shall be provided in both printed and disk formats.
10. Any tests that fail to demonstrate the operation of the system shall be repeated at a later date. The contractor shall be responsible for any necessary repairs or revisions to the hardware or software to successfully complete all tests.

B. Acceptance:

1. All tests described in this specification shall have been performed to the satisfaction of both the engineer and owner prior to the acceptance of the control system as meeting the requirements of completion. Any tests that cannot be performed due to circumstances beyond the control of the contractor may be exempt from the completion requirements if stated as such in writing by the engineer. Such tests shall then be performed as part of the warranty.
2. The system shall not be accepted until all forms and checklists completed as part of the demonstration are submitted and approved as required in Part 1, "Submittals".

3.12 TRAINING

A. Provide training for a designated staff of Owner's representatives. Training shall be provided classroom training and field training.

1. Field training shall provide operators and Owner's technical staff with facility specific details of the installation including the locations of field controllers, sequence of operations, network diagrams, etc.
2. Training shall be provided for up to 6 people.
3. Classroom training shall enable students to accomplish the following objectives.
4. Day-to-day Operators:
 - a. Proficiently operate the system.
 - b. Understand control system architecture and configuration.
 - c. Understand BAS system components.
 - d. Understand system operation, including BAS system control and optimizing routines (algorithms).
 - e. Operate the workstation and peripherals.
 - f. Log on and off the system.
 - g. Access graphics, point reports, and logs.
 - h. Adjust and change system set points, time schedules, and holiday schedules.

- i. Recognize malfunctions of the system by observation of the printed copy and graphical visual signals.
 - j. Understand system drawings and Operation and Maintenance manual.
 - k. Understand the job layout and location of control components.
 - l. Access data from BAS controllers and ASCs.
 - m. Operate portable operator's terminals.
- B. Advanced Operators:
 - 1. Make and change graphics on the workstation.
 - 2. Create, delete, and modify alarms, including annunciation and routing of these.
 - 3. Create, delete, and modify point trend logs and graph or print these both on an ad-hoc basis and at user-definable time intervals.
 - 4. Create, delete, and modify reports.
 - 5. Add, remove, and modify system's physical points.
 - 6. Create, modify, and delete programming.
 - 7. Add panels when required.
 - 8. Add operator interface stations.
 - 9. Create, delete, and modify system displays, both graphical and others.
 - 10. Perform BAS system field checkout procedures.
 - 11. Perform BAS controller unit operation and maintenance procedures.
 - 12. Perform workstation and peripheral operation and maintenance procedures.
 - 13. Perform BAS system diagnostic procedures.
 - 14. Configure hardware including PC boards, switches, communication, and I/O points.
 - 15. Maintain, calibrate, troubleshoot, diagnose, and repair hardware.
 - 16. Adjust, calibrate, and replace system components.
- C. System Managers/Administrators:
 - 1. Maintain software and prepare backups.
 - 2. Interface with job-specific, third-party operator software.
 - 3. Add new users and understand password security procedures.
- D. Organize the training into sessions or modules for the three levels of operators listed above. (Day-to-Day Operators, Advanced Operators, System Managers and Administrators). Students will receive one or more of the training packages, depending on knowledge level required.
- E. Provide course outline and materials according to the submittal requirements of this specification. Provide one copy of training material per student.
- F. The instructor(s) shall be factory-trained and experienced in presenting this material.
- G. Classroom training shall be done using a network of working controllers' representative of installed hardware.
- H. Classroom training shall be held offsite within 30 miles of the Owner's site.
- I. Provide training for up to 8 people for day-to-day operators and advanced operators. Provide training for up to 4 people for system managers training.

END OF SECTION 230923

SECTION 230910 - BAS FIELD DEVICES

PART 1 - GENERAL

1.1 SECTION INCLUDES

- A. Local Control Panels.
- B. Controller Software.
- C. Controllers.
- D. Input and Output Interface.

1.2 LOCAL CONTROL PANELS

- A. All control panels shall be factory constructed, unitized cabinet type with relays and controls mounted on board, incorporating the BAS manufacturer's standard designs and layouts. All control panels shall be UL inspected and listed as an assembly and carry a UL 508 label listing compliance. Control panels shall be fully enclosed, with sub-panel, hinged door, and key-locking latch.
- B. In general, the control panels shall consist of the BAS controller(s), display module, and I/O devices—such as relays, transducers, and so forth—that are not required to be located external to the control panel due to function. The display module shall be flush mounted in the panel face unless otherwise noted.
- C. All I/O connections on the BAS controller shall be extended to a numbered, color-coded, and labeled terminal strip for ease of maintenance and expansion. Wiring to I/O devices shall be made from this terminal strip.
- D. All other wiring in the panel, internal and external, shall be made to additional line or low voltage color-coded and labeled terminal strips. Low and line voltage wiring shall be segregated. All terminal strips and wiring shall be UL listed, 300-volt service and provide adequate clearance for field wiring.
- E. All wiring for every control panel shall follow a common color-coded format. All terminal strip color coding and numbering shall follow a common format. All wiring shall be neatly installed in plastic trays or tie-wrapped.
- F. Controllers for critical applications shall be provided by an Uninterruptable Power Source as required in specifications.

1.3 CONTROLLER SOFTWARE

- A. Furnish the following applications for building and energy management. All software application shall reside and operate in the system controllers. Applications shall be editable through operator workstation, web browser interface, or engineering workstation.
- B. Scheduling. Provide the capability to execute control functions according to a user created or edited schedule. Each schedule shall provide the following schedule options as a minimum:
 - 1. Weekly Schedule. Provide separate schedules for each day of the week. Each schedule shall be able to include up to 5 occupied periods (5 start-stop pairs or 10 events).
 - 2. Exception Schedules. Provide the ability for the operator to designate any day of the year as an exception schedule. Exception schedules may be defined up to a year in advance. Once an exception schedule has executed, the system shall discard and replace the exception schedule with the standard schedule for that day of the week.
 - 3. Holiday Schedules. Provide the capability for the operator to define up to 24 special or holiday schedules. These schedules will be repeated each year. The operator shall be able to define the length of each holiday period.
- C. System Coordination. Operator shall be able to group related equipment based on function and location and to use these groups for scheduling and other applications.
- D. Remote Communication. System shall automatically contact operator workstation or server on receipt of critical alarms.
- E. Maintenance Management. The system shall be capable of generating maintenance alarms when equipment exceeds adjustable runtime, equipment starts, or performance limits.
- F. Sequencing. Application software shall sequence chillers, boilers, and pumps as specified elsewhere.
- G. PID Control. System shall provide direct- and reverse-acting PID (proportional-integral-derivative) algorithms. Each algorithm shall have anti-windup and selectable controlled variable, setpoint, and PID gains. Each algorithm shall calculate a time-varying analog value that can be used to position an output or to stage a series of outputs. The calculation interval, PID gains, and other tuning parameters shall be adjustable by a user with the correct security level.
- H. Anti-Short Cycling. All binary output objects shall be protected from short cycling by means of adjustable minimum on-time and off-time settings.
- I. On and Off Control with Differential. Provide an algorithm that allows a binary output to be cycled based on a controlled variable and a setpoint. The algorithm shall be direct-acting or reverse-acting.
- J. Runtime Totalization. Provide software to totalize runtime for each binary input and output. Configure and enable runtime totalization and alarms as specified.

1.4 CONTROLLERS

- A. General. Provide an adequate number of Building Controllers (BC), Advanced Application Controllers (AAC), Application Specific Controllers (ASC), Smart Actuators (SA), and Smart Sensors (SS) as required to achieve performance (System Performance). Every new device in

the system which executes control logic and directly controls HVAC equipment must conform to a standard BACnet Device profile as specified in ANSI/ASHRAE 135, BACnet Annex L, MODBUS, OPC, or Ethernet/IP. Unless otherwise specified, hardwired actuators and sensors may be used in lieu of BACnet Smart Actuators and Smart Sensors.

- B. All BC and AAC shall be capable of managing the I/O, alarming and trending requirements for the specific application as shown on the plans and specifications plus an additional I/O capability of 10% (minimum of 4), additional trending capability of 15%, and additional alarming capability of 25% beyond current requirements.
- C. Communication
 - 1. Service Port. Each controller shall provide a service communication port for connection to a Portable Operator's Terminal.
 - 2. Signal Management. BC and ASC operating systems shall manage input and output communication signals to allow distributed controllers to share real and virtual object information and to allow for central monitoring and alarms.
 - 3. Data Sharing. Each BC and AAC shall share data as required with each networked BC and AAC.
 - 4. Stand-Alone Operation. Each major piece of equipment (air handler, chiller, boiler, lab controller) shall be served by one controller, or multiple controllers with I/O hardwired between, to provide stand-alone operation without dependence on the BAS or IT network. Functions dependent upon the network such as outside air conditions shall be provided with default values in the event in loss of network communication.
- D. Environment. Controller hardware shall be suitable for anticipated ambient conditions.
 - 1. Controllers used outdoors or in wet ambient conditions shall be mounted in waterproof enclosures and shall be rated for operation at -29°C to 60°C (-20°F to 140°F).
 - 2. Controllers used in conditioned space shall be mounted in dust-protective enclosures and shall be rated for operation at 0°C to 50°C (32°F to 120°F).
- E. Keypad. Provide a local keypad and display for each BC and AAC. Operator shall be able to use keypad to view and edit data. Keypad and display shall require password to prevent unauthorized use. If the manufacturer does not normally provide a keypad and display for each BC and AAC, provide the software and any interface cabling needed to use a laptop computer as a Portable Operator's Terminal for the system.
- F. Real-Time Clock. Controllers that perform scheduling shall have a real-time clock.
- G. Serviceability. Provide diagnostic LEDs for power, communication, and processor. All wiring connections shall be made to a field-removable modular terminal strip or to a termination card connected by a ribbon cable. Each BC and AAC shall continually check its processor and memory circuit status and shall generate an alarm on abnormal operation. System shall continuously check controller network and generate alarm for each controller that fails to respond.
- H. Memory.
 - 1. Controller memory shall support operating system, database, and programming requirements.
 - 2. Each BC and AAC shall retain BIOS and application programming for at least 72 hours in the event of power loss.

3. Each ASC and SA shall use nonvolatile memory and shall retain BIOS and application programming in the event of power loss. System shall automatically download dynamic control parameters following power loss.
- I. Immunity to Power and Noise. Controllers shall be able to operate at 90% to 110% of nominal voltage rating and shall perform an orderly shutdown below 80% nominal voltage. Operation shall be protected against electrical noise of 5 to 120 Hz and from keyed radios up to 5 W at 1 m (3 ft).

1.5 INPUT AND OUTPUT INTERFACE

- A. General. Hard-wire input and output points to BCs, AACs, ASCs, or SAs.
- B. Protection. All input points and output points shall be protected such that shorting of the point to itself, to another point, or to ground shall cause no damage to the controller. All input and output points shall be protected from voltage up to 24 V of any duration, such that contact with this voltage will cause no controller damage.
- C. Binary Inputs. Binary inputs shall allow the monitoring of ON/OFF signals from remote devices. The binary inputs shall provide a wetting current of at least 12 mA to be compatible with commonly available control devices and shall be protected against contact bounce and noise. Binary inputs shall sense dry contact closure without application of power external to the controller.
- D. Pulse Accumulation Inputs. Pulse accumulation inputs shall conform to binary input requirements and shall also accumulate up to 10 pulses per second.
- E. Analog Inputs. Analog inputs shall allow the monitoring of low-voltage (0–10 Vdc), current (4–20 mA), or resistance (thermistor or RTD) signals. Analog inputs shall be compatible with and field configurable to commonly available sensing devices.
- F. Binary Outputs. Binary outputs shall provide for ON/OFF operation or a pulsed low-voltage signal for pulse width modulation control. Binary outputs on Building Controllers shall have three-position (on-off-auto) override switches and status lights. Outputs shall be selectable for normally open or normally closed operation.
- G. Analog Outputs. Analog outputs shall provide a modulating signal for the control of end devices. Outputs shall provide either a 0–10 Vdc or a 4–20 mA signal as required to properly control output devices. Each Building Controller analog output shall have a two-position (auto-manual) switch, a manually adjustable potentiometer, and status lights. Analog outputs shall not drift more than 0.4% of range annually.
- H. Tri-State Outputs. Control three-point floating electronic actuators without feedback with tri-state outputs (two coordinated binary outputs). Tri-State outputs may be used to provide analog output control in zone control and terminal unit control applications such as VAV terminal units, duct-mounted heating coils, and zone dampers.
- I. Universal Inputs and Outputs. Inputs and outputs that can be designated as either binary or analog in software shall conform to the provisions of this section that are appropriate for their designated use.

- J. System Object Capacity. The system size shall be expandable to at least twice the number of input/ output objects required for this project. Additional controllers (along with associated devices and wiring) shall be all that is necessary to achieve this capacity requirement. The operator interfaces installed for this project shall not require any hardware additions or software revisions in order to expand the system.

PART 2 - PRODUCTS

This Part Not Used.

PART 3 - EXECUTION

This Part Not Used.

END OF SECTION 230910

SECTION 230930 - ENTERPRISE BAS I AND C DEVICES FOR HVAC

PART 1 - GENERAL

1.1 SECTION INCLUDES

- A. Auxiliary Control Devices.
- B. Electric Control Components.

1.2 REFERENCES

- A. ASME B16.22 - Wrought Copper and Copper Alloy Solder Joint Pressure Fittings.
- B. ASTM B32 - Solder Metal.
- C. ASTM B280 - Seamless Copper Tube for Air Conditioning and Refrigeration Field Service.
- D. ASTM D1693 - Environmental Stress - Cracking of Ethylene Plastics.
- E. NFPA 70 - National Electrical Code.
- F. NFPA 90A - Installation of Air Conditioning and Ventilation Systems.

1.3 SUBMITTALS FOR REVIEW

- A. Product Data: Provide description and engineering data for each control system component. Include sizing as requested. Provide data for each system component and software module.

1.4 SUBMITTALS AT PROJECT CLOSEOUT

- A. Operation and Maintenance Data: Include inspection period, cleaning methods, recommended cleaning materials, and calibration tolerances.

1.5 QUALITY ASSURANCE

- A. Manufacturer Qualifications: Company specializing in manufacturing the Products specified in this section with minimum 3 years' experience.

1.6 REGULATORY REQUIREMENTS

- A. Products Requiring Electrical Connection: Listed and classified by Underwriters Laboratories Inc., testing firm acceptable to the authority having jurisdiction as suitable for the purpose specified and indicated.

PART 2 - PRODUCTS

A. Auxiliary Control Devices

1. Electric Damper and Valve Actuators.
 - a. Stall Protection. Mechanical or electronic stall protection shall prevent actuator damage throughout the actuator's rotation.
 - b. Spring-return Mechanism. Actuators used for power-failure and safety applications shall have an internal mechanical spring-return mechanism or an uninterruptible power supply (UPS).
 - c. Signal and Range. Proportional actuators shall accept a 0–10 Vdc or a 0–20 mA control signal and shall have a 2–10 Vdc or 4–20 mA operating range. (Floating motor actuators may be substituted for proportional actuators in terminal unit applications as approved by Engineer.)
 - d. Wiring. 24 Vac and 24 Vdc actuators shall operate on Class 2 wiring.
 - e. Manual Positioning. Operators shall be able to manually position each actuator when the actuator is not powered. Non-spring-return actuators shall have an external manual gear release. Spring-return actuators with more than 7 N·m (60 in.-lb) torque capacity shall have a manual crank.
2. Pneumatic Damper and Valve Actuators and Positioners.
 - a. Type. Pneumatic actuators shall be piston-rolling diaphragm type or diaphragm type. Diaphragm shall be easily replaceable, beaded, molded neoprene.
 - b. Housing. Actuator housings shall be molded or die-cast zinc or aluminum. Exception: Actuator housings for terminal unit zone control dampers or valves may be of high-impact plastic construction with a minimum ambient temperature rating of 10°C–60°C (50°F–140°F). Isolate plastic devices from return air plenums in an auxiliary metal enclosure with a quick-opening access panel.
 - c. Selection. Size actuators and select spring ranges suitable for intended application and in accordance with manufacturer's recommendations.
 - d. Actuators shall have sufficient reserve power to operate related control damper or valve with smooth modulating or two-position action.
 - e. Actuators shall have proper response speed at design velocity and pressure.
 - f. Actuators shall be rated for a minimum 140 kPa (20 psig).
 - g. Actuator close-off force shall effectively seal damper or valve at maximum design system pressure. At design flow and pressure actuator shall modulate smoothly.
 - h. For sequencing applications, size valve and damper actuators for a maximum of 14 kPa (2 psi) shift in nominal spring range. Select spring ranges to prevent overlap or provide positive positioners.
3. Positive Positioners. Provide positive positioners on inlet vane actuators and on other actuators as required to provide smooth modulation or proper sequencing.
 - a. Positive positioners shall be high-capacity force balance relay type with suitable mounting provisions and shall have a position feedback linkage tailored for its actuator.
 - b. Positive positioners shall use full control air pressure at any point in stem travel to initiate stem movement or to maintain stem position. Positioners shall operate on a 20–100 kPa (3–15 psig) input signal unless otherwise required to satisfy specified sequences of operation.
 - c. Positive positioners shall have the following performance characteristics.
 - d. Linearity: $\pm 10\%$ of output signal span.
 - e. Hysteresis: 3% of span.
 - f. Response: 1.7 kPa ($\frac{1}{4}$ psig) input change.

- g. Maximum Pilot Signal Pressure: 140 kPa (20 psig).
 - h. Maximum Control Air Supply Pressure: 420 kPa (60 psig).
- 4. Binary Temperature Devices.
 - a. Low-Voltage Space Thermostats. Low-voltage space thermostats shall be 24 V, bimetal-operated, mercury-switch type, with adjustable or fixed anticipation heater, concealed setpoint adjustment, 13°C–30°C (55°F–85°F) setpoint range, 1°C (2°F) maximum differential, and vented ABS plastic cover.
 - b. Line-Voltage Space Thermostats. Line-voltage space thermostats shall be bimetal-actuated, open-contact type or bellows-actuated, enclosed, snap-switch type or equivalent solid-state type, with heat anticipator, UL listing for electrical rating, concealed setpoint adjustment, 13°C–30°C (55°F–85°F) setpoint range, 1°C (2°F) maximum differential, and vented ABS plastic cover.
 - c. Low-Limit Thermostats. Low-limit airstream thermostats shall be UL listed, vapor pressure type. Element shall be at least 6 m (20 ft) long. Element shall sense temperature in each 30 cm (1 ft) section and shall respond to lowest sensed temperature. Low-limit thermostat shall be manual reset only.
- 5. Temperature Sensors.
 - a. Sensor range: When matched with A/D converter of controller, sensor range shall provide a resolution of no worse than 0.3°F (unless noted otherwise). Where thermistors are used, the stability shall be better than 0.25°F over 5 years.
 - b. Single-Point Duct Temperature Sensor: Shall consist of sensing element, junction box for wiring connections and gasket to prevent air leakage or vibration noise. Temperature range as required for resolution indicated in paragraph directly above.
 - 1) Sensor probe shall be 316 or 304 stainless steel.
 - 2) Sensing element shall be platinum RTD, thermistor, or integrated circuit, +/- 0.3°F accuracy at calibration point.
 - 3) Liquid Immersion Temperature Sensor shall include brass thermowell, sensor and connection head for wiring connections. Temperature range shall be as required for resolution of 0.15 °F.
 - 4) Sensing element (chilled water/glycol systems) shall be thermistor or platinum RTD ±0.5 °F measured at 32 °F.
 - c. Room Temperature Sensor: Shall be an element contained within a ventilated cover, suitable for wall mounting. Provide insulated base. Following sensing elements are acceptable:
 - 1) Sensing element shall be platinum RTD, thermistor, or integrated circuit, +/- 1.0°F accuracy at calibration point.
 - 2) Provide setpoint adjustment with initial normal setpoint 72.5°F and adjustable range of +/- 2°F. The setpoint adjustment shall be a warmer/cooler indication that shall be scalable via the BAS. Provide an occupancy override button on the room sensor enclosure. This shall be a momentary contact closure. Provide nominal heating and cooling
 - 3) Provide user adjustable temperature offset and unoccupied override indication via an LED readout.
- 6. Matched Sensors: The following applications shall require matched sensors:
 - a. Hydronic Temperature Difference Calculations: Provide matched supply and return temperature sensors where the pair is used for calculating temperature difference for use in load calculations or sequencing such as across chillers and plants. Sensing element shall be platinum RTD guaranteeing an accuracy of +/- 0.5% of span plus 0.3°F.

- b. Air Handling Unit Sequencing: Provide matched pair for the cooling and heating coil leaving sensors where the sequence includes calculating an offset from the supply air setpoint to maintain a leaving heating coil temperature. Sensing element shall be platinum RTD guaranteeing an accuracy of $\pm 0.5\%$ of span plus 0.3°F .
- 7. Averaging Duct Temperature Sensor: Shall consist of an averaging element, junction box for wiring connections and gasket to prevent air leakage. Provide sensor lengths and quantities to result in one lineal foot of sensing element for each three square feet of cooling coil/duct face area. Temperature range as required for resolution indicated in paragraph A.
 - a. Sensing element shall be platinum RTD $\pm 0.3^{\circ}\text{F}$ accuracy at calibration point.
- 8. Pipe Surface-Mount Temperature Sensor: Not allowed without prior approval.
- 9. Outside Air Sensor: Shall consist of a sensor, sun shield, utility box, and watertight gasket to prevent water seepage. Temperature range shall be as required for resolution indicated.
 - a. Sensing element shall be platinum RTD, thermistor, or integrated circuit, sensor range shall provide a resolution of no worse than $\pm 0.1^{\circ}\text{F}$ measured at 40°F .
- 10. Humidity Transmitters:
 - a. Units shall be suitable for duct, wall (room) or outdoor mounting. Unit shall be two-wire transmitter utilizing bulk polymer resistance change or thin film capacitance change humidity sensor. Unit shall produce linear continuous output of 4-20 mA for percent relative humidity (% RH). A combination temperature and humidity sensor may be used for zone level monitoring. Sensors shall have the following minimum performance and application criteria:
 - 1) Input Range: 0 to 100% RH.
 - 2) Accuracy (% RH): $\pm 2\%$ (enthalpy calculation, dew point calculation or humidifier control) or $\pm 3\%$ (monitoring only) between 20-90% RH at 77°F , including hysteresis, linearity, and repeatability.
 - 3) Sensor Operating Range: As required by application
 - 4) Long Term Stability: Less than 1% drift per year.
 - 5) Acceptable Manufacturers: Units shall be Vaisala HM Series, Rotronics, E+E Elektronik, or approved equal.
- 11. Flow Switches. Flow-proving switches shall be paddle (water service only) or differential pressure type (air or water service) as shown. Switches shall be UL listed, SPDT snap-acting, and pilot duty rated (125 VA minimum).
 - a. Paddle switches shall have adjustable sensitivity and NEMA 1 enclosure unless otherwise specified.
 - b. Differential pressure switches shall have scale range and differential suitable for intended application and NEMA 1 enclosure unless otherwise specified.
- 12. Relays.
 - a. Control Relays. Control relays shall be plug-in type, UL listed, and shall have dust cover and LED "energized" indicator. Contact rating, configuration, and coil voltage shall be suitable for application.
 - b. Time Delay Relays. Time delay relays shall be solid-state plug-in type, UL listed, and shall have adjustable time delay. Delay shall be adjustable $\pm 100\%$ from setpoint shown. Contact rating, configuration, and coil voltage shall be suitable for application. Provide NEMA 1 enclosure for relays not installed in local control panel.
- 13. Override Timers.
 - a. Unless implemented in control software, override timers shall be spring-wound line voltage, UL Listed, with contact rating and configuration required by

- application. Provide 0–6 hour calibrated dial unless otherwise specified. Flush mount timer on local control panel face or where shown.
14. Current Switches.
- a. Clamp-On or Solid-Core Design Current Operated Switch (for Constant Speed Motor Status Indication).
 - 1) Range: 1.5 to 150 amps.
 - 2) Trip Point: Adjustable.
 - 3) Switch: Solid state, normally open, 1 to 135 Vac or Vdc, 0.3 Amps. Zero off state leakage.
 - 4) Lower Frequency Limit: 6 Hz.
 - 5) Trip Indication: LED.
 - 6) Approvals: UL, CSA.
 - 7) Max. Cable Size: 350 MCM.
 - 8) Acceptable Manufacturers: Veris Industries H-708/908; Inc., RE Technologies SCS1150A-LED, or approved equal.
 - b. Clamp-on or Solid-Core Wire Through Current Switch (CS/CR) (for Constant Speed Motors): Same as CS with 24v command relay rated at 5A @ 240 Vac resistive, 3A @ 240 Vac inductive, load control contact power shall be induced from monitored conductor (minimum conductor current required to energize relay 5A, max. rating of 135A). Acceptable Manufacturers shall be Veris Industries, Inc., Model # H938/735; RE Technologies RCS 1150 or approved equal.
 - 1) Where used for single-phase devices, provide the CS/CR in a self-contained unit in a housing similar with override switch to Kele RIBX or approved equal.
 - c. Clamp-On Design Current Operated Switch for Variable Speed Motor Status Indication.
 - 1) Range: 1.5 to 135 Amps.
 - 2) Trip Point: Self-calibrating based on VA memory associated with frequency to detect loss of belt with subsequent increase of control output to 60 Hz.
 - 3) Switch: Solid state, normally open, 1 to 135 Vac or Vdc, 0.3 Amps. Zero off state leakage.
 - 4) Frequency Range: 5-75 Hz.
 - 5) Trip Indication: LED.
 - 6) Approvals: UL, CSA.
 - 7) Max. Cable Size: 350 MCM.
 - 8) Acceptable Manufacturers: Veris Industries, Inc. H-904, or approved equal.
 - d. Clamp-On Wire Through Current Switch (CS/CR) (for Variable Speed Motors): Same as CS with 24v command relay rated at 5A @ 240 Vac resistive, 3A @ 240 Vac inductive, load control contact power shall be induced from monitored conductor (minimum conductor current required to energize relay 5A, max. rating of 135A). Acceptable manufacturer shall be Veris Industries, Inc., Model # H934.
 - 1) Variable Speed Status: Where current switches are used to sense the status for variable speed devices, the CT shall include on-board VA/Hz memory to allow distinction between a belt break and subsequent ramp up to 60 Hz, versus operation at low speed. The belt break scenario shall be indicated as a loss of status and the operation at low speed shall indicate normal status.
15. Current Transformers.
- a. Clamp-On Design Current Transformer (for Motor Current Sensing).
 - 1) Range: 1-10 amps minimum, 20-200 amps maximum.

- 2) Trip Point: Adjustable.
 - 3) Output: 0-5 VDC.
 - 4) Accuracy: $\pm 0.2\%$ from 20 to 100 Hz.
 - 5) Acceptable Manufacturers: Veris H221, KELE SA100 or approved equal.
16. Voltage Transmitters.
- a. AC voltage transmitters shall be self-powered single-loop (two-wire) type, 4–20 mA output with zero and span adjustment.
 - b. Adjustable full-scale unit ranges shall be 100–130 Vac, 200–250 Vac, 250–330 Vac, and 400–600 Vac. Unit accuracy shall be $\pm 1\%$ full-scale at 500 ohm maximum burden.
 - c. Transmitters shall meet or exceed ANSI/ISA S50.1 requirements and shall be UL/CSA recognized at 600 Vac rating.
17. Voltage Transformers.
- a. AC voltage transformers shall be UL/CSA recognized, 600 Vac rated, and shall have built-in fuse protection.
 - b. Transformers shall be suitable for ambient temperatures of 4°C–55°C (40°F–130°F) and shall provide $\pm 0.5\%$ accuracy at 24 Vac and 5 VA load.
 - c. Windings (except for terminals) shall be completely enclosed with metal or plastic.
18. Differential Pressure Transmitters.
- a. General Purpose Low Pressure Air: Generally for each measurement of duct pressure, filter differential pressure or constant volume air velocity pressure measurement where the range is applicable.
 - 1) General: Loop powered two-wire differential capacitance cell-type transmitter.
 - 2) Output: two wire 4-20 mA or 0-5 volt for runs less than 100' output with zero adjustment.
 - 3) Overall Accuracy: Plus or minus 1%.
 - 4) Minimum Range: 0.1 in. w.c.
 - 5) Maximum Range: 10 in. w.c.
 - 6) Housing: Polymer housing suitable for surface mounting.
 - 7) Acceptable Manufacturers: Units shall be Modus T30, Veris PX Series, or Dwyer Series 616. Substitutions shall be allowed per Division 1.
 - 8) Static Sensing Element: Pitot-type static pressure sensing tips similar to Dwyer model A-301 and connecting tubing.
 - 9) Range: Select for specified setpoint to be between 25% and 75% full-scale.
 - b. General Purpose Low Pressure/Low Differential Air: Generally for use in static measurement of space pressure or constant volume air velocity pressure measurement where the range is applicable.
 - 1) General: Loop powered, two-wire differential capacitance cell type transmitter.
 - 2) Output: Two-wire 4-20 mA or 0-5 volt for runs less than 100' output with zero adjustment.
 - 3) Overall Accuracy: Plus or minus 1%.
 - 4) Minimum Repeatability: $\pm .25\%$ of reading.
 - 5) Maximum Range: 0.1, 0.25, or 0.5 in. w.c.
 - 6) Housing: Polymer housing suitable for surface mounting.
 - 7) Acceptable Manufacturers: Modus T30. Substitutions shall be allowed per Division 1.
 - 8) Static Sensing Element: Pitot-type static pressure sensing tips similar to Dwyer model A-301 and connecting tubing.

- 9) Range: Select for specified setpoint to be between 25% and 75% full-scale.
19. VAV Velocity Pressure: Generally for use in variable volume air velocity pressure measurement where the range is applicable.
 - a. General: Loop powered two-wire differential capacitance cell type transmitter.
 - b. Output: Two-wire, 4-20 mA output with zero adjustment.
 - c. Overall Accuracy: Plus or minus 0.25% .
 - d. Minimum Range: 0 in. w.c.
 - e. Maximum Range: 1 in. w.c.
 - f. Housing: Polymer housing suitable for surface mounting.
 - g. Acceptable Manufacturers: Setra or Approved Equal or approved equal.
 - h. Range: Select for minimum range that will accept the maximum velocity pressure expected.
20. Differential Pressure Switches
 - a. General Service Auto Reset - Air: Diaphragm with adjustable setpoint and differential and snap acting form C contacts rated for the application. Provide manufacturer's recommended static pressure sensing tips and connecting tubing. Acceptable Manufacturer - Dwyer Series 1900 or equal.
 - b. General Service Manual Reset - Air: Diaphragm with adjustable setpoint and differential and snap acting form C contacts rated for the application. Provide manufacturer's recommended static pressure sensing tips and connecting tubing. Acceptable Manufacturer - Dwyer Series 1900 or equal.
 - c. General Service - Water: Diaphragm with adjustable setpoint, 2 psig or adjustable differential and snap-acting Form C contacts rated for the application. 60 psid minimum pressure differential range and 0 °F to 160 °F operating temperature range.
21. Pressure Switches.
 - a. Diaphragm or bourdon tube with adjustable setpoint and differential and snap-acting Form C contacts rated for the application. Pressure switches shall be capable of withstanding 150% of rated pressure.
 - b. Acceptable Manufacturers: Square D, ITT Neo-Dyn, ASCO, Penn, Honeywell, and Johnson Controls or approved equal.
22. Transducers.
 - a. Standard Capacity Electronic-to-Pneumatic (E-P) Transducers: E-P transducers shall be Voltage-to-Pneumatic (V-P) type, Current-to-Pneumatic (I-P) type:
 - 1) Electrical Power Supply: 24 Vac or 24 Vdc.
 - 2) Pneumatic Air Supply: 30 psig (2.07 bar) maximum.
 - 3) Air Capacity: 1100 scim @ 20 psig (300 cm³/sec @ 1.4 bar).
 - 4) Air Consumption: Zero at steady state.
 - 5) Output Span: 0-20 psig (0-1.4 bar).
 - 6) Input: 4-20 mA, 0-5 Vdc, 1-5 Vdc, 0-10 Vdc, 2-10 Vdc, 0-15 Vdc, or 3-15 Vdc input.
 - 7) Filter: Provide inline filter at the main air connection to remove oil, moisture and dirt with an indicator for contamination.
 - 8) Gauges: Provide with main and branch air gauges
 - 9) Enclosure: Polymer designed for surface or panel mount. Provide with main air and branch air gauges.
 - 10) Air Connections: ¼" (6.35 mm) barbed.
 - 11) Failure Mode on Power Loss: Non-failsafe transducers shall have no output air loss. Failsafe transducers shall exhaust output upon power loss.

- 12) Acceptable Manufacturers: RE Technologies Model UCP-522 or Approved Equal.
- b. Electronic-to-Pneumatic (E-P) Transducers: E-P transducers shall be Voltage-to-Pneumatic (V-P) type or Current-to-Pneumatic (I-P) type:
 - 1) Electrical Power Supply: 24 Vac or 24 Vdc.
 - 2) Accuracy: $\pm 1\%$
 - 3) Feedback: Branch pressure feedback from an on board pressure sensor - VDC Feedback
 - 4) Override: Manual Potentiometer
 - 5) Pneumatic Air Supply: 25-30 psig (2.07 bar) maximum.
 - 6) Air Capacity: .5 scim @ 20 psig (300 cm³/sec @ 1.4 bar).
 - 7) Air Consumption: None
 - 8) Output Span: 3-15 psig factory set, field adjustable
 - 9) Input: 4-20 mA, 0-5 Vdc, 0-10 Vdc, 2-10 Vdc, 0-18 Vdc.
 - 10) Filter: Provide inline filter at the main air connection to remove oil, moisture and dirt with an indicator for contamination.
 - 11) Gauges: Provide with main and branch air gauges
 - 12) Enclosure: NEMA 1. Provide with main air and branch air gauges.
 - 13) Air Connections: $\frac{1}{4}$ " (6.35 mm) barbed brass.
 - 14) Failure Mode on Power Loss: Non-failsafe transducers shall have no output air loss. Failsafe transducers shall exhaust output upon power loss.
23. Outdoor static pressure sensor tip
 - a. Pressure sensor: Pressure sensing tip shall be designed to minimize the effects of wind and resulting velocity pressure up to 80 mph. Acceptable manufacturers shall be Dwyer A-306 or approved equal.
 - b. Low Air Pressure Surge Dampener: 30-second time constant. Acceptable manufacturer shall be Modus SD030.
24. CO₂ Sensors/Transmitters (CO₂)
 - a. CO₂ sensors shall use silicon based, diffusion aspirated, infrared single beam, dual-wavelength sensor.
 - 1) Accuracy: ± 36 ppm at 800 ppm and 68 °F.
 - 2) Stability: 5% over 5 years.
 - 3) Output: 4-20 mA, 0-10 Vdc or relay.
 - 4) Mounting: Duct or Wall as indicated.
 - 5) Calibration Kit – Provide 1 calibration kit for a project that contains at least 1 CO₂ sensor. Kit shall include 2 CO₂ calibration gas cylinders; one 200 ppm and one 1000 ppm, gas regulator, tubing, and fittings, adapters, sensor cones etc. for the application.
25. CO/NO₂ sensors located in parking deck and loading dock areas shall be gas specific electro-chemical type with an accuracy of ± 0.5 to 1.0 ppm. Sensors shall be located 5 ft. above finished floor elevation and cover a radius of 50 ft. Sensors shall include up to three (minimum) programmable stage alarm levels. Controllers shall interface with up to 16 sensors (per controller). Provide 120V power to controller with sensors powered by controller. Controllers shall include 4-20 ma output and dry contact. Communication shall be via RS 485 busway. The level setpoint shall be 50 ppm (adjustable) for CO and 5.0 (adjustable) for NO₂. All controllers shall include a BACnet coupler for interface with the BAS system. System shall be InTec or equal.
26. Water leak detectors shall sense the presence of water and alert the BAS system as well as local alert via a red LED light. Alarm shall be activated within 5 seconds of detection of water. Sensors shall be an attached stainless steel probe with adjustable depth screw

- (0.63" to 0.84"), remote pan mounted sensor with adjustable depth (0.62" to 0.5"), or remote plenum rated rope sensor (for area water detection) as required for the sensor location and duty. The unit shall include four remote alarm contacts, green power light, red alarm light and shall be 24VAC/VDC power in a NEMA 4 enclosure. Unit shall be allow options for manual reset, automatic reset and Unsupervised or supervised modes, BAPI – BA LDT* or equal.
27. Occupancy Sensors. Occupancy sensors shall utilize Passive Infrared (PIR) and/or Microphonic Passive technology to detect the presence of people within a room. Sensors shall be mounted as indicated on the approved drawings. The sensor output shall be accessible by any lighting and/or HVAC controller in the system. Occupancy sensors shall be capable of being powered from the lighting or HVAC control panel, as shown on the drawings. Occupancy sensor delay shall be software adjustable through the user interface and shall not require manual adjustment at the sensor.

B. Electric Control Components

1. Limit Switches (LS): Limit switches shall be UL listed, SPDT or DPDT type, with adjustable trim arm. Limit switches shall be as manufactured by Square D, Allen Bradley or approved equal.
2. Electric Solenoid-Operated Pneumatic Valves (EP): EP valves shall be rated for a minimum of 1.5 times their maximum operating static and differential pressure. Valves shall be ported 2-way, 3-way, or 4-way and shall be normally closed or open as required by the application. EPs shall be sized for minimum pressure drop, and shall be UL and CSA listed. Furnish and install gauges on all inputs of EPs. Furnish an adjustable air pressure regulator on input side of solenoid valves serving actuators operating at greater than 30 psig.
 - a. Coil Enclosure: Indoors shall be NEMA-1, Outdoors and NEMA-3, 4, 7, 9.
 - b. Fluid Temperature Rating: Valves for compressed air and cold water service shall have 150 °F (66 °C) minimum rating. Valves for hot water or steam service shall have fluid temperature rating higher than the maximum expected fluid temperature.
 - c. Acceptable Manufacturers: EP valves shall be as manufactured by ASCO or Parker or approved equal.
 - d. Coil Rating: EP valves shall have appropriate voltage coil rated for the application (i.e., 24 VAC, 120 VAC, 24 VDC, etc.).
3. Low Temperature Detector ('Freezestat') (FZ): Low temperature detector shall consist of a 'cold spot' element which responds only to the lowest temperature along any one foot of entire element, minimum bulb size of 1/8" x 20' (3.2mm x 6.1m), junction box for wiring connections and gasket to prevent air leakage or vibration noise, DPDT (4 wire, 2 circuit) with manual reset. Temperature range 15 to 55 °F (-9.4 to 12.8 °C), factory set at 38 °F.
4. High Temperature Detectors ('Firestat') (FS): High temperature detector shall consist of 3-pole contacts, a single point sensor, junction box for wiring connections and gasket to prevent air leakage of vibration noise, triple-pole, with manual reset. Temperature range 25 to 215 °F (-4 to 102 °C).
5. Control Relays: All control relays shall be UL listed, with contacts rated for the application, and mounted in minimum NEMA-1 enclosure for indoor locations, NEMA-4 for outdoor locations.
 - a. Control relays for use on electrical systems of 120 volts or less shall have, as a minimum, the following:
 - b. AC coil pull-in voltage range of +10%, -15% or nominal voltage.

- c. Coil sealed volt-amperes (VA) not greater than four (4) VA.
 - d. Silver cadmium Form C (SPDT) contacts in a dustproof enclosure, with 8 or 11 pin type plug.
 - e. Pilot light indication of power-to-coil and coil retainer clips.
 - f. Coil rated for 50 and 60 Hz service.
 - g. Acceptable Manufacturers: Relays shall be Potter Brumfield, Model KRPA or approved Equal.
 - h. Relays used for across-the-line control (start/stop) of 120V motors, 1/4 HP, and 1/3 HP, shall be rated to break minimum 10 Amps inductive load. Relays shall be IDEC. Substitutions shall be allowed per Division 1.
 - i. Relays used for stop/start control shall have low voltage coils (30 VAC or less), and shall be provided with transient and surge suppression devices at the controller interface.
 - j. All safety circuits shall be installed to operate individual interposing relays located in the associated equipment control panel. Each safety device (i.e. Freezestat, DP safety, smoke detector, firestat, etc.) wiring circuit shall be installed with individual homeruns back to the associated control panel. See control drawings for details.
6. General Purpose Power Contactors: NEMA ICS 2, AC general-purpose magnetic contactor. ANSI/NEMA ICS 6, NEMA type 1 enclosure. Manufacturer shall be Square 'D', Cutler-Hammer or Westinghouse or approved equal.
7. Control Transformers: Furnish and install control transformers as required. Control transformers shall be machine tool type, and shall be US and CSA listed. Primary and secondary sides shall have replaceable fuses in accordance with the NEC. Transformer shall be proper size for application, and mounted in minimum NEMA-1 enclosure. Transformers shall be sized so that the connected load does not exceed more than 75% of the manufacturer's stated rating.
- a. Transformers shall be manufactured by Westinghouse, Square 'D', or Jefferson or approved equal.
8. Time Delay Relays (TDR): TDRs shall be capable of on or off delayed functions, with adjustable timing periods, and cycle timing light. Contacts shall be rated for the application with a minimum of two (2) sets of Form C contacts, enclosed in a dustproof enclosure.
- a. TDRs shall have silver cadmium contacts with a minimum life span rating of one million operations. TDRs shall have solid state, plug-in type coils with transient suppression devices.
 - b. TDRs shall be UL and CSA listed, Crouzet type or approved equal.
9. Electric Push Button Switch: Switch shall be momentary contact, oil tight, push button, with number of N.O. and/or N.C. contacts as required. Contacts shall be snap-action type, and rated for minimum 120 Vac operation. Switch shall be 800T type, as manufactured by Allen Bradley or approved equal.
10. Pilot Light: Panel-mounted pilot light shall be NEMA ICS 2 oil tight, transformer type, with screw terminals, push-to-test unit, LED type, rated for 120 VAC. Unit shall be 800T type, as manufactured by Allen-Bradley or approved equal.
11. Alarm Horn: Panel-mounted audible alarm horn shall be continuous tone, 120 Vac Sonalert solid-state electronic signal, as manufactured by Mallory or approved equal.
12. Electric Selector Switch (SS): Switch shall be maintained contact, NEMA ICS 2, oil-tight selector switch with contact arrangement, as required. Contacts shall be rated for minimum 120 Vac operation. Switch shall be 800T type, as manufactured by Allen-Bradley or approved equal.

PART 3 - EXECUTION

3.1 Examination

- A. Verify that systems are ready to receive work.
- B. Sequence work to ensure installation of components is complementary to installation of similar components in other systems
- C. Coordinate installation of system components with installation of mechanical systems equipment such as air handling units.

3.2 Installation

- A. Install in accordance with manufacturer's instructions.
- B. Check and verify location of thermostats and other exposed control sensors with plans and room details before installation. Locate 48 inches above floor, maximum. Align with lighting switches.
- C. Mount freeze protection thermostats using flanges and element holders.
- D. Mount outdoor reset thermostats and outdoor sensors indoors, with sensing elements outdoors.
- E. Provide separable sockets for liquids and flanges for air bulb elements.
- F. Provide mixing dampers of parallel blade construction arranged to mix streams.
- G. Mount control panel in equipment room, adjacent to associated equipment on vibration free walls or free standing angle iron supports. One cabinet may accommodate more than one system in same equipment room. Provide engraved plastic nameplates for instruments and controls inside cabinet and engraved plastic nameplates on cabinet face.
- H. Install "hand/off/auto" selector switches in starter face to override automatic interlock controls when switch is in "hand" position.
- I. Provide conduit and electrical wiring in accordance with NEC.
- J. Provide pressure gages with pulsation dampers across domestic water meters. Provide valves to isolate each gage. Extend nipples to allow clearance from insulation.
- K. Provide isolation valves around water and gas meter assemblies. Valve types shall be per meter manufacturer recommendation.
- L. Provide straight pipe upstream and downstream for all water and gas meters per manufacturer recommendations to achieve maximum accuracy.
- M. Thermostats installed on exterior walls shall be provided with insulated backing to avoid impact of cold/hot air on thermostat reading.

END OF SECTION

SECTION 230935 - BAS COMMUNICATION AND WIRING

PART 1 - GENERAL

- 1.1 Install and configure building gateway(s) to provide interface between the VLAN and the server. Install systems and materials in accordance with manufacturer's instructions, roughing-in drawings and details shown on drawings. Ensure that gateway(s) combined network usage on the control network does not exceed the 30% bandwidth utilization.
 - A. Provide and install all necessary cat 6a wiring as required to support BAS network needs downstream of the building gateway.
 - B. All wiring shall be in accordance with manufacturer's requirements and the National Electric Code. All wire insulation shall be labeled with BRADY style markers for ease of identification. Communication wiring shall be provided in a customized color jacketing material. Material color shall be blue and submitted and approved by the Client. In addition, all wiring jackets shall be labeled "BAS" in 3 foot or fewer intervals along the length of the jacket material.
 1. Contractor shall supply all communication wiring between Building Controllers, Routers, Gateways, AAC's, ASC's and local and remote peripherals (e.g., operator workstations, printers, and modems).
 2. Primary and Secondary Controller LANs: Communication wiring shall be individual 100% shielded pairs per manufacturers recommendations for distances installed, with overall PVC cover, Class 2, plenum-rated run with no splices and separate from any other wiring. Shielding shall be terminated and wiring shall be grounded as recommended by manufacturer. At the point of exit within any control panel, communication wiring shall be tagged with the destination panel or device ID. Communications wiring shall be installed in EMT conduit unless routed over accessible ceiling spaces or when routed 8 ft AFF or higher. Plenum rated wire used above ceilings will be bundled with wire ties every 24 inches and fastened to the structure or hung through bridle rings at least every 6 feet in a workmanlike manner to avoid a conflict with electrical or HVAC installations.
 - C. Signal Wiring: Contractor shall run all signal wiring in accordance with National Electric Code. All wire insulation shall be color-coded and labeled with BRADY style markers for ease of identification.
 1. Signal wiring to all field devices, including, but not limited to, all sensors, transducers, transmitters, switches, etc. shall be per manufacturer's requirements. Signal wiring shall be run with no splices and separate from all other wiring above thirty (30) volts.
 - D. Low Voltage Analog Output Wiring: Contractor shall run all low voltage control wiring in accordance with National Electric Codes. All wire insulation shall be color-coded and labeled with BRADY style markers for ease of identification.
- 1.2 Low voltage control wiring shall be per manufacturer's requirements. Low voltage control wiring shall be run with no splices separate from any wiring above thirty (30) volts.

PART 2 - PRODUCTS

This Part Not Used.

PART 3 - EXECUTION

This Part Not Used.

END OF SECTION

SECTION 230940 - ENTERPRISE BAS SOFTWARE AND GRAPHICAL USER INTERFACE

PART 1 - GENERAL

1.1 GENERAL

- A. Graphics shall reside at the master server.
- B. Graphic software shall facilitate user-friendly interface to all aspects of the System Software specified above. The intent of this specification is to require a graphic package that provides for intuitive operation of the systems without extensive training and experience. It shall facilitate logical and simple system interrogation, modification, configuration, and diagnosis.
- C. Software shall provide the ability to alarm graphically even when operator is in another software package.
- D. Dynamic Data Displays: Dynamic physical point values shall automatically update at a minimum frequency of 10 updates per minute without operator intervention. Point value fields shall be displayed with a color code depicting normal, abnormal, override and alarm conditions.
- E. Point Override Feature: Each displayed point shall be individually enabled/disabled to allow mouse-driven override of digital points or changing of analog points. Such overrides or changes shall occur in the control unit, not just in the workstation software. The graphic point override feature shall be subject to password level protection. Points that are overridden shall be displayed in a coded color. list of points that are currently in an override state shall be available through menu selection and shall display the operator's name.
- F. The BAS and the GUI shall be made available for remote access by the client, the Engineer and the Commissioning Agent when the pre-functional checklists are submitted and accepted by the Cx agent.

1.2 GRAPHIC SOFTWARE (DESIGN REQUIREMENTS)

- A. Site Plan Graphics.
 - 1. Provide campus site plan graphics for all buildings served by the BAS controlled equipment.
 - 2. Provide links from each building to building summary page.
 - 3. Provide Campus Operations Summary table.
 - 4. Provide color code indication for any building that has a system in priority one alarm.
- B. Building Plan Graphics.
 - 1. Provide building overview graphic.
 - 2. Provide list of major equipment in the building.
 - 3. Provide link from major equipment to the individual Equipment Graphic.
 - 4. Provide links to each Floor Plan Layout Graphic.
 - 5. Provide Building Optimization Summary table.

6. Provide a single gauge type meter displaying the ratio of total building energy usage to the baseline total building energy usage over the last 60 minutes. This ratio shall be provided by the EMIS system.
- C. Floor Plan Layout Graphics:
1. Provide floor plan graphics for all areas/ floors served by BAS controlled equipment. Provide links from large floor plans to smaller, more detailed graphics (Zoom in feature).
 2. Locate all controlled or monitored equipment on the floor plan graphics with a link to the equipment.
 3. Show locations of all terminal unit Zone Sensors on the floor plans.
 4. Areas served by zone level equipment shall be clearly delineated and color coded. Color coding shall be chosen so that adjacent zones are different colors or, are clearly outlined to designate the area served by the equipment. This is especially important when a zone includes multiple rooms.
 5. Ensure room numbers reported on the floor plan graphics match the room number signage located at each room. These numbers may or may not correspond to the numbers presented on the contract documents. This contractor is responsible for coordinating with the owner to verify final room numbering signage.
 6. Review the floor plan layout design with the owner prior to installation on the server. This contractor is responsible for coordinating and receiving acceptance of the graphic layout design from the Owner, Engineer and Cx agent.
- D. Equipment Graphics (General):
1. All specified I/O points for the unit shall be shown on the graphic.
 2. In addition, display all setpoints for any controlled components on the graphic. The setpoint shall be changeable from the graphic interface.
 3. Provide a link and description of any "Parent" equipment feeding the equipment/unit that is controlled by the BAS. Also, provide the current primary value of the service being provided. i.e.: For an AHU, provide a link to the ChW & HW systems providing heating and cooling water to the unit on the unit's graphic. Next to the link, display the current supply temperature.
 4. For any equipment that has remotely located sensors, the graphic for that unit shall contain a detailed description of the location of the sensor (i.e. down duct static pressure sensors, remote hydronic DP sensors, etc.). Ideally, provide the actual room number where the sensor is located and any other descriptive information (above ceiling, etc.).
- E. Terminal Unit Graphics:
1. All specified I/O points for the unit shall be shown on the graphic.
 2. In addition, display all setpoints for any controlled components on the graphic. The setpoint shall be changeable from the graphic interface.
 3. The following additional points shall also be included (where applicable):
 - a. Minimum Flow Setpoint (VAV terminal unit).
 - b. Maximum Flow Setpoint (VAV terminal unit).
 - c. Heating Maximum Flow Setpoint (VAV terminal unit).
 - d. Base Zone Temperature setpoint.
 - e. Setpoint adjust.
 - f. Effective Heating setpoint.
 - g. Effective Cooling setpoint.
 - h. Occupancy Mode/Command.
 - i. Terminal Load (% Heating/Cooling).
 - j. Any Active Alarms (status).

4. Provide a link and description of any “Parent” equipment feeding the terminal unit. Also, provide the current primary value of the service being provided. i.e.: For a VAV box, provide a link to the AHU providing supply air to the terminal unit on the terminal unit’s graphic. Next to the link, display current the supply air temperature. Similarly, provide a link to the HW system and the HW Supply temperature. This applies to all terminal equipment and to any unit that is served by another system (i.e. AHUs, Energy Recovery Systems, etc.).
- F. Campus Operations Summary.
1. The contractor shall create a table hyperlinked from the site map. The table will be used by maintenance personnel to quickly check the status of the campus major system components.
 2. Each cell, corresponding to equipment and building shall display red or green. Red indicates this system in the building is in alarm. Green indicates ‘normal’ operation. Where multiple boilers, chillers, air handlers or exhaust fans exist in one building then the graphical user interface shall also include the ‘number of the units meeting the below alarm condition’. The contractor shall provide a hyperlink from each red/green indicator light or cell to the building in reference. Reference the below table.
 3. A chilled water system shall indicate red if any of the following conditions are met:
 - a. Chilled water supply temperature exceeds setpoint by a user definable amount, or
 - b. Emergency shutdown mode is active, or
 - c. Distribution loop differential pressure is below setpoint by a user definable amount.
 4. A heating water system shall indicate red if any of the following conditions are met:
 - a. Hot water supply temperature exceeds setpoint by a user definable amount, or
 - b. Emergency shutdown mode is active, or
 - c. System (boiler or pumps) is sent a run command but status is not proven, or
 - d. Distribution loop differential pressure is below setpoint by a user definable amount.
 5. An air handler system shall be considered in alarm if any of the following conditions are met:
 - a. Preheat temperature (or mixed air temp if no preheat coil is installed) is below 45°F, or
 - b. Down duct static pressure is below 0.5 in. w.c. while the unit is commanded on, or
 - c. Emergency shutdown mode is active, or
 - d. Supply air temperature is greater than 70°F or less than 50°F for more than 15 minutes while the unit is in occupied status.
 6. A laboratory exhaust fan system shall be considered in alarm if any of the following conditions are met:
 - a. Exhaust duct static pressure is less than 0.5 in. w.c. while system in run mode.

Campus Operations Summary Table Example:

	Bldg A	Bldg B	Bldg C	Bldg D	Bldg E	Bldg F	Bldg G	Bldg H	Bldg I	Etc.
Boiler										
Chiller										
AHU										
Lab Exhaust										

G. Building Optimization Summary.

1. The Contractor shall create a table hyperlinked from the building summary page. The table will be used by maintenance personnel to quickly check for efficient operation of HVAC systems. The contractors shall populate each cell with values corresponding to the header.
2. Each cell, corresponding to equipment and building shall display red or green. Red indicates this system in the building is in alarm. Green indicates 'normal' operation. The cell shall also include measured values corresponding to the equipment and value denoted on the table. The contractor shall provide a hyperlink from each red/green indicator light or cell to the equipment in reference. See table below for more information.
3. An air handler shall indicate red when any of the following conditions are met:
 - a. Supply air temperature differs from setpoint by more than 2°F for more than 15 mins (adj) while AHU is in run status, or
 - b. For mixed air units, return air temperature is greater than 75°F or less than 70°F for more than 15 mins (adj) while AHU is in run status, or
 - c. Duct static pressure differs from setpoint by more than 0.2 in. w.c. for more than 15 mins (adj) while AHU is in run status, or
 - d. Air handler chilled water valve is more than 95% open for more than 15 mins (adj) while AHU is in run status, or
 - e. For mixed air units with economizer, outside air temperature is less than 65°F and unit is not in economizer mode.
4. A chilled water system shall indicate red when any of the following conditions are met:
 - a. Chilled water supply temperature differs from setpoint by more than 2°F for more than 15 mins (adj) while AHU is in run status, or
 - b. Chilled water delta T is less than 8°F for more than 15 mins (adj) while system is in run status, or
 - c. Chilled water pump speed is greater than 95% for more than 15 mins (adj).
5. A heating water system shall indicate red when any of the following conditions are met:
 - a. Heating water supply temperature differs from setpoint by more than 2°F for more than 15 mins (adj) while AHU is in run status, or
 - b. Heating water pump speed is greater than 95% for more than 15 mins (adj), or
 - c. More than 5 terminal box reheat valves are open 95% or more.

	Supply Temperature	Return Temperature	RA rH	SP or DP	Status	VFD Speed	# TU in Htg	# TU in Clg
AHU #								
Chilled Water							N/A	N/A
Heating Water							N/A	N/A

1.3 WEB BROWSER CLIENTS

- A. The system shall be capable of supporting an unlimited number of clients using a standard Web browser such as Internet Explorer™ or Google Chrome™ utilizing HTML5 technology. Systems requiring additional software (to enable a standard Web browser) to be resident on the client machine, or manufacture-specific browsers shall not be acceptable.
1. 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 BAS, shall not be acceptable.
 2. 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.
 3. 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.
 - 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. Real-time values displayed on a Web page shall update automatically without requiring a manual “refresh” of the Web page.
 - e. Users 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 set points in a graphical manner.
 - 2) Schedule times will be adjusted using a graphical slider, without requiring any keyboard entry from the operator.
 - 3) Holidays shall be set by using a graphical calendar, without requiring any keyboard entry from the operator.

- f. 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.
- g. View logs and charts
- h. View and acknowledge alarms
- i. 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.
- j. 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.

PART 2 - PRODUCTS

This Part Not Used.

PART 3 - EXECUTION

This Part Not Used.

END OF SECTION

SECTION 230950 - ENTERPRISE BAS ALARMING AND REPORTING

PART 1 - GENERAL

1.1 SECTION INCLUDES

- A. Alarm management and reporting requirements.

1.2 ALARM MANAGEMENT

- A. Event Alarm Notification and actions
 - 1. The building gateway shall provide alarm recognition, storage; routing, management, and analysis to supplement distributed capabilities of equipment or application specific controllers.
 - 2. The building gateway shall be able to route any alarm condition to any defined user location whether connected to a local network or remotely connected.
 - 3. Alarm generation shall be selectable for annunciation type and acknowledgement requirements including but limited to:
 - a. To alarm
 - b. Return to normal
 - c. To fault
- B. Provide timed (schedule) routing of alarms by class, object, group, or node.
- C. 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.
- D. Control equipment and network failures shall be treated as alarms and annunciated.
- E. Alarms shall be annunciated in any of the following manners as defined by the user:
 - 1. Screen message text
 - 2. Email or SMTP messaging of the complete alarm message to multiple recipients. Provide the ability to route and email alarms based on:
 - a. Day of week
 - b. Time of day
 - c. Recipient
 - 3. Graphic with flashing alarm object(s)
- F. The following shall be recorded by the building gateway for each alarm (at a minimum):
 - 1. Time and date
 - 2. Location (building, floor, zone, office number, etc.)
 - 3. Equipment (air handler #, accessway, etc.)
 - 4. Acknowledge time, date, and user who issued acknowledgement.
 - 5. Duration of alarm condition.
 - 6. Number of occurrences since last acknowledgement.

- G. Alarm actions may be initiated by user defined programmable objects created for that purpose.
- H. Defined users shall be given proper access to acknowledge any alarm, or specific types or classes of alarms defined by the user.
- I. A log of all alarms shall be maintained by the building gateway and/or a server (if configured in the system) and shall be available for review by the user.
- J. Binary Alarms. Each binary object shall have the capability to be configured to alarm based on the operator-specified state. Provide the capability to automatically and manually disable alarming.
- K. Analog Alarms. Each analog object shall have both high and low alarm limits. The operator shall be able to enable or disable these alarms.
- L. Alarm Reporting. The operator shall be able to determine the action to be taken in the event of an alarm. An alarm shall be able to start programs, print, be logged in the event log, generate custom messages, and display on graphics.
- 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.
- P. Alarm definitions shall be multi-conditional such that up to three ‘if/then’ filter statements can be utilized by the owner.
- Q. Operator shall be able to enable runtime alarm based on exceeded adjustable runtime limit.
- R. Alarm definitions shall be capable of comparing current input values to be compared to resettable output values such as supply air temperature vs. resettable supply air temperature setpoint.

1.3 ALARM AND EVENT MANAGEMENT REPORTING

- A. Alarm management shall be provided to monitor, buffer, and direct alarms and messages to operator devices and memory files. The BAS shall perform distributed, independent alarm analysis and filtering to minimize operator interruptions due to non-critical alarms, minimize network traffic, and prevent alarms from being lost. At no time shall a building controller’s ability to report alarms be affected by either operator activity at an Operator Workstation or local handheld device, or by communications with other panels on the network.
 - 1. Alarm Descriptor: Each alarm or point change shall include that point’s English language description, the time and date of occurrence. The user shall be able to print, display and store all alarm information for future reference. Alarms requiring mechanical reset shall be noted in the descriptor.
 - 2. Alarm Prioritization: The software shall allow users to define the handling and routing of each alarm by their assignment to discrete priority levels. A minimum of 10 priority

- levels shall be provided. For each priority level, users shall have the ability to enable or disable an audible tone whenever an alarm is reported and whenever an alarm returns to normal condition. Users shall have the ability to manually inhibit alarm reporting for each individual alarm and for each priority level. Contractor shall coordinate with Engineer of Record, Commissioning Agent and the owner on establishing alarm priority definitions.
3. Alarm Report Routing: Each alarm priority level shall be associated with a unique user-defined list of operator devices including any combination of local or remote workstations, printers, email accounts, SMS accounts and workstation disk files. All alarms associated with a given priority level shall be routed to all operator devices on the user-defined list associated with that priority level. For each priority level, alarms shall be automatically routed to a default operator device in the event that alarms are unable to be routed to any operator device assigned to the priority level.
 4. Alarm Acknowledgment: For alarm priority levels that are directed to a workstation screen, an indication of alarm receipt shall be displayed immediately regardless of the application in use at the workstation, and shall remain on the screen until acknowledged by a user having a password that allows alarm acknowledgment. Upon acknowledgment, the complete alarm message string (including date, time, and user name of acknowledging operator) shall be stored in the database.
- B. It shall be possible for any operator to receive a summary of all alarms, regardless of acknowledgement status, for which a particular recipient is enrolled for notification, based on current event state, based on the particular event algorithm (e.g., change of value, change of state, out of range, and so on), alarm priority, and notification class.

PART 2 - PRODUCTS

This Part Not Used.

PART 3 - EXECUTION

This Part Not Used.

END OF SECTION

SECTION 230960 - ENTERPRISE BAS POINT STRUCTURE AND NAMING

PART 1 - GENERAL

1.1 GENERAL

- A. Name points consistently across all facilities. Contractor shall configure the systems from the perspective of the entire BAS network, not solely the local project. The following requirement establishes a standard for naming points and addressing Buildings, Networks, Devices, Instances, and the like. The convention shall be implemented as much as practical, and any deviations from this naming convention shall be pre-approved by the Owner.

1.2 POINT SUMMARY TABLE

- A. The term 'Point' is a generic description for the class of object represented by analog and binary inputs, outputs, and values.
 - 1. With each schematic, Contractor shall provide a Point Summary Table listing:
 - a. Building number and abbreviation
 - b. System type
 - c. Equipment type
 - d. Point suffix
 - e. Full point name (see Point Naming Convention paragraph)
 - f. Point description
 - g. Ethernet backbone network number,
 - h. Network number
 - i. Device ID
 - j. Device MAC address
 - k. Object ID (object type, instance number)
 - l. Engineering units.
- B. Point Summary Table shall be provided in both hard copy and in electronic format (ODBC-compliant).
- C. Point Summary Table shall illustrate Network Variables and Data Link Bindings.
- D. The BAS Contractor shall coordinate with the Owner and compile and submit a proposed Point Summary Table for review prior to any object programming or project startup.
- E. The Point Summary Table shall be kept current throughout the duration of the project by the Contractor as the Master List of all points for the project. Project closeout documents shall include an up-to-date accurate Point Summary Table. The Contractor shall deliver to the Owner the final Point Summary Table prior to Substantial Completion of the system. The Point Summary Table shall be used as a reference and guide during the commissioning process.
- F. The Point Summary Table shall contain all data fields on a single row per point. The Point Summary Table is to have a single master source for all point information in the building that is

easily sorted and kept up-to-date. The point description shall be an easily understandable English-language description of the point.

Point Summary Table Example

Row Headers and Examples

(Transpose for a single point per row format)

Point Component Description	Example
Campus or Client	Raleigh
Building Number	006
System Type	Cooling
Equipment Type	Chiller
Point Suffix	CHLR1KW
Point Name (Object Name)	Ral.006.COOLING.CHILLER.CHLR1KW
Point Description (Object Description)	Chiller 1 kW
Object Type	AI
Instance Number	4
Engineering Units	KW

1.3 POINT NAMING CONVENTION

- A. All point names shall adhere to the format as established below. Said objects shall include all physical I/O points, calculated points used for standard reports, and all application program parameters. For each BAS object, a specific and unique object name shall be required.
- B. For each point, four (4) distinct descriptors shall be linked to form each unique object name: Building, System, Equipment, and Point. All keyboard characters except a space are allowable. Each of the four descriptors must be bound by a period to form the entire object name. Reference the paragraphs below for an example of these descriptors.
- C. The Owner shall designate the Building descriptor. The System descriptor shall further define the object in terms of air handling, cooling, heating, or other system. The Equipment descriptor shall define the equipment category; e.g., Chiller, Air Handler, or other equipment. The Point descriptor shall define the hardware or software type or function associated with the equipment; e.g., supply temperature, water pressure, alarm, mixed air temperature setpoint, etc. and shall contain any numbering conventions for multiples of equipment; e.g., CHLR1KW (Chiller 1 kW), CHLR2KW (Chiller 2 kW), BLR2AL (Boiler 2 Alarm), HWP1ST (Hot Water Pump 1 Status).
- D. A consistent object (point) naming convention shall be utilized to facilitate familiarity and operational ease across the BAS network. Inter-facility consistency shall be maintained to ensure transparent operability to the greatest degree possible.

Object Name Requirements

Descriptors		Comment
Campus, Building Number & Building Association	RAL0006ZZ RAL0134ZZ	The Master Building List also has the correct abbreviations for each building.
System	AIRHANDLING EXHAUST HEATING COOLING UTILITY ENDUSE MISC	Boilers and ancillary equipment Chillers and ancillary equipment Main electrical and gas meters Specific building loads by type
Equipment	BOILERS CHILLERS FACILITY TOWERS WEATHER	Non-specific boiler system points Non-specific chiller system points
Point Suffix	See “System Point Names” summary table for conventions	

- E. Examples: Within each object name, the descriptors shall be bound by a period or underscore character. Within each descriptor, words shall not be separated by dashes, spaces, or other separators as follows:
1. RAL0006ZZ.COOLING.CHILLERS.CHWP1ST
 2. RAL0006ZZ.HEATING.BOILERS.BLR1CFH

1.4 DEVICE ADDRESSING CONVENTION

- A. All assignment of network numbers and Device Object IDs shall be coordinated with the Owner.
- B. Each Network number shall be unique throughout all facilities and shall be assigned in the following manner unless specified otherwise:
 1. BBBFF, where: BBB = 1-999 assigned to each building, FF = 00 for building backbone network, 1-99 indicating floors or separate systems in the building.
- C. Each Device Object Identifier property shall be unique throughout the system and shall be assigned in the following manner unless specified otherwise:
 1. XXFFBBB, where: XX = number 0 to 99, FF = 00 for building backbone network, 1-99 indicating floors or separate systems in the building. BBB = 1-999 assigned to each building.
- D. Alternative Device ID schemes or cross project Device ID duplication if allowed shall be approved before project commencement by the Owner.

PART 2 - PRODUCTS

This Part Not Used.

PART 3 - EXECUTION

This Part Not Used.

END OF SECTION

SECTION 230970 - ENTERPRISE BAS TRENDING

PART 1 - GENERAL

1.1 SUBMITTALS

- A. The contractor shall provide the trending plan for review and approval.
- B. The user interface shall be able to display historical data in both a tabular and graphical format. The requirements of this trending shall include the following:
 - 1. Provide trends for all physical points, setpoints, other virtual and calculated variables indicated on plans.
 - 2. A minimum of 80% of the systems AI/AO trends can be active without impacting remote data access performance.
 - 3. In the graphical format, the trend shall plot at least 4 different values for a given time period superimposed on the same graph. The 4 values shall be distinguishable by using unique colors. Displayed trend graphs shall indicate the engineering units for each trended value.
 - 4. The sample rate (up to 5 second interval) and data selection shall be selectable by the operator.
 - 5. The trended value range shall be selectable by the operator.
 - 6. The trend plot shall be capable of dynamic zoom.
 - 7. Where trended values on one table/graph are Change of Value (COV), software shall automatically fill the trend samples between COV entries.
- C. Trending Requirements: Refer to the plans for information about control points for long term trending. All I/O points on primary equipment shall be trended throughout the Cx process on 1 min. intervals for analog values and change-of-value for binary values. Commissioning period trends shall include but are not necessarily limited to the following points.
 - 1. Outside air temperature.
 - 2. Outside air relative humidity.
 - 3. Outside air enthalpy.
 - 4. Cooling tons.
 - 5. All sensed hydronic temperatures.
 - 6. All sensed air temperatures and relative humidity measurements on primary equipment.
 - 7. All damper outputs on primary equipment.
 - 8. All valve outputs on primary equipment.
 - 9. All sensed fan volumes (flow) on primary equipment.
 - 10. All inputs and outputs to VSDs.
 - 11. Return (or exhaust) air temperature on each air handler.
 - 12. All safety indications.
 - 13. Status on all primary equipment.
 - 14. All air and water pressures on primary equipment or systems.
 - 15. Zone temperatures.
 - 16. Electricity consumption where monitored.
 - 17. Basically, all points on primary equipment and selected sampling of terminal points unless approved otherwise.

- D. Data Buffering and Archiving: Trend data shall be buffered at the building controller/gateway, and uploaded to remote storage when archival is desired. Archive shall be capable of storing 14 days of trend data accessible at the operator's interface. Storage and retrieval of the archive shall not impact remote data access performance. All archived trends shall be accessible by the user as applicable. Uploads shall occur based upon a user-defined interval, manual command, or automatically when the trend buffers become full.

PART 2 - PRODUCTS

This Part Not Used.

PART 3 - EXECUTION

This Part Not Used.

END OF SECTION

SECTION 232113 - HYDRONIC PIPING

PART 1 - GENERAL

1.1 SECTION INCLUDES:

- A. Pipe and pipe fittings for:
 - 1. Heating water piping system.
 - 2. Chilled water piping system.
 - 3. Equipment drains and overflows.
- B. Valves:
 - 1. Gate valves.
 - 2. Globe or angle valves.
 - 3. Ball valves.
 - 4. Butterfly valves.
 - 5. Check valves.

1.2 GENERAL REQUIREMENTS

- A. Where more than one piping system material is utilized, ensure system components are compatible and joined to ensure the integrity of the system is not jeopardized. Provide necessary joining fittings. Ensure flanges, union, and couplings for servicing are consistently provided.
- B. Use non-conducting dielectric connections whenever jointing dissimilar metals in open systems.
- C. Use unions, flanges, and couplings downstream of valves and at equipment or apparatus connections. Do not use direct welded connections to valve bodies, equipment or other apparatus.
- D. Except where shown otherwise, use ball or butterfly valves for shut-off and to isolate equipment, part of systems, or vertical risers.
- E. Use ball or butterfly valves for throttling, bypass, or manual flow control requirements for water systems if special valves or fittings are not indicated.
- F. Use spring loaded check valves on discharge of pumps when piped in parallel.
- G. Use lug type butterfly valves to isolate equipment.
- H. Use 3/4-inch ball valve with cap for drains at low points of piping, bases of vertical risers, and at equipment.
- I. All piping and fittings to be made in USA.

1.3 REFERENCES

- A. ASME - Boiler and Pressure Vessel Codes, SEC 9 - Qualification Standard for Welding and Brazing Procedures, Welders, Brazers, and Welding and Brazing Operators.
- B. ASME B16.22 - Wrought Copper and Copper Alloy Solder Joint Pressure Fittings.
- C. ASME B31.9 - Building Services Piping.
- D. ASTM A53 - Pipe, Steel, Black and Hot-Dipped, Zinc coated Welded and Seamless.
- E. ASTM A234 - Piping Fitting of Wrought Carbon Steel and Alloy Steel for Moderate and Elevated Temperatures.
- F. ASTM B32 - Solder Metal.
- G. ASTM B88 - Seamless Copper Water Tube.

1.4 DELIVERY, STORAGE, AND HANDLING

- A. Accept valves on site in shipping containers. Protect machined surfaces.
- B. Protect piping systems from entry of foreign materials by temporary covers, completing sections of the work, and isolating parts of completed system.

PART 2 - PRODUCTS

2.1 REQUIREMENTS:

- A. All piping material shall be manufactured in the USA.

2.2 HEATING WATER, CHILLED WATER, ABOVE GROUND

- A. Steel Pipe: ASTM A53, Schedule 40, (0.375-inch (10 mm) wall for sizes 2-1/2 inch (300 mm) and over,) black.
 - 1. Fittings: ASTM B16.3, malleable iron or ASTM A234, forged steel welding typed fittings.
 - 2. Joints: Threaded or welded.
- B. Copper Tubing: ASTM B88, Type L hard drawn for pipe sizes 2" and smaller.
 - 1. Fittings: ASME B16.18, cast brass, or ASME B16.22, solder, wrought copper.
 - 2. Joints: Solder, lead free 95-5 tin-antimony, or tin and silver, with melting range 430 to 535 degrees F.

2.3 EQUIPMENT DRAINS AND OVERFLOWS

A. Drains:

1. Copper tubing, ASTM B-88, Type L hard drawn.
 - a. Fittings: ASME B16.18, cast brass, or ASME B16.22, solder wrought copper.
 - b. Joints: Solder, lead free 95-5 tin-antimony, or tin and silver, with melting range 430 to 535 degrees F.

2.4 UNIONS, FLANGES, AND COUPLING

A. Union for Pipe 2 inches and Under:

1. Ferrous Piping: 150 psig malleable iron, threaded.
2. Copper Pipe: Bronze, soldered joints.

B. Flanges for Pipe Over 2 inches:

1. Ferrous Piping: 150 psig forged steel, slip-on.
2. Copper Piping: Bronze.
3. Gaskets: 1/16-inch-thick preformed neoprene.

2.5 VALVES

A. Furnish and install all valves as called for, shown on drawings or as required for proper operation and servicing of the equipment. Valves shall be of manufacturer as noted or equivalent.

B. Butterfly valves; "bubble tight" at 150 psi and 200 degrees. Construction shall be:

1. Body - Ductile Iron.
2. Seat - E.P.D.M.
3. Disc - Ductile iron or aluminum-bronze.
4. Stem - 304, 316 or 17-4PH S.S.
5. Hammond 6000 Series, Victaulic, Nibco LD-1000 or equivalent.
6. Provide 9" lever handle with infinitely adjustable throttling plate with lock nut and memory stop. Valves in insulated piping shall have 2" extended neck. VALVES 8" and larger; screw or gear operator. All butterfly valves shall be "lug" type for bolting to a standard flange.

C. Ball Valves - 600# W.O.G., 3-piece, full port:

1. Body - Bronze.
2. Seat - Teflon.
3. Ball - 304 or 316 stainless steel.
4. Stem - 304 or 316 stainless steel.
5. O-Ring - Viton or Teflon.
6. Hammond 8303, Victaulic, Nibco 595-Y-66 or equivalent.
7. Valves in insulated piping; 2" extended neck.

D. Globe valves 0-2" - 300# Bronze, Rising Stem:

1. Body – Bronze.
 2. Stem - Silicon Bronze.
 3. Disc – Bronze.
 4. Handwheel - Malleable iron.
 5. Packing - Teflon impregnated, asbestos-free.
 6. Hammond IB412, Nibco T-275 or equivalent.
- E. Globe valves over 2” - 125# O.S.&Y, Rising Stem:
1. Body – Iron.
 2. Stem - Brass or Bronze.
 3. Disc – Bronze.
 4. Seat Ring – Bronze.
 5. Yoke Bushing – Bronze.
 6. Packing - Teflon impregnated, asbestos-free.
 7. Hammond IR116, Nibco F-718-B or equivalent.
- F. Swing Check Valves 0 - 2” - 150# bronze:
1. Body – Bronze.
 2. Disc – Bronze.
 3. Hammond IB 904, Nibco T-433 or Victaulic equivalent.
- G. Swing Check Valves 2” and over - 125# iron:
1. Body – Iron.
 2. Disc – Bronze.
 3. Seat ring – Bronze.
 4. Hammond IR1124, Nibco F-918 or Victaulic equivalent.
- H. Non-slam check valves:
1. Body – Iron.
 2. Disc – Bronze.
 3. Seat – Bronze.
 4. Spring - Stainless Steel.
 5. Mueller No. 105, Williams-Hagen, Victaulic or equivalent.

PART 3 - EXECUTION

3.1 PREPARATION

- A. Ream pipe and tube ends. Remove burrs.
- B. Remove scale and dirt on inside and outside before assembly.
- C. Make piping connections to equipment with flanges or unions.

- D. Keep open ends of pipe free from scale and dirt. Protect open ends with temporary plugs or caps.

3.2 INSTALLATION

- A. Install in accordance with manufacturer's instructions.
- B. All chilled and hot water piping shall be hydrostatically tested for pressure of 1-1/2 times the working pressure of the line, but not less than 150 psig for a minimum period of 24 hours. This hydrostatic test shall be witnessed by the Engineer.
- C. Route piping in orderly manner, parallel to building structure, and maintain gradient.
- D. Install piping to conserve building space, and not interfere with use of space and other trades.
- E. Group piping whenever practical at common elevations.
- F. Sleeve pipe passing through masonry partitions, walls, and floors.
- G. Slope piping and arrange to drain at low points.
- H. Install piping to allow for expansion and contraction without stressing pipe, joints, or connected equipment.
- I. Inserts:
 - 1. Provide inserts for placement in concrete formwork.
 - 2. Where concrete slabs form finished ceiling, locate inserts flush with slab surface.
 - 3. Where inserts are omitted, drill concrete slab from below and provide expansion anchor or use an appropriate powder driven stud where permitted.
- J. Pipe Hangers and Supports:
 - 1. Install in accordance with ASTM B31.9.
 - 2. Support horizontal piping as scheduled.
 - 3. Install hangers to provide minimum 1/2-inch space between finished covering and adjacent work.
 - 4. Place hangers within 30 inches of each horizontal elbow or tee.
 - 5. Use hangers with 1-1/2-inch minimum vertical adjustment. Arrange hangers for pipe movement without disengagement of supported pipe.
 - 6. Support vertical piping at every other floor. Support riser piping independently of connected horizontal piping.
 - 7. Where several pipes can be installed insulated parallel and at same elevation, provide trapeze hangers.
 - 8. Prime coat exposed steel hangers and supports and prepare for finish painting. Hangers and supports located in crawl spaces, pipe shafts, and suspended ceiling spaces are not considered exposed.

- K. Provide clearance in hangers and from structure and other equipment for installation of insulation and access to valves and fittings.
- L. Provide access where valves and fittings are not exposed.
- M. Slope piping and arrange system to drain at low points. Use eccentric reducers to maintain proper grade.
- N. Where pipe support members are welded to structural building framing, scrape, brush clean, and apply one coat of zinc rich primer to welds.
- O. Install valves with stems upright or horizontal, not inverted.
- P. Pipe Joints: Unless otherwise specified, join pipes as follows:
 - 1. Steel pipe 2-1/2" to 4", screwed or welded joints.
 - 2. Steel pipe 4" and larger, welded, or flanged joints.
 - 3. For welded joints, use only welding type fittings and welding neck flanges with the following exception:
 - a. "Weldolet" or "Threadolet" type of welding fittings for intersection welding of small branches to mains may be used where branch is two-pipe sizes smaller than the main.
- Q. Do not make direct welded connections to valves, expansion joints, strainers, apparatus, or any other units which are intended to be removable.
- R. Copper tube, Type "K" and "L" shall have soldered joints with sweat joint type bronze or copper fittings up through 1-1/2" size. Fitting sizes 2" and larger shall be brazed joints. Flared joints with flare type bronze fittings may be used where approved for specific service.
- S. For screwed joints, use Teflon tape or approved pipe joint compound; apply only on male threads.

3.3 SCHEDULES

- A. Pipe Hanger Spacing:

Pipe Size Inches	Max Hanger Spacing Feet	Diameter Inches
1/2 to 1-1/4	6.5	3/8
1-1/2 to 2	10	3/8
2-1/2 to 3	10	1/2
4 to 6	10	5/8
8 to 12	12	7/8
14 and Over	12	1
Non-metallic (All Sizes)	6	3/8

END OF SECTION 232113

SECTION 232116 - HYDRONIC SPECIALTIES

PART 1 - GENERAL

1.1 SECTION INCLUDES:

- A. Expansion tanks.
- B. Air vents.
- C. Air separators.
- D. Strainers.
- E. Pump suction fittings.
- F. Flow indicators, controls, meters.
- G. Pressure Reducing valves.
- H. Relief valves.
- I. Flexible coupling.

1.2 QUALIFICATIONS

- A. Manufacturer: Company specializing in manufacturing the products specified in this section with minimum three years' experience.

1.3 DELIVERY, STORAGE, AND HANDLING

- A. Accept valves on site in shipping containers with labeling in place. Inspect for damage.
- B. Provide temporary protective coating on cast iron and steel valves.
- C. Provide temporary end caps and closures on piping and fittings. Maintain in place until installation.
- D. Protect piping systems from entry of foreign materials by temporary covers, completing sections of the work, and isolating parts of completed system.

PART 2 - PRODUCTS

2.1 EXPANSION TANKS

- A. Construction: System Connection – Forged Steel, Shell – Carbon Steel, Bladder – Heavy Duty Butyl Rubber, Designed and constructed per ASME section VIII, Division I. The tank shall be fitted with lifting rings and a floor mounted skirt for vertical installation.
- B. Provide pre-charged steel expansion tank with replaceable heavy duty Butyl rubber bladder/diaphragm.
- C. Provide charging valve to facilitate on-site charging of the tank to meet system requirements. Charge bladder tanks to minimum fill pressure as shown on plans.

2.2 AIR VENTS

- A. Manual Type: Short vertical sections of 2-inch diameter pipe to form air chamber, with one-piece, 1/4" ball valve at top of chamber.

2.3 AIR SEPARATORS

- A. Combination Air Separators/Strainers:
 - 1. Steel, tested and stamped in accordance with ASME SEC 8-D for 1125 psig operating pressure, with integral bronze strainer, tangential inlet and outlet connections, and internal stainless steel air collector tube.

2.4 STRAINERS

- A. Size 2 inch and Under:
 - 1. Screwed brass or iron body for 175 psig working pressure, Y pattern with 1/32-inch stainless steel perforated screen.
- B. Size 2-1/2 inch to 4 inch:
 - 1. Flanged iron body for 175 psig working pressure, basket pattern with 1/8 in stainless steel perforated screen.

2.5 PUMP SUCTION FITTINGS

- A. Fitting: Angle pattern, cast-iron body, threaded for 2 inch and smaller, flanged for 2-1/2 inch and larger, rated for 175 psig working pressure, with inlet vanes, cylinder strainer with 3/16-inch diameter openings, disposable fine mesh strainer to fit over cylinder strainer, and permanent magnet located in flow stream and removable for cleaning.
- B. Accessories: Adjustable foot support, blowdown tapping in bottom, gage tapping inside.

2.6 AUTOMATIC FLOW LIMITING CONTROL VALVES

- A. Automatic Flow Limiting Control Valves: Automatic flow limiting control valve cartridges shall automatically control flow rates with +/- 5% accuracy over an operating pressure differential range of at least 14 times the minimum required for control. Valve internal control mechanism shall consist of a stainless-steel one-piece cartridge with segmented port design and full travel linear coil spring. Manufacturer shall be able to provide certified independent laboratory tests verifying accuracy of performance. All flow control valve cartridges shall be warranted by the manufacturer for five years. Meter kit shall be provided as a single hose portable or double hose portable kit; pressure gauge with 4.5" dial shall have a range of -14.7 to 150 psig. Kit shall have end connections for either pressure or pressure/temperature test valves and shall include carrying cases. All kits shall include flow rate chart for determining flow rate.

2.7 COMBINATION BALANCING FITTING (WITH FLOW READ OUT)

- A. Manufacturers:
 - 1. Bell & Gossett.
 - 2. Taco.
 - 3. Armstrong.
- B. Construction: Bronze body/brass ball construction with glass and carbon filled TFE seat rings.
- C. Functions: 1/4" Pressure/temperature readout ports.
 - 1. Flow measurement.
 - 2. Flow balancing.
 - 3. Positive shut-off.
 - 4. Drain port.
- D. Control Mechanism: Calibrated ball valve with hand wheel indicating balance positions and memory stop.
- E. Working Pressure: 200 PSI.

2.8 PRESSURE REDUCING VALVE

- A. Iron body, low inlet pressure check valve, removable strainer. 125 psi working pressure.

2.9 RELIEF VALVES

- A. Bronze body, Teflon seat, stainless steel stem and springs, automatic, direct pressure actuated, capacities ASME certified and labeled.

2.10 FLEXIBLE COUPLINGS & VIBRATION ISOLATION

- A. Rotating and reciprocating equipment provided with suitable vibration isolating system. Isolation for all equipment above the ground floor designed for at least 95% absorption efficiency. Select isolators for proper loading to obtain desired efficiency.

- B. Provide flexible duct connections at inlet and outlet of all fans or cabinets containing fans.
- C. Piping connections to pieces of equipment containing rotating or reciprocating machinery (except inline pumps) provided with isolators to prevent transmission of vibration or noise to building structure. Water lines shall be provided with flexible Teflon coupling designed for service and operating pressure. Flexible metal hose shall be of approved design. Where such flexible connections do not accomplish full desired result, piping shall be suspended by means of properly loaded and distributed vibration eliminators design for support rods.

PART 3 - EXECUTION

3.1 INSTALLATION

- A. Install specialties in accordance with manufacturer's instructions.
- B. Where large air quantities can accumulate, provide enlarged air collection standpipes.
- C. Provide manual air vents at system high points and as indicated.
- D. Provide air separator on suction side of system pumps and connect to expansion tank.
- E. Provide valved drain and hose connection on strainer blow down connection.
- F. Provide pump suction fitting on suction side of base mounted centrifugal pumps. Remove temporary strainers after cleaning systems.
- G. Provide combination pump discharge valve on discharge side of base mounted centrifugal pumps.
- H. Provide relief valves on pressure tanks, low pressure side of reducing valves, heat exchangers, and expansion tanks.
- I. Select equipment relief valve capacity to exceed rating of connected equipment.
- J. Pipe relief valve outlet to nearest floor drain.

END OF SECTION 232116

SECTION 232123 - PUMPS

PART 1 - GENERAL

1.1 WORK INCLUDED

A. Furnish and install centrifugal type pumps with the following characteristics:

1. End Suction.
2. Flexible coupled.
3. Bronze fitted.
4. Non-overloading.
5. Single stage.
6. Drive by single-speed, squirrel-cage motors, suitable for VFD control.

1.2 QUALITY ASSURANCE

- A. Pump manufacturer accepts responsibility for performance and operation at specified conditions and compatibility of components consisting of pump, motor, coupling, and base plate.
- B. Motor HP indicated on schedule to allow non-overloading operation of pump.
- C. Pumps requiring larger motors are not acceptable.

PART 2 - PRODUCTS

2.1 ACCEPTABLE MANUFACTURERS

- A. Bell & Gossett.
- B. Armstrong.
- C. Taco.

2.2 BASE MOUNTED PUMPS

- A. Flexible coupled connected as scheduled. Designed to back pull-out. Flexible connected pumps to have rigid base.
- B. Non-overloading, centrifugal, end suction type with casings design for a working pressure of not less than 125# per sq. in. or 1-1/2 times the actual discharge pressure (Pump head plus static head) whichever is greater. Pressure classification of flange connection shall correspond to casing working pressure. High points of pump casing provided with air vent cocks. Where pumps are insulated extend vent cocks outside insulation. Coupling guard for flexible connected pumps.

- C. Impeller shall be cut to provide capacities called for in schedules.
- D. Fully bronze fitted with enclosed impeller, dynamically balanced. Bronze wear ring or impeller runner provided on the suction side of the impeller.
- E. Shaft shall be stainless steel or carbon steel with bronze sleeve extending through seal assembly.
- F. Ball or roller bearings with ample oil reservoirs. Bearing effectively sealed to prevent loss of lubricant and entrance of dirt or water.
- G. Mechanical seals or packing gland seal as noted in the schedule.
- H. Integral horsepower motors to have double shielded, deep-groove, grease lubricated bearings. Motor sized not to overload at any point within range of impeller and piping system.
- I. Cast iron or steel base for flexible connected pumps. Base to have a raised lip and drain tapping or bearing brackets to have integral drip pockets with drain tapping. Coupling shall impose no restriction on normal end play or expansion.
- J. Set on concrete foundation pads at least 4" high.

2.3 MECHANICAL SEALS

- A. All metal parts 304 stainless steel with Buna-N Elastomers, ceramic seat, and carbon seal ring.
- B. For Split Coupled Pumps, shall be ceramic type with stationary seats. Provide factory installed flush line with manual vent.
- C. Suitable for 225° F continuous operation.

2.4 NAMEPLATE

- A. Provide pump and motor with stainless steel nameplate securely fastened to casing.
- B. Nameplates to provide all data necessary for equipment identification and replacement.

PART 3 - EXECUTION

3.1 INSTALLATION

- A. Install pumps where shown, in accordance with manufacturer's written instructions and with recognized industry practices to ensure that pumps comply with requirements and serve intended purposes. Comply with NEMA standards and requirements of NEC.
- B. Provide pumps with base plates or feet carefully leveled and bolted in place on concrete pads or foundations with vibration isolation devices as specified or shown on drawings.

- C. Grout bedplates with expanding type grout containing catalyzed metallic aggregate.
- D. After grout has set, cut flush with bedplate and seal to prevent deterioration at edges.
- E. Provide Suction Diffusers on each pump unless specifically noted otherwise.
- F. Decrease from line size with long radius reducing elbows or reducers. Support piping adjacent to pump so no weight is carried on pump casings. Provide supports under elbows on pump suction and discharge line sizes 4 inches and larger.
- G. Provide air cock and drain connection on horizontal pump casings. Provide drains for bases and seals.
- H. Provide drains for bases and seals.
- I. Manufacturer's representative and/or technician certified by the manufacturer shall be required to provide alignment of motor and pump, a laser alignment tool is required for this service. The pump and motor shall be aligned in the vertical angular, horizontal angular, vertical parallel and horizontal parallel. The alignment shall be within the recommended value by pump manufacturer but not over 0.002 (in) parallel and 0.005 (in) angular per radius inch. A printout of the alignment procedure, the pump manufacturer's alignment specifications, and the correct alignment shall be provided to the engineer.
- J. The contractor shall record and submit all results of alignment procedure and the pump manufacturer's alignment specifications to the design engineer. The specifications should also require this approved submittal information is included in the O&M Manual.

END OF SECTION 232123

SECTION 232500 – CHEMICAL WATER TREATMENT

PART 1 - GENERAL

1.1 SECTION INCLUDES

- A. Cleaning of piping systems.
- B. Chemical feeder equipment.
- C. Chemical treatment.

1.2 REFERENCES

- A. NFPA 70 - National Electrical Code.

1.3 OPERATION AND MAINTENANCE DATA

- A. Operation and Maintenance Data: Include data on chemical feed pumps, agitators, and other equipment including spare parts lists, procedures, and treatment programs. Include step by step instructions on test procedures including target concentrations.

1.4 QUALIFICATIONS

- A. Manufacturer: Company specializing in manufacturing the products specified in this Section with minimum three years' experience. Company shall have local representatives with water analysis laboratories and full-time service personnel.

1.5 REGULATORY REQUIREMENTS

- A. Conform to applicable code for addition of non-potable chemicals to building mechanical systems, and for to public sewage systems.
- B. Products Requiring Electrical Connection: Listed and classified by testing firm acceptable to the authority having jurisdiction as suitable for the purpose specified and indicated.

1.6 MAINTENANCE SERVICE

- A. Furnish service and maintenance of treatment systems for one year from Date of Substantial Completion.
- B. For the first year, tests shall be monthly and additional treatment added as the tests indicate the need. All labor and material furnished by the contractor at no charge to the owner during this period.

- C. Provide laboratory and technical assistance services during this maintenance period.
- D. Include two-hour training course for operating personnel, instructing them on installation, care, maintenance, testing, and operation of water treatment systems. Arrange course at startup of systems.
- E. Provide on site inspections of equipment during scheduled or emergency shutdown to properly evaluate success of water treatment program and make recommendations in writing based upon these inspections.

1.7 MAINTENANCE MATERIALS

- A. Provide sufficient chemicals for treatment and testing during warranty period.

PART 2 - PRODUCTS

2.1 MATERIALS

- A. System Cleaner:
 - 1. Liquid alkaline compound with emulsifying agents and detergents to remove grease and petroleum products.
 - 2. Biocide; chlorine release agents such as sodium hypochlorite or calcium hypochlorite, or microbiocides such as quaternary ammonia compounds, tributyl tin oxide, methylene bis (thiocyanate), or isothiazolones.
- B. Closed System Treatment (Water):
 - 1. Sequestering agent to reduce deposits and adjust Ph.
 - 2. Corrosion inhibitors.
 - 3. Conductivity enhancers.

2.2 BY-PASS (POT) FEEDER

- A. 5.0-gal quick opening cap for working pressure of 175 psig.

PART 3 - EXECUTION

3.1 PREPARATION

- A. Prior to extended operation, all new pipework shall be cleaned with a material especially formulated to remove grease, oil, mill scale, and other foreign materials. Cleaner will be added to achieve an M.O. Alkalinity of 3,000 - 3,500 ppm and circulated for a minimum of 12 hours prior to flushing until analytical tests indicate removal of cleaner and foulants.

- B. Systems shall be operational, filled, started, and vented prior to cleaning. Use water meter to record capacity in each system.
- C. Place terminal control valves in open position during cleaning.

3.2 CLEANING SEQUENCE

- A. Concentration:
 - 1. As recommended by chemical feed company.
- B. Chilled and Hot Water Systems:
 - 1. Circulate for 48 hours, then drain systems as quickly as possible.
 - 2. Refill with clean water, circulate for 24 hours, then drain.
 - 3. Refill with clean water and repeat until system cleaner is removed.
- C. Use neutralizer agents on recommendation of system cleaner supplier.
- D. Flush open systems with clean water for one hour minimum. Drain completely and refill.
- E. Remove, clean, and replace strainer screens.
- F. Inspect, remove sludge, and flush low points with clean water after cleaning process is completed. Include disassembly of components as required.

3.3 INSTALLATION

- A. Install in accordance with manufacturer's instructions.

3.4 CLOSED SYSTEM TREATMENT

- A. Provide one bypass feeder on each system. Install isolating and drain valves and necessary piping.
- B. Introduce closed system treatment through bypass feeder when required or indicated by test.

END OF SECTION 232500

SECTION 233100 - DUCTWORK

PART 1 - GENERAL

1.1 PERFORMANCE REQUIREMENTS

- A. Variation of duct configuration or sizes permitted for job conditions. Size ducts installed in accordance with ASHRAE table of equivalent rectangular and round ducts.

1.2 REFERENCES

- A. NFPA 90A - Installations of Air Conditioning and Ventilating Systems.
- B. SMACNA – HVAC Air Duct Leakage Test Manual.
- C. SMACNA – HVAC Duct Construction Standards – Metal and Flexible.
- D. SMACNA – Fibrous Glass Duct Construction Standards.
- E. UL 181 – Factory-Made Air Ducts and Connectors.

1.3 REGULATORY REQUIREMENTS

- A. Construct ductwork to NFPA 90A, NFPA 96 and SMACNA standards.

1.4 ENVIRONMENTAL REQUIREMENTS

- A. Do not install duct sealants or adhesives when temperatures are less than those recommended by manufacturer.
- B. Maintain temperatures during and after installation of duct sealants.

1.5 SUBMITTALS

- A. Product Data:
 - 1. Provide the following information for each sealant system furnished on the Project:
 - a. Sealant name and type.
 - b. Sealant system design pressure.
 - c. Duct material.
 - d. Duct gage.
 - e. Transverse joint methods.
 - f. Longitudinal seam type.

PART 2 - PRODUCTS

2.1 MATERIALS

- A. Galvanized Steel Ducts: ASTM A623 and ASTM A623M galvanized steel sheet, lock-forming quality, having G60 zinc coating in conformance with ASTM A90.
- B. Uninsulated Flexible Ducts (Exhaust or Return):
 - 1. Manufacturers: Flexmaster Type NI35.
 - 2. UL-181, Class I: corrosion resistant galvanized steel helix permanently bonded to an impregnated, coated woven fiberglass cover.
 - 3. Pressure rating: 10" positive, 4" negative.
 - 4. Maximum velocity: 5000 fpm.
 - 5. Operating temperature: 0° to 200°F.
- C. Insulated Low Pressure Flexible Ducts:
 - 1. Manufacturer: Flexmaster Type 8M.
 - 2. UL-181, Class I: coated, woven glass fiber mesh liner bonded permanently to corrosion resistant, galvanized steel helix, thick glass fiber insulation and low-perm vapor barriers of glass fiber reinforced metalized laminate with 3 plg standing seam and brass grommets.
 - 3. Pressure rating: 4" positive, 2" negative.
 - 4. Maximum Velocity: 3500 fpm.
 - 5. Operating Temperature: 0° to 180°F.
 - 6. Thermal Conductance: .23 @ 75°F.
- D. Insulated Medium Pressure Flexible Ducts:
 - 1. Manufacturer: Flexmaster Type 4M.
 - 2. UL-181, Class I: a heavy coated fiberglass cloth locked permanently to a galvanized steel helix, glass fiber insulation with fiberglass scrim on the outside; polyolefin vapor barrier jacket.
 - 3. Pressure rating: 10" positive.
 - 4. Maximum Velocity: 5000 fpm.
 - 5. Operating Temperature: -20° to 200°F.
 - 6. Thermal Conductance: .23 @ 75°F.
- E. Fasteners: Rivets, bolts, or sheet metal screws; stainless steel for stainless steel ductwork.
- F. Sealants:
 - 1. Non-hardening, water resistant, fire resistive, compatible with mating materials; liquid used alone or with tape, or heavy mastic.
 - 2. Sealant shall be water based latex UL 181A-M, B-M reinforced sealant conforming to the product specifications.
 - 3. Sealant shall be water based latex UL 181 B-M non-reinforced sealant conforming to the product specifications.

4. All ductwork in a UL classified rolled mastic duct sealant rated tape system shall be comprised of:
 - a. Rolled Mastic Sealant 2 mil foil faced with 15 mils of butyl adhesive/sealant conforming to the product specifications for UL classified sealants.
 - b. Rolled Mastic Sealant 2 mil foil faced with 15 mils of modified butyl mastic/sealant meeting UL-181 BFX (pressure sensitive tapes for use with flexible air ducts) for UL listed sealants.
- G. Hanger Rod: ASTM A36; steel, threaded both ends, threaded one end, or continuously threaded.

2.2 DUCTWORK FABRICATION

- A. Fabricate and support in accordance with SMACNA HVAC Duct Construction Standards – Metal and Flexible, and as indicated. Provide duct material, gages, reinforcing, and sealing for operating pressures indicated. Unless noted otherwise, pressure class shall be determined by fan rating.
- B. Construct T's, bends, and elbows with radius of not less than 1-1/2 times width of duct. Where not possible and where rectangular elbows are used, provide turning vanes. Where acoustical lining is indicated, provide turning vanes of perforated metal with glass fiber insulation.
- C. Increase duct sizes gradually, not exceeding 15 degrees divergence wherever possible; maximum 30 degrees divergence upstream of equipment and 45 degrees convergence downstream.
- D. Fabricate continuously welded round and oval duct fittings two (2) gages heavier than duct gages indicated in SMACNA Standard. Prime coat welded joints with zinc-rich paint.
- E. Provide standard 45-degree lateral wye takeoffs or 90-degree conical tee connections.
- F. Uninsulated panels of ducts over 12 inches wide shall be cross braced, except plenum casings, which shall be braced with angle iron as called for.
- G. All ductwork must present a smooth interior and joints must be air tight.
- H. Manual volume and splitter dampers to be furnished and installed where shown and where necessary for proper regulation of the air distribution. A quadrant and set screw equal to "Ventlock" #641 shall be installed for all dampers which are accessible.
- I. When the system is in operation, the ductwork shall be free from rattles and air noises caused by unsecure duct construction.
- J. All ductwork, low pressure supply, medium pressure supply, return, exhaust, and outside air ductwork shall be constructed to meet SMACNA seal class A.
- K. Refer to section 3.3 for ductwork pressure class schedule.

2.3 MANUFACTURED DUCTWORK AND FITTINGS

- A. Manufacture in accordance with SMACNA HVAC Duct Construction Standards – Metal and Flexible, and as indicated. Provide duct material, gages, reinforcing, and sealing for operating pressures indicated in paragraph 3.3.
- B. Round ducts shall be prefabricated spiral lock seam conduit with fabricated fittings. All ells shall be 5-piece type. Take-offs shall be formed conical “T”, or 45 degree “Y”.
- C. Round Ducts:
 - 1. Manufacturers:
 - a. United Sheet Metal.
 - b. Semco.
 - c. Hamlin Sheet Metal.
 - 2. Machine made from round spiral lockseam duct with reinforcing corrugations; fittings manufactured of at least two (2) gages heavier metal than duct.
- D. Transverse Duct Connection System:
 - 1. Manufacturers:
 - a. Duct Mate.
 - 2. SMACNA “E” rated rigid connection, interlocking angle and duct edge connection system with sealant, gasket, cleats, and corner clips.

2.4 ACCESS DOORS

- A. All access doors shall close with air pressure. Small doors for access to dampers, etc., shall be 16” x 16” minimum. They need not be hinged but shall be held in place with sash type locks. They shall have a flanged frame that overlaps liner or insulation.
- B. Ultra-low leakage doors. Nailor Model 0800 Type M1 Double Flange Frame for rectangular duct and Model 0895 for round duct, or equivalent. Knock-over tab frames are not permitted. Maximum leakage must not exceed British Standard DW144 Class A, B, and C.
- C. Provide a safety chain for doors accessed by ladder. Provide grab handles for doors 18" x 10" and larger when there is a positive pressure greater than 3 i.w.c.
- D. Provide long-life closed-cell gaskets.
- E. Provide access door at all locations requiring service access.

PART 3 - EXECUTION

3.1 ISNTALLATION DUCTWORK

- A. Install in accordance with manufacturer's instructions.
- B. Install and seal ducts in accordance with SMACNA HVAC Duct Construction Standards – Metal and Flexible. It is essential that all air ductwork be practically air tight. Before being insulated or concealed, all medium pressure air ducts and lab exhaust ducts, including the terminal connections, shall be tested for leakage. Each duct, under an air pressure test shall have no noticeable leaks. The total amount of leakage in the medium pressure supply ductwork of any system shall not exceed 1% of the total cfm of that system as measured by a manometer and a calibrated orifice. Test pressure for medium pressure systems shall be 8" WG and 6" WG for lab exhaust system.
- C. Duct sealant installation shall be in accordance with manufacturer's published recommendations. Allow duct sealant system to cure minimum 48 hours before pressure testing for the fluid applied mastics. Rolled mastic sealants can be tested immediately. All low, medium, and high-pressure duct systems (positive or negative) shall be pressure tested according to SMACNA test procedures (HVAC Air Duct Leakage Test Manual). Notify Owner minimum seven (7) calendar days in advance of leakage testing.
- D. Duct sizes on plans are inside clear dimensions.
- E. Provide openings in ductwork where required to accommodate thermometers and controllers. Provide pilot tube openings where required for testing of systems, complete with metal can with spring device or screw to ensure against air leakage. Where openings are provided in insulated ductwork, install insulation material inside a metal ring.
- F. Locate ducts with sufficient space around equipment to allow normal operating and maintenance activities.
- G. Use double nuts and lock washers on threaded rod supports.
- H. Connect diffusers to low pressure ducts with maximum length of flexible duct as detailed on plans. Duct to be held in place with strap or clamp.
- I. Connect flexible ducts to metal ducts with adhesive and draw bands. Use sheet metal screws for positive pressure over 2".
- J. During construction, provide temporary closures of metal or taped polyethylene on open ductwork to prevent construction dust or weather from entering ductwork system.

3.2 DUCTWORK PRESSURE CLEANING SCHEDULE

Air System	Pressure Class Inch
Low Pressure Supply (HVAC Systems and downstream of terminal units)	2
Medium Pressure Supply (upstream of terminal units)	8
All Other Ducts	2

END OF SECTION 233100

SECTION 233300 - DUCTWORK ACCESSORIES

PART 1 - GENERAL

1.1 SECTION INCLUDES

- A. Air turning devices/extractors.
- B. Backdraft dampers.
- C. Duct test holes.
- D. Flexible duct connections.
- E. Volume control dampers.

1.2 REFERENCES

- A. NFPA 90A - Installation of Air conditioning and Ventilating Systems.
- B. NFPA 92A - Smoke Control Systems.
- C. SMACNA - HVAC Duct Construction Standards - Metal and Flexible.
- D. UL 33 - Heat Responsive Links for Fire-Protection Service.
- E. UL 555 - Fire Dampers and Ceiling Dampers.
- F. UL 555S - Leakage Rated Dampers for Use in Smoke Control Systems.

1.3 DELIVERY, STORAGE, AND HANDLING

- A. Protect dampers from damage to operating linkages and blades.

PART 2 - PRODUCTS

2.1 AIR TURNING DEVICES/EXTRACTORS

- A. Multi-Blade device with radius blades attached to pivoting frame and bracket, steel, or aluminum construction, with push-pull operator strap. Provide air turning vanes in all supply and return square elbows. Vanes in medium pressure supply duct shall be double wall type.
- B. Steel or fiberglass fixed vanes for 90 deg. Elbows.

2.2 BACKDRAFT DAMPERS

- A. Manufactures:
 - 1. Ruskin Manufacturing Co.
 - 2. Arrow.
 - 3. United Emertech.
 - 4. Kinetics Noise Control.
- B. Gravity backdraft dampers furnished with air moving equipment may be air moving equipment manufacturer's standard construction.
- C. Multi-Blade, Parallel Action Gravity Balanced Backdraft Dampers: galvanized steel, extruded aluminum, with felt or flexible vinyl sealed edges, linked together in rattle-free manner with 90-degree stop, and plated steel pivot pin adjustment device to permit setting for varying differential static pressure.

2.3 DUCT TEST HOLES

- A. Temporary Test Holes: Cut or drill in ducts as required. Cap with neat patches, neoprene plugs, threaded plugs, or threaded or twist-on metal caps.
- B. Permanent Test Holes: Factory fabricated, airtight flanged fittings with screw cap. Provide extended neck fittings to clear insulation.

2.4 FLEXIBLE DUCT CONNECTIONS

- A. Fabricate in accordance with SMACNA Medium Pressure Duct Construction Standards, and as indicated.
- B. UL listed fire-retardant neoprene coated woven glass fiber fabric to NFPA 90A, minimum density 20 oz. per sq. yd., approximately 2 inches wide, crimped into metal edging strip.

2.5 VOLUME CONTROL DAMPERS

- A. Manufactures:
 - 1. Ruskin Manufacturing Co.
 - 2. Arrow.
 - 3. United Emertech.
- B. Fabricate in accordance with SMACNA Low Pressure Duct Construction Standards, and as indicated.
- C. Fabricate splitter dampers of material same gage as duct to 24 inches size in either direction, and tow gages heavier for sizes over 24 inches.

- D. Fabricate splitter of double thickness sheet metal to streamline shape. Secure blade with continuous hinge or rod. Operate with minimum 1/4-inch diameter rod in self aligning, universal joint action flanged bushing with set screw.
- E. Fabricate single blade dampers for duct sizes to 12 x 48 inch.
- F. Fabricate multi-blade damper of opposed blade pattern with maximum blade sizes 122 x 72 inch. Assemble center and edge crimped blades in prime coated or galvanized channel frame with suitable hardware.
- G. Except in round ductwork 12 inches and smaller, provide end bearings. On multiple blade dampers, provide oil-impregnated nylon or sintered bronze bearings.
- H. Provide locking, indicating quadrant regulators on single and multi-blade dampers.
- I. On insulated ducts mount quadrant regulators on stand-off mounting brackets, bases, or adapters.

PART 3 - EXECUTION

3.1 PREPARATION

- A. Verify that electric power is available and of the correct characteristics.

3.2 INSTALLATION

- A. Install accessories in accordance with manufacturer's instructions, NFPA 90A, and follow SMACNA HVAC Duct Construction Standards - Metal and Flexible.
- B. Provide backdraft dampers on exhaust fans or exhaust ducts nearest to outside and where indicated.
- C. Provide flexible connections immediately adjacent to equipment in ducts associated with fans and motorized equipment.
- D. Provide duct test holes where indicated and required for testing and balancing purposes. Neoprene plugs.
- E. Install automatic dampers in manner directed by Temperature Control Sub-Contractor.
- F. Provide balancing dampers at points on supply, return, and exhaust systems where branches are taken from larger ducts as required for air balancing. Install minimum 2 duct widths from duct take-off.
- G. Provide balancing dampers on duct take-off to diffusers, grilles, and registers, regardless of whether dampers are specified as part of the diffuser, grille, or register assembly.

END OF SECTION 233300

SECTION 233400 - POWER VENTILATORS

PART 1 - GENERAL

1.1 SECTION INCLUDES

- A. Inline Centrifugal.
- B. Roof Exhausters.
- C. Motors and drives.
- D. Fan accessories.

1.2 RELATED SECTIONS

- A. All Sections Apply.

1.3 REFERENCES

- A. ABMA STD 9 - Load Ratings and Fatigue Life for Ball Bearings.
- B. ABMA 11 Load Ratings and Fatigue Life for Roller Bearings.
- C. AMCA 210 Laboratory Methods of Testing Fans for Rating Purposes.
- D. AMCA 261 - Directory of Products Licensed to Use the AMCA Certified Ratings Seal.
- E. AMCA 301 Method for Calculating Fan Sound Ratings from Laboratory Test Data.

1.4 QUALITY ASSURANCE

- A. Manufacturer Qualifications: Company specializing in manufacturing the Products specified in this section with minimum 5 years documented experience.

1.5 REGULATORY REQUIREMENTS

- A. Products Requiring Electrical Connection: Listed and classified by testing firm acceptable to the authority having jurisdiction as suitable for the purpose specified and indicated.

1.6 DELIVERY, STORAGE, AND PROTECTION

- A. Protect motors, shafts, and bearings from weather and construction dust.

1.7 EXTRA MATERIALS

- A. Supply two sets of belts for each fan.

PART 2 - PRODUCTS

2.1 INLINE CENTRIFUGAL

- A. Manufacturer:
 - 1. Greenheck.
 - 2. Other acceptable manufacturers offering equivalent products:
 - a. Greenheck.
 - b. Cook.
 - c. Twin City.
- B. Impeller: Wheel shall be centrifugal backward inclined, constructed of 100% aluminum, including a precision machined cast aluminum hub. Wheel inlet shall overlap an aerodynamic aluminum inlet cone to provide maximum performance and efficiency. Wheel shall be balanced in accordance with AMCA Standard 204-96, Balance Quality and Vibration Levels for Fans. Motor pulleys shall be adjustable for system balancing. Factory wiring shall be provided from motor to the handy box.
- C. Frame: The fan shall be of bolted construction utilizing corrosion resistant fasteners. Housing shall be minimum 18-gauge galvanized steel with integral duct collars. Bolted access doors shall be provided on two sides, sealed with closed cell neoprene gasketing. Pivoting motor plate shall utilize threaded L-bolt design for positive belt tensioning. Housing shall be pre-drilled to accommodate universal mounting feet for vertical or horizontal installation. Unit shall bear an engraved aluminum nameplate and shall be shipped in ISTA certified transit tested packaging.
- D. Bearings: Bearings shall be designed and individually tested specifically for use in air handling applications. Construction shall be heavy duty regreasable ball type in a pillow block cast iron housing selected for a minimum L50 life in excess of 200,000 hours at maximum cataloged operating speed.
- E. Belts and Drives: Belts shall be oil and heat resistant, non-static type. Drives shall be precision machined cast iron type, keyed and securely attached to the wheel and motor shafts. Drives shall be sized for 150% of the installed motor horsepower. The variable pitch motor drive must be factory set to the specified fan RPM.
- F. Motor: Motor shall be heavy duty type with permanently lubricated sealed ball bearings and furnished at the specified voltage, phase, and enclosure.
- G. Isolators: Provide hanging spring isolators.

2.2 BEARINGS AND DRIVES

- A. Shafts: Hot rolled steel, ground and polished, with keyway; protectively coated with lubricating oil.
- B. V Belt Drive: Cast iron or steel sheaves, dynamically balanced, keyed. Variable and adjustable pitch sheaves for motors 15 hp and under selected so required rpm is obtained with sheaves set at mid position; fixed sheave for 20 hp and over, matched belts, and drive rated as recommended by manufacturer or minimum 1.5 times nameplate rating of the motor.
- C. Belt Guard: Fabricate to SMACNA Standards; of 12-gauge, 3/4-inch diamond mesh wire screen welded to steel angle frame or equivalent, prime coated. Secure to fan or fan supports without short circuiting vibration isolation, with provision for adjustment of lubrication, and use of tachometer with guard in place.
- D. Lubrication: Extend lubrication fittings to outside of casing.

2.3 ACCESSORIES

- A. Straightening Vanes: Welded steel construction with airfoil vanes and casing flanges, finished to mach casing.
- B. Inlet Screens: Galvanized steel welded grid to fit inlet.
- C. Dampers: Welded steel construction, consisting of two semicircular vanes pivoted on oil retaining bearings in short casing section, finished with one coat enamel.
- D. Access Doors: Shaped to conform to casing with quick opening latches and gaskets.

2.4 ROOF VENTILATORS, SUPPLY, AND EXHAUST

- A. Manufacturers:
 - 1. Greenheck.
 - 2. Other acceptable manufacturers offering equivalent products:
 - a. Greenheck.
 - b. Cook.
 - c. Twin City.
- B. Fan Unit: V-belt or direct driven as indicated, with spun aluminum housing; resilient mounted motor; 1/2-inch mesh, 16 gage aluminum bird screen; square base to suit roof curb with continuous curb gaskets.
- C. Roof Curb: 16-inch-high self-flashing of aluminum with continuously welded seams, built in cant strips one inch insulation, and factory installed nailer strip.
- D. Electrical Characteristics and Components, Single Phase Motors”
 - 1. Wiring Terminations: Provide terminal lugs to match branch circuit conductor quantities, sizes, and materials indicated. Enclose terminal lugs in terminal box sized to NFPA 70.

- 2. Disconnect Switch: Factory wired, non-fusible, in housing for thermal overload protected motor and solid-state speed controller.
- E. Backdraft Damper: Gravity actuated, aluminum multiple blade construction, felt edged with nylon bearings.
- F. Sheaves: Cast iron or steel, dynamically balanced, bored to fit shafts and keyed; variable and adjustable pitch motor sheave selected so required rpm is obtained with sheaves set at mid-position.
- G. Fan shaft with self-aligning pre-lubricated ball bearings.

2.5 INSTALLATION

- A. Install in accordance with manufacturer's instructions.
- B. Install fans as indicated. Install with resilient mountings and with flexible electrical leads.
- C. Install flexible connections specified in between fan inlet and discharge ductwork. Ensure metal bands of connectors are parallel with minimum one inch flex between ductwork and fan while running.
- D. Provide fixed sheaves required for final air balance.
- E. Provide safety screen where inlet or outlet is exposed.
- F. Provide ceiling suspended units with support brackets bolted to casing flange.

END OF SECTION 233400

SECTION 233500 - TERMINAL HEAT TRANSFER

PART 1 - GENERAL

1.1 SECTION INCLUDES

- A. Fan Coil Units

PART 2 - PRODUCTS

2.1 FAN COIL UNITS

- A. Manufacturer:
 - 1. Trane
 - 2. Johnson Controls
 - 3. Carrier
 - 4. Whalen
- B. Cabinet: The cabinet shall be constructed of heavy-gauge galvanized steel. It shall be internally insulated with ½" thick foil-faced fiberglass insulation. Exposed corners and edges shall be rounded. One or two supply air openings shall be provided as indicated on the plans. All valves and accessories shall be accessible through removal of the return panel.
- C. Return Panel: The return panel shall be louvered and removable for access to fan/motor, valves, filters, etc. It shall be internally lined to match the rest of the unit.
- D. Coils: Evenly spaced aluminum fins mechanically bonded to copper tubes, factory tested for 400 psi and 200°F. Provide insulated drain pan under cooling coil, easily removable for cleaning, with drain connection and float switch for unit shutoff. Heating coil shall be in reheat position.
- E. Finish (exposed units): Finish shall be applied in the factory. Clean, phosphatize, and apply baked enamel of color as selected on visible surfaces of enclosure or cabinet.
- F. Fans: Centrifugal forward curved double width wheels, statically and dynamically balanced, direct driven as scheduled. Arrange for draw-thru airflow.
- G. Motor: Shall be brushless ECM motors with thermal overload protection. Motor controller shall be mounted in control box with a built-in user interface and tachometer. Adjustments can be made through momentary contact switches accessible on motor control board. Fan speed control shall be available with or without control interface and shall be unit mount. The speed control shall incorporate 0-10 Vdc signal providing limitless control of the motor RPM between factory set low and high speeds. The control box will include a line voltage to 24-volt transformer, ECM motor controller.

- H. Provide unit mounted disconnect switch.
- I. Filter: Easily removed 1-inch-thick glass fiber throw away type, MERV 8, located to filter air before coil.
- J. Piping package shall be provided that will include ball type shut off valves on the coil supply and returns with automatic flow limiting balancing valves, strainer, and unions. Controllers and control valves shall be furnished by controls contractor and fan coil unit manufacturer shall factory install. The package shall fit inside the unit casing and shall be accessible.
- K. Sound pressure level shall not exceed 30 dBA as measured 8' from return grille.

PART 3 - EXECUTION

3.1 INSTALLATION

- A. Duct Connection:
 - 1. Duct connections to unit to allow for straight and smooth airflow.
 - 2. Do not install duct turns at the fan discharge, which are in the opposite direction to a fan wheel rotation.
 - 3. Provide flexible connections at duct connections to unit.
- B. Piping Connections:
 - 1. Support piping independently of coils and with adequate flexibility to prevent undue stress at coil header connections.
 - 2. Install full size drain lines from the drain pan connection to permit condensate to drain freely.
 - 3. Route condensate drain piping to drain riser as indicated on plans. Mechanical Contractor shall ensure condensate pans are slope properly, 1/8" per foot, inside fan coil units for condensate to flow.
 - 4. Install service valves and companion flanges or unions on supply and return lines to coils.
 - 5. Coordinate with controls contractor for control valve to be installed with the pipe package provided with the unit to be installed inside the vertical stack unit. All the valves and controls inside the vertical stack unit must be installed in a manner they will be accessible for service from the return air access panel in front of the unit.

END OF SECTION 233500

SECTION 23 37 00 – AIR INLETS AND OUTLETS

PART 1 - GENERAL

1.1 SECTION INCLUDES

- A. Diffusers.
- B. Registers/grilles.

1.2 REFERENCES

- A. AMCA 500 - Test Method for Louvers, Dampers and Shutters.
- B. ARI 650 - Air Outlets and Inlets.
- C. ASHRAE 70 - Method of Testing for Rating the Air Flow Performance of Outlets and Inlets.
- D. SMACNA - HVAC Duct Construction Standard - Metal and Flexible.

1.3 QUALITY ASSURANCE

- A. Test and rate air outlet and inlet performance in accordance with ADC Equipment Test Code 1062 and ASHRAE 70.
- B. Test and rate louver performance in accordance with AMCA 500.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

- A. Acceptable Manufacturers:
 - 1. Metalaire
 - 2. Price
 - 3. Carnes
 - 4. Nailor
 - 5. Titus
 - 6. Tuttle & Bailey

2.2 RECTANGULAR CEILING DIFFUSERS

- A. Type: Louvered directional face diffuser, to discharge air in square pattern.
- B. Frame: Shall be suitable for the type of the ceiling specified on the architectural drawings.
- C. Fabrication: Aluminum with baked enamel off-white finish.

2.3 WALL EXHAUST REGISTERS/GRILLES – ALTERNATE M4

- A. Type: Individually adjustable curved blades, 3/4 inch minimum depth, 3/4 inch maximum spacing with spring or other device to set blades, vertical or horizontal face as specified.
- B. Frame: 1-1/4inch margin with countersunk screw, concealed mounting and gasket.
- C. Fabrication: Aluminum with 20 gage minimum frames and 22 gage minimum blades, with factory off-white baked enamel finish.
- D. Damper: Aluminum Integral, opposed blade type with removable key operator, operable from face.

PART 3 - EXECUTION

3.1 INSTALLATION

- A. Install in accordance with manufacturer's instructions.
- B. Check location of outlets and inlets and make necessary adjustments in position to conform with architectural features, symmetry, and structural limitations.
- C. Connect diffusers to ductwork with air tight connection.
- D. Provide balancing dampers on duct take-off to diffusers, and grilles and registers, despite whether dampers are specified as part of the diffuser, grille or register assembly.
- E. Paint ductwork visible behind air outlets and inlets matte black.

END OF SECTION

SECTION 236412 - AIR COOLED WATER CHILLERS

PART 1 - GENERAL

1.1 SECTION INCLUDES

- A. Chiller package.
- B. Charge of refrigerant and oil.
- C. Controls and control connections.
- D. Chilled water connections.
- E. Starters.

1.2 REFERENCES

- A. ARI 590 - Positive Displacement Compressor Water - Chilling Packages.
- B. ASHRAE 15 - Safety Code for Mechanical Refrigeration.
- C. ASHRAE 90A - Energy Conservation in New Building Design.

1.3 QUALITY ASSURANCE

- A. Manufacturer Qualifications: Company specializing in manufacturing the products specified in this section with minimum three years documented experience.

1.4 WARRANTY

- A. Provide 5 years parts and labor warranty on the compressor and 2 years refrigerant warranty. The warranty will start on owner acceptance of the equipment.

1.5 REGULATORY REQUIREMENTS

- A. Products Requiring Electrical connection: Listed and classified by testing firm acceptable to the authority having jurisdiction as suitable for the purpose specified and indicated.

PART 2 - PRODUCTS

2.1 ACCEPTABLE MANUFACTURERS

- A. Trane.
- B. York/JCI.
- C. Daikin.
- D. Or approved equal.

2.2 MANUFACTURED UNITS

- A. Provide factory assembled and tested outdoor air cooled liquid chillers consisting of compressors, condenser, evaporator, thermal expansion valve, refrigeration accessories, and control panel. Provide microprocessor based control system. Construction, testing, and ratings shall be in accordance with ARI 590.
- B. Conform to UL 465 code for construction of water chillers and provide UL label.
- C. Conform to ASME SEC 8 Boiler and Pressure Vessel Code for construction and testing of water chillers.
- D. Conform to ASHRAE 15 code for construction and operation of water chillers.
- E. Chillers shall have multiple scroll type compressors with independent refrigerant circuits.

2.3 HERMETIC COMPRESSORS

- A. Scroll Compressors:
 - 1. Unit: Direct drive, hermetic, scroll compressor with control panel.
 - 2. Features: Differential refrigerant pressure oil pump, oil level sight glass, oil heater, oil separator and filter, oil charging valve, flooded lubrication for the journal and thrust bearings, check valve on the scroll discharge port.
 - 3. Motor: Suction gas-cooled, hermetically sealed, squirrel cage induction.

2.4 EVAPORATOR

- A. Provide shell and tube type evaporator, seamless or welded steel or stainless steel construction with cast iron or fabricated steel heads, seamless copper tubes or red brass tubes with integral fins, rolled or silver brazed into tube sheets. Provide multiple refrigerant circuits on multiple compressor units.
- B. Design, test, and stamp refrigerant side for 225 psig working pressure and water side for 150 psig working pressure, in accordance with ASME SEC 8.
- C. Insulate with 1.25-inch minimum thick flexible polyurethane foam insulation with maximum K value of 0.28.
- D. Provide water drain connection and thermometer wells for temperature controller and low temperature cutout.

2.5 CONDENSERS

- A. Construct condenser coils of aluminum fins mechanically bonded to seamless copper tubing or aluminum tubing. Provide sub-cooling circuits with liquid accumulators. Air test under water to 425 psig. Provide louvered panels to cover the complete condensing coil.
- B. Provide vertical discharge direct driven propeller type low sound condenser fans with fan guard on discharge. Equip with roller or ball bearings with grease fittings extended to outside of casing. Low sound fans shall be dynamically and statically balanced, corrosion resistant glass fiber reinforced composite blades molded into a low noise fan blade.
- C. Provide fan motors with permanently lubricated ball bearings.

2.6 ENCLOSURES

- A. House components in welded steel frame with or galvanized steel panels with weather resistant baked enamel finish capable of withstanding 500-hour salt spray test in accordance with the ASTM B-117 standard.
- B. Mount starters and disconnects in NEMA ICS 6 weatherproof panel provided with full opening access doors. Provide mechanical interlock to disconnect power when door is opened.

2.7 REFRIGERANT CIRCUIT

- A. Provide HFC-R410A refrigerant or R-134a as indicated in the Schedule.
- B. Provide two separate refrigerant circuits, factory supplied and piped.
- C. Provide for each refrigerant circuit:
 - 1. Liquid line solenoid valve.
 - 2. Filter dryer (replaceable core type).
 - 3. Liquid line sight glass and moisture indicator.
 - 4. Thermal expansion valve sized for maximum operating pressure.
 - 5. Charging valve.
 - 6. Insulated suction line.
 - 7. Discharge line check valve.
 - 8. Compressor discharge service valve.
 - 9. Condenser pressure relief valve.
 - 10. Suction line accumulator.

2.8 MISCELLANEOUS FEATURES

- A. Provide one compressor cycle counter and hour meter(s) for each circuit.
- B. Provide neoprene-in-shear isolators, suction and discharge pressure gauges and oil pressure gauge, flow switch for field installation.

- C. Unit shall have 2 separate single-pole, double-throw contacts to indicate compressor operation. Failure shall indicate manual reset required.
- D. Provide across-the-line starter, factory mounted and fully wired to the compressor and control panel. Starters shall be housed in a weather tight enclosure.
- E. Provide two-point lubrication for each bearing and connecting rod.
- F. Unit voltage shall be as shown on the schedule. Chiller shall require only one connection including unit power, control and heat trace power. All required transformers shall be provided.
- G. NEMA rated, weatherproof, heavy duty chiller disconnect switch will be supplied.
- H. Provide electric heat tracing to -20°F.
- I. Provide factory installed wire mesh guards for the compressors and louvers to protect the condenser section.
- J. Provide factory installed water inlet strainer.

2.9 CONTROLS

- A. Provide NEMA ICS 6 weatherproof steel control panel, containing starters power and control wiring, molded case disconnect switch, factory wired. Provide star delta closed transition starters. Provide disconnect for outdoor duty.
- B. Provide compressor overload, starter relay, and control power transformer or terminal for controls power. Provide manual reset current overload protection.
- C. Chiller control shall be standalone direct digital control (DDC) system which shall be capable of communications with the building automation system through a BACnet interface.
- D. Provide safety controls with display on control panel, arranged so any one will shut down chiller and require manual reset.
 - 1. Low chilled water temperature switch.
 - 2. High discharge pressure switch for each compressor.
 - 3. Low suction pressure switch for each compressor.
 - 4. Oil pressure switch for each circuit.
 - 5. Flow switch in chilled water line.
 - 6. Phase loss/reversal.
 - 7. Compressor overload.
 - 8. Loss of refrigerant charge.
 - 9. High motor winding temperature.
 - 10. Over and under voltage protection.
 - 11. Phase loss and phase reversal protection.
 - 12. Operating Controls:
 - a. For multi-compressor unit, provide modulating chilled water temperature controller, which matches chiller capacity to load.
 - b. Microprocessor shall be capable of communicating to building EMS.
 - c. Provide anti-recycle timer.

- d. Leaving chilled water temperature control based on factory P.I. algorithms.
- 13. Display suction and discharge refrigerant pressures, and oil pressures for each compressor, entering and leaving chilled water temperature, diagnostic checks at control panel.

PART 3 - EXECUTION

3.1 INSTALLATION

- A. Install in accordance with manufacturer's instructions.
- B. Align chiller package on concrete foundations.
- C. Connect to electrical service. Refer to Division 26.
- D. Connect to chilled water piping.
 - 1. On inlet, provide:
 - a. Thermometer well for temperature controller.
 - b. Thermometer well for temperature limit controller.
 - c. Flexible pipe connector.
 - d. Shut-off valve.
 - e. Strainer.
 - 2. On outlet, provide:
 - a. Flexible pipe connector.
 - b. Shut-off valve.
 - c. See detail for all piping requirements.
- E. Arrange piping for easy dismantling to permit tube cleaning.

3.2 MANUFACTURER'S FIELD SERVICES

- A. Starting of System: Prepare and start system.
- B. Supply service of factory trained representative for a period of 1 day to supervise testing dehydration and charging of machine, start-up, and instruction on operation and maintenance to Owner.
- C. Supply initial charge of refrigerant and oil.

3.3 DEMONSTRATION AND INSTRUCTIONS

- A. Demonstrate system operation and verify specified performance.

END OF SECTION 236412

SECTION 23 73 00 - AIR HANDLING UNITS

PART 1 - GENERAL

1.1 WORK INCLUDED

- A. This section of the work includes the design, fabrication, testing, cleaning and packaging, shipment and final assembly of air handling units by the unit manufacturer in complete accordance with the following specification.
- B. The details outlined and component manufacturers named in this specification may not be deviated from in the air handling unit manufacturer's preparation of the bid, even where techniques are required which the manufacturer does not consider standard.

1.2 PRODUCT CLEANING, DELIVERY, STORAGE, AND HANDLING

- A. Thoroughly clean equipment, components and subassemblies of water, dirt, debris, weld splatter, grease, oil and other foreign matter prior to shipment.
- B. Seal and protect all openings in unit casings, housings and enclosures with thin gauge sheet metal closure sheets. Seal closures, caps and plugs dust-tight and moisture-tight.
- C. Protect pipe flanges with plywood coverings. Protect pipe threads with plastic end caps or plugs.
- D. Protect machined surfaces with suitable, easily removable rust preventive.
- E. Provide full charge of proper lubricant for grease lubricated bearings.
- F. Provide desiccant bags or vapor phase inhibitors where required to keep components dry.
- G. Units delivered with scratched, dented, or dirty surfaces or damage of any type shall be restored to "as new" condition as directed by the Architect/Engineer/Owner at no cost to Owner.
- H. If equipment is to be stored before use, the shipping protection provided by the unit manufacturer shall remain on the unit until the unit is installed. In addition, manufacturer shall submit written recommendations for field storage, both indoor and outdoor.
- I. Provide non-corrosive nameplate permanently attached to each piece of equipment containing the following information at a minimum:
 - a. Manufacturer's project number
 - b. Plant name and location
 - c. Equipment number
 - d. Date of manufacture

1.3 QUALITY ASSURANCE

- A. Certify unit components in accordance with ARI Standard 430.
- B. Certify coil performance in accordance with ARI Standard 410.

- C. Provide ARI certified, computer-generated performance ratings for each fan and coil selection.
- D. Provide certified sound power levels for all air handling systems.

1.4 WARRANTY

- A. All equipment, materials, and workmanship shall be warranted for twenty-four (24) months from startup and shall cover both parts and labor.
- B. During the warranty period, the manufacturer shall repair or replace, at no additional cost to the Owner, any equipment, material, or workmanship in which defects may develop.

PART 2 - PRODUCTS

2.1 ACCEPTABLE MANUFACTURERS

- A. Trane
- B. Johnson Controls
- C. Carrier

2.2 GENERAL DESCRIPTION

- A. Fabricate air-handling units suitable for the scheduled capacities.
- B. Factory fabricate and test air handling units of sizes, capacities, and configuration as indicated and specified.
- C. Base performance on sea level conditions.
- D. All internal components specified in the air handling unit schedule shall be factory furnished and installed. Unit(s) shall be completely factory assembled.
- E. Units shall ship in one (1) piece whenever possible. A minimal number of shipping splits may be provided as required for installation. Lifting lugs will be supplied on each side of the split to facilitate rigging and joining of segments. Modules shall be broken down completely if unable to fit thru existing doors into basement equipment rooms or mechanical crawl spaces.

2.3 AHU CONSTRUCTION

- A. Unit Casing
 - 1. All unit panels shall be 2-inch solid, double-wall construction to facilitate cleaning of unit interior. All exterior and interior AHU panels will be made of galvanized steel. Motor and drive locations can be on the same side as the unit coil connections or on the opposite side. The casing shall be able to withstand up to 6 inches w.g. positive or negative static pressure. The unit panels shall not

exceed 0.005 inch deflection per inch of panel span at 6 inches w.g. positive or negative static pressure.

2. Door construction shall match the rest of the unit and shall have heavy-duty hinges which allow removal of the door by removal of the hinge pin.
3. All pipe and conduit penetrations shall be sealed airtight. After wire is pulled conduit shall be sealed so that air cannot be transferred into or out of the unit.

B. Blower Section

1. Provide units with factory-mounted variable frequency drive (VFD).
2. Provide fans with the following accessories:
 - a. Fan inlet screens in the inlets of fan housing.
3. Provide airfoil fans with blades formed of extruded aluminum. Bent sheet metal blades are not acceptable.
4. Provide fans with polished steel shafts with first critical shaft speed at least 125% of the maximum operating speed for the fan pressure class. Shaft shall have an anti-corrosion coating.
5. Dynamically balance fans before and after installation in the cabinet section.
6. Key fan shaft to the wheel in accordance with manufacturer's standard design to meet the specified performance.
7. Equip units with internally mounted fan motors.
8. Provide spring type vibration isolators with 2 inch static deflection for fan assembly. Fan and motor assembly shall be internally isolated from the unit casing.

C. Bearings

1. Provide bearings complying with ANSI/AFBMA 9 for fatigue life ratings.
2. Provide fan bearings with an average life L10 of at least 200,000 hours, as scheduled.
3. Provide re-greaseable bearings with hydraulic grease fittings and lube lines extended to the motor side of the fan.
4. Fan bearing rpm shall not exceed 90% of fan construction rpm.

D. Electrical Characteristics and Components

1. Fan motors shall be NEMA design ball bearing type with electrical characteristics and horsepower as specified on the schedule. Motors shall be 1750 RPM open

drip proof type. All motors shall be premium efficiency. All motors shall meet the requirements of specification section 23 03 00.

2. The motor shall be mounted on the same isolation base as the fan. The motor shall be on an adjustable base.

E. Cooling and Heating Coils

1. Cooling coil segments shall have a full width, sloped drain pan that extends downstream of the coil a minimum of 8" to contain moisture carryover. The unit design and coil selection shall not require a drain pan in any downstream section to contain the coil condensate. Drain pans shall be sloped in a minimum of 2 planes; cross break interior pans and pitch toward drain connections to ensure complete condensate drainage. Units with cooling coils shall have drain pans under complete cooling coil section. A minimum of 1" clearance shall be provided from the bottom of the coil casing to the drain pan so that the drain pan can be visually inspected and physically cleaned, including underneath coil, without removal of the coil. All drain pan connections will be to one side of the unit to enable proper trapping. Drain pans that do not comply with these maintenance requirements will be the responsibility of the contractor to field modify. The pan shall be of 16-gauge stainless steel construction (including stainless steel construction for intermediate troughs) and shall be fully insulated. Drain pan shall be provided with a minimum 1-1/4" FPT condensate connection positioned beneath the lowest point of the drain pan. Extend drain pan downstream of coils by 6" minimum.
2. Maximum fin density shall be 14 fins per inch and maximum coil depth shall be 6 rows.
3. Coils with finned height greater than 48" shall have an intermediate drain pan extending the entire finned length of the coil. Cooling coils in excess of 48" in height shall not be acceptable unless provided with an intermediate drain pan. The intermediate pans shall have drop tubes to guide condensate to the main drain pan.
4. All cooling and/or heating coils shall be furnished to meet the performance requirements set forth in the schedule. All water coils shall have performance certified in accordance with ARI Standard 410. Coils used with glycol are outside the scope of ARI-410, but shall be selected to meet scheduled performance.
5. All coils shall be slide out, "shipping" type, mounted on tracks and easily removable from the air-handling unit by removing only one exterior panel. Coils that require additional disassembly of the unit or replacement of the entire coil section (e.g. "unit" type coils) for coil removal are unacceptable.
6. Drainable Water coils shall be designed to operate at 250 psig design working pressure and up to 300°F and shall be tested with 325 psig compressed air under water. Circuiting shall provide free and complete draining and venting when installed in the unit. All vent and drain connections shall be extended to the outside of the unit casing. Coils shall be circuited for counter flow of air and water. Water velocities shall not exceed 6 feet per second or be less than 4 feet per second and/or exceed the water pressure drops scheduled. All coils shall have same end connections regardless of the number of rows

deep. Coils using turbulators are unacceptable. Units with staggered coil arrangements are unacceptable.

7. Coil casing to be constructed of stainless steel casing. Intermediate casing supports shall be supplied for finned lengths that exceed 60 inches.
8. The primary surface shall be 1/2" O.D. copper tube, staggered in direction of airflow. Tubes shall be mandrel expanded to form fin bond and provide burnished, work-hardened interior surface. The tubes shall have a minimum tube wall thickness of 0.035". Specified thickness shall be maintained throughout the tube including brazed U-bends. Coils manufactured with hairpin bends shall provide increased nominal wall thickness as required to compensate for the thinning of tube walls that occurs at the exterior of each bend.
9. Extended surface shall consist of die-formed, continuous, aluminum fins. The fins shall have fully drawn collars to accurately space fins, and to form a protective sheath for the primary surface. The fin thickness shall be a minimum of 0.0095".
10. Headers shall be of heavy seamless copper tubing, silver-brazed to tubes. Connections shall be of steel, with male pipe threads, silver-brazed to the headers. A 1/4" FPT, plugged, vent, or drain tap shall be provided on each connection. All vent and drain connections shall be factory extended to the outside of the unit casing.
11. Coil grommets shall be provided on all coils to completely seal the area between the coil connection and the unit casing.

F. Dampers

1. Dampers shall be of low leak design having stamped 16-gauge galvanized steel blades. The damper blades shall be provided with a PVC coated polyester fabric mechanically locked into the blade edge. The jamb is a flexible metal, compression type. Leakage will not exceed 4.0 CFM/square foot at 1" w.g. and 8.0 CFM/square foot at 4" w.g., i.e. class 1 leakage. The blades shall be parallel acting unless otherwise scheduled.

G. FILTER SECTION

1. Filters and filter segments shall be provided as scheduled. Filter frames shall be constructed of galvanized steel and be built as an integral part of the unit. Filter media shall be listed Class 2 or Class 1 under U.L. Standard 900 as required by local codes.
2. Units shall be provided with Pleated Filter Segments designed to accommodate 2" pre-filters (MERV 8, 30% efficient) as scheduled.
3. Filters shall be provided at optimize size (24" x 24", 20" x 24" or 12" x 24"). The filter face velocity shall not exceed 550 fpm at maximum design conditions.

4. Furnish three complete sets of filters for each AHU. Prior to testing or start-up, the first set shall be installed. The second set to be installed after testing and balancing, but prior to acceptance of the building. The third filter shall be delivered to FSU prior to acceptance.
5. The first set may remain in the AHU during test and balance if upon inspection the filters are less than 50% loaded and accepted by FSU.

PART 3 - EXECUTION

3.1 INSTALLATION

- A. Air handling units shall be broken down completely as required to enter space and be field erected.
- B. Mount each unit on neoprene pad isolators to prevent transmission of vibration.
- C. Coordinate the selection of the isolators with manufacturer of the air-handling units to assure compatibility of mounting details.
- D. Units with internal frame to utilize internal vibration isolation.
- E. Provide clearance at each unit for routine service including the changing of filters, removal of coils, bearing greasing, opening of access doors, and pulling of blower shaft.
- F. Provide Magnehelic type differential pressure gauge (Dwyer Series 2000 or approved equal; Accuracy within 2%, calculated operating point shall be at 50% of full range with minor divisions of 0.05" w.g.) across the following: each filter type. Differential pressure gauge shall utilize copper tubing for sensing points. Mount pressure gauge on the exterior of the air handling unit. Gauge shall not be mounted into the air-handling unit housing or onto doors. Mount gauge on the exterior of the air-handling unit at a fixed location. Provide on-off-vent valves at differential pressure gauge to provide static and differential pressure in each section of the air handling unit.
- G. Duct Connection:
 1. Duct connections to each unit to allow for straight and smooth airflow.
 2. Do not install duct turns at the fan discharge, which are in the opposite direction to a fan wheel rotation.
 3. Duct connections shall be made with flexible connections.
- H. Piping Connections:
 1. Support piping independently of coils and with adequate flexibility to prevent undue stress at coil header connections.
 2. Install full size drain lines from the drain pan connection and trap to permit condensate to drain freely.
 3. Install service valves and companion flanges or unions on supply and return lines to coils.
 4. Arrange piping such that valves can be shut off, a small section of pipe removed, and the coil pulled.

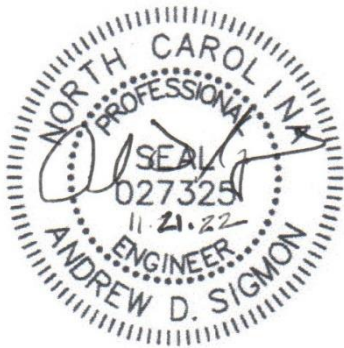
3.2 Start-up And Owner Orientation:

- A. Provide three (3) sets of filters for this project (one set to be installed prior to unit start-up, one set installed prior to acceptance of building and test and balance work, and one set turned over to the Owner at project closeout).
- B. Equipment start-up and owner maintenance orientation shall be the responsibility of the unit manufacturer and shall utilize a factory-authorized service representative in order to activate equipment warranty and assure that the Owner and his facility personnel are comfortable and familiar with equipment maintenance. In addition to start-up, factory authorized service representative shall review equipment installation including piping and electrical connections.
- C. Manufacturer shall include a minimum of four (4) hours on-site for owner maintenance training and orientation.
- D. The air handling unit manufacturer shall be responsible for proper operation and shall be required to meet the scheduled capacities and specified performance for this equipment.

END OF SECTION

DIVISION 26 - ELECTRICAL SPECIFICATIONS
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SECTION 26 05 00 – COMMON WORK RESULTS FOR ELECTRICAL

PART 1 GENERAL

1.1 REQUIREMENTS

- A. General Conditions of the Contract, Supplementary General Conditions, Instructions to Bidders, and General Requirements sections contained in the contract documents are a part of these Specifications.

1.2 EXTENT OF THE WORK

- A. This Contractor shall furnish all labor, materials, and equipment, and perform all operations necessary for installation of complete electrical work within the intent of, and as indicated on, the drawings and as herein specified.

1.3 REGULATIONS AND COMPLIANCE

- A. Latest editions of the National Electrical Code and the North Carolina State Building Code govern this work. All their requirements shall be satisfied.
- B. This Contractor shall secure and pay for all permits, fees, inspections, and licenses required. The electrical contractor shall notify the Office of the State Electrical Inspector at the State Construction Office (SCO) (authority having jurisdiction), to schedule required electrical inspections including, but not limited to, rough-in, above ceiling, and final inspections. Upon completion of the job he shall present to the Engineer a certificate of inspection and approval from the inspection authorities.

PART 2 PRODUCTS

2.1 MATERIALS

- A. All materials shall be new, with required Underwriter's Laboratories (or other agency approved by the State) label, and with manufacturer's label or nameplate giving complete electrical data.
- B. Where a manufacturer's catalog number is used, all parts shall be furnished to make it complete and to fit the construction intended.
- C. Within ten days after award, Contractor shall submit to Engineer a complete list in triplicate of all materials he proposes to use. List shall show a single manufacturer with not only major materials and equipment, but also such items as conduit fittings, raceway supports, conductive pipe thread compound, asphaltum, sealing material, clamps, anchors, outlet boxes, gutters, terminal cabinets, wire-pulling compound, splice connectors, tape, wire markers, lamps, etc.
- D. Material shall be the make and number given in these Specifications or shown on Drawings, or equivalent where specifically stated as being allowed. Equivalent items or materials will be subject to acceptance by the Engineer at submittal stage. If Contractor wishes to furnish a substitute for

the item(s) specified (or equivalent where allowed), he shall furnish complete, detailed data and obtain approval of the substitution in writing from the Engineer no later than ten (10) days prior to bid. In some cases, at the request of the Engineer, samples of the substitute items shall be submitted for review. Data (and sample if required) shall be submitted in a timely manner such that approval by Engineer can be returned to Contractor no later than ten (10) days prior to bid date. Data or sample not submitted in sufficient time to allow evaluation by Engineer will be automatically rejected.

- E. Engineer's review of samples, cut sheets, shop drawings, and other matter submitted by the Contractor shall not relieve the Contractor of responsibility for full compliance with the Drawings and Specifications. If a submitted item does not comply in any way (color, style, quality, function, or performance), Contractor shall call the specific non-compliance to the attention of the Engineer in writing in a cover letter to the submittals requesting a deviation from specifications. This does not imply that approval of requested deviation will be given, only that it will be reviewed.
- F. Engineer's review of submittals is not intended to confirm quantity counts of materials and equipment made by Contractor. Contractor is required to provide quantities of items as necessary for systems to function as described and shown on the plans and in these specifications.
- G. Specialty systems such as fire alarm systems, etc., that are included as part of the Electrical Contract shall be furnished and installed by an authorized representative of the manufacturer of the equipment supplied. This includes use of factory trained and authorized installers where required to fulfill manufacturer's warranty provisions.
- H. Submit cuts of fixtures, shop drawings on panels, and other descriptive materials requested, in six copies, or as required by the General Requirements section. Submittals will not be accepted or reviewed by the Engineer unless the electrical contractor's stamp signifying his review and approval is evident on the submittals.
- I. Materials should be inspected upon their arrival at the site to be sure they are correct. No extension of time for completion will be allowed because materials received are wrong. Completely adequate housing shall be provided on the site for orderly and careful storage of all materials and equipment. Nothing shall be stored outside except conduit, which may be stored in racks so it is at least twelve (12) inches above ground and not subject to mud being spattered on it.

2.2 PAINTING

- A. Suitable finish coatings shall be provided under this section of the Specifications on all items of electrical equipment and wiring which are exposed. This shall consist of either an approved factory applied finish or an acceptable finish applied during or after installation. Equipment which is furnished in finishes such as stainless steel or satin aluminum are not to be painted. Exposed equipment and/or wiring in finished areas such as panel covers or surface raceway shall be supplied with factory applied prime coat and shall be professionally painted or enameled as directed to result in a completely coated and attractively finished manner. All such finishing shall be as directed by and shall be satisfactory to the Architect and Engineer.

PART 3 EXECUTION

3.1 GENERAL INSTALLATION

- A. The electrical drawings are diagrammatic only, and are intended to explain system function and define quality of materials and installation. They are not intended to define construction methods.
- B. Contractor shall keep on the site at all times one set of electrical drawings and specifications, and one set of drawings and specifications on the work of other trades. In addition, one complete set of all electrical submittals and shop drawings shall be maintained at the site by the electrical contractor.
- C. The electrician shall check other trades' drawings, specifications, and shop drawings to see if there are any conflicts or discrepancies. If so, he shall contact the Engineer for instructions.
- D. The Contractor shall properly protect his work against damage by weather or other trades. All work shall be left well cleaned, and damaged finishes shall be restored to original condition.
- E. The Contractor shall place his own sleeves and notify other trades of chases and openings far enough ahead so they can be properly built in. Where any raceways, supports, etc., installed under the contract pierce the roof, suitable pitch pockets shall be provided and coordinated with the roofing contractor as necessary to be acceptable to the Engineer. Provide suitable fittings where any raceways or equipment cross expansion joints.
- F. This contractor shall be responsible for all trenching, backfilling, cutting, core drilling, and patching related to his work.
- G. Contractor shall provide firestops and smoke seals per Project Specifications and UL Details shown on drawings. All penetrations shall be sealed accordingly.
- H. Contractor should not scale drawings for outlet and equipment locations. Unless specifically dimensioned on drawings or defined in specifications, outlets and equipment shall be located as evidently intended or as detailed on Architectural drawings. Lighting outlets are to be centered or spaced symmetrically unless they are dimensioned. Any dimensions shown on the drawings shall be verified in the field by the contractor prior to roughing. All outlet and equipment locations shall be coordinated with the other trades. If any doubt arises, contact the Engineer prior to roughing.
- I. Contractor shall keep premises free of debris resulting from this work.

3.2 TESTS AND GUARANTEES

- A. All current-carrying phase conductors and neutrals shall be tested as installed, and before connections are made, for insulation resistance and accidental grounds. Each fixture and item of equipment for connection under the Contract shall be tested for insulation resistance from its conductors to its grounded surface or contact. These tests shall be done with a 500 volt (minimum) high voltage "megger."
 - 1. Minimum readings shall be one million (1,000,000) or more ohms for #6 AWG and smaller wire, 250,000 ohms or more for #4 AWG and larger wire, between conductors and between conductor and the grounding conductor.
 - 2. After all fixtures, devices, and equipment are installed and all connections completed to each panel, the contractor shall disconnect the neutral feeder conductor from the neutral bar and

take a megger reading between the neutral bar and the grounded enclosure or ground bar. If this reading is less than 250,000 ohms, the contractor shall disconnect the branch circuit neutral wires from this neutral bar. He shall then test each one separately to the panel and until the low readings are found. The contractor shall correct troubles, reconnect and retest until at least 250,000 ohms from the neutral bar to the grounded panel can be achieved with only the neutral feeder disconnected.

3. The Contractor shall send a letter to the engineer certifying that the above has been done and showing the tabulation of the megger readings for each panel or feeder. This shall be done at least four (4) days prior to final walk-through by engineer, and SCO.
 4. At final walk-through by the engineer and SCO, the contractor shall furnish a megger and demonstrate that the panels comply with the above requirements. He shall also furnish a clamp-on type ammeter and a voltmeter to take current and voltage readings as directed by the engineer, or SCO representatives.
- B. Validity of the ground path shall be assured by constant and careful attention to the thorough tightening of all couplings, connectors, locknuts, screws, bolts, etc., and by frequent checking of the path resistance with a quality low-range ohmmeter. Resistance of the path should not exceed one ohm between any two points. If a reading in excess of this is observed, it shall be discussed with the Engineer for an appraisal of the condition.
- C. Contractor shall guarantee that the work is done in accordance with drawings and specifications, and that it is free of imperfect materials or defective workmanship. Anything unsatisfactory shall be corrected immediately and at Contractor's expense.
- D. All test results for items A. and B. above shall be included in Operation and Maintenance manuals for Owner future trending.
- E. For the period of one year after acceptance by the Owner, the Contractor shall replace, without any expense to the Owner, any imperfect materials or defective workmanship.

3.3 RECORD DRAWINGS/MANUALS

- A. Upon completion of the installation, Contractor shall submit to the Engineer marked prints of Drawings showing any changes made in circuits, location of equipment, panelboards, or any other revision in the Contract Drawings, for the Owner's use in maintenance work and for future additions and expansions. Marked changes shall also include changes due to change orders unless already recorded by revised drawing or bulletin drawing.
- B. These record drawings shall be submitted in one of two formats: either a clean, legible, marked set of prints with all markings in distinguishable colored pencil such as red; or a set of reverse-run reproducible sepia prints marked in soft pencil so that blue-line prints can be reproduced as required. The format to be used shall be as defined in the General Requirements section of the contract documents. If no format is defined, the marked blue-line prints shall be submitted.
- C. Operation and Maintenance manuals shall be submitted to the Engineer at the end of the project prior to closeout of the project. Information included shall be a copy of all submittal data, shop drawings, and necessary operating and maintenance instructions and wiring diagrams on all major

items of equipment and all special systems (fire alarm, intercom, etc.). Submit these manuals in the quantities and format described in the General Requirements Section.

END OF SECTION 26 0500

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SECTION 26 05 19 – LOW-VOLTAGE ELECTRICAL POWER CONDUCTORS AND CABLES

PART 1 GENERAL

1.1 REQUIREMENTS

A. All material shall be U.L. listed and shall be installed in conformance with the National Electrical Code.

PART 2 PRODUCTS

2.1 MATERIALS

A. Manufactured by Southwire, Rome, or Triangle, or as otherwise noted in the specifications.

B. Normal trade standard "building wire" of copper.

C. Power and lighting circuits #10 AWG and smaller shall have solid copper conductors. Conductor sizes #8 AWG and larger shall have Class B stranded copper conductors. Maximum conductor size shall be 500 KCMIL.

D. All sizes shall bear easily readable size and insulation grade marking along entire length.

E. Insulation on #6 and smaller shall be suitably colored in manufacturing. Conductors #4 and larger may be identified with bands of proper color plastic tape near each termination and in each junction box.

F. Insulation on service and feeders shall be 600 volt Type XHHW or THHN/THWN unless noted otherwise in the specifications, specifically noted on the drawings, or Code requires another type.

G. Branch circuits shall be a minimum of #12, with 600 volt THHN/THWN insulation unless noted otherwise in the specifications, specifically noted on the drawings, or Code requires another type. Circuit wires carried through rows of fluorescent fixtures shall be at least Type THHN.

H. Conductors in any location subject to temperatures higher than 60°C shall have insulation of a type approved by NEC for temperature encountered.

I. Control and signal conductors shall be type and size indicated in those sections of the Specifications, or as specifically indicated on drawings.

J. Conductors for branch circuits shall be sized to prevent a voltage drop exceeding three percent (3%) at the farthest outlet of power, heating and lighting loads, or any combination of such loads. The maximum total voltage drop on both feeders and branch circuits combined to the farthest outlet shall not exceed five percent (5%). Where the conductor length from the panel to the first outlet on a 277V circuit exceeds 125 feet, the branch circuit conductors from the panel to the first outlet shall not be smaller than #10 AWG. Where the conductor length from the panel to the first outlet on a

120 volt circuit exceeds 50 feet, the branch circuit conductors from panel to the first outlet shall not be smaller than #10 AWG. Where ungrounded conductors are increased in size from the minimum size that has sufficient ampacity for the intended installation, wire-type equipment grounding conductors shall be increased in size proportionately according to the circular mil area of the ungrounded conductor.

K. Conductors for VFDs shall meet the following requirements (unless noted otherwise in the specifications, specifically noted on the drawings, or where Code requires another type):

1. 12 AWG to 2 AWG:
 - a) Belden Classic 300% Ground VFD Cable (or approved equivalent).
 - b) Overall Duofoil® Shield + 85% TC Braid plus full size TC Drain Wire.
 - c) One Full-sized Insulated Ground (Same AWG as Circuit Conductors).
 - d) Three Stranded Class D Tinned Copper (TC)
 - e) Circuit Conductors with XLPE Insulation.
 - f) Black Sunlight- and Oil-Resistant PVC Jacket.
 - g) 1000V UL Flexible Motor Supply
 - h) 600V UL 1277 Type TC-ER
 - i) 1000V UL 2277 Type WTTC
 - j) 1000V CSA AWM I/II A/B FT4
 - k) IEEE 1202
 - l) UL Direct Burial
 - m) XHHW-2, RHW-2 rated circuit conductors
 - n) 90°C Wet/Dry
 - o) Suitable for Class I, II & III, Division 2 hazardous locations
 - p) MSHA
 - q) UL 1685 Vertical Tray Flame Test
 - r) RoHS compliant
 - s) CE approved
 - t) C(UL) 600V Type CIC TC
2. 1 AWG to 4/0 AWG:
 - a) Belden Classic 100% Symmetrical Ground VFD Cable (or approved equivalent).
 - b) Two Spiral Copper Tape Shields (100% Coverage).
 - c) Three Symmetrical Bare Copper (BC) Grounds
 - d) Three Stranded Class D Tinned Copper (TC)
 - e) Circuit Conductors with XLPE Insulation
 - f) Black Sunlight- and Oil-Resistant PVC Jacket.
 - g) 1000V UL Flexible Motor Supply
 - h) 600V UL 1277 Type TC-ER
 - i) 1000V UL 2277 Type WTTC
 - j) 1000V CSA AWM I/II A/B FT4
 - k) IEEE 1202
 - l) UL Direct Burial
 - m) XHHW-2 rated circuit conductors
 - n) 90°C Wet/Dry
 - o) Suitable for Class I, II & III, Division 2 hazardous locations
 - p) MSHA
 - q) UL 1685 Vertical Tray Flame Test
 - r) RoHS compliant

- s) CE approved
- t) C(UL) 600V Type RW90 TC

PART 3EXECUTION

3.1INSTALLATION

A.All wiring shall be color coded:

1. On 120/208 volt, 3 phase, 4 wire systems - phase A, black; phase B, red; phase C, blue; neutral, white. On 277/480 volt, 3 phase, 4 wire systems - phase A, brown; phase B, orange; phase C, yellow; neutral, natural gray. Ground conductor on all systems shall be green.
2. Unless noted or accepted otherwise, busses in panels and switchgear shall be considered "A", "B", and "C" from left to right, top to bottom, or front to back when facing equipment.
3. Control wiring shall not use black, red, or blue; but shall use white for neutrals and green for grounding. Any other colors may be used but the coding shall provide same color between any two terminals being joined.
4. Switchlegs, including "travelers" in 3-way and 4-way switching systems, shall be same color as phase leg.

B.Joints in #10 and smaller wire may be either made with approved twist-type connectors such as Ideal, Buchanan, T&B, Scotch, etc. "Stakon" or other permanent type crimp connectors shall not be used for branch circuit wiring.

C.Joints in #8 and larger wire shall be made with approved Burndy, T&B, or O.Z. Manufacturing Co., mechanical pressure type connectors or lugs along with their UL approved insulating covers.

D.Manufactured insulators for connectors may be used, provided they cover completely and securely all exposed metal. If joints and splices are taped, they shall be carefully covered with top-grade Okonite, Scotch Brand, or approved equivalent plastic or rubber and friction, laid on with half laps to result in a joint insulation equivalent to that of the conductor insulation.

E.Circuit joints shall not be made on twin screws of convenience receptacles. Make joints as described above and run single leads to receptacle.

F.All wiring lugs throughout the project, including, but not limited to, breakers, panelboard/switchboard lugs, safety switch lugs, and transformers lugs, shall be rated for use with 75 degree conductors sized in accordance with NEC Table 310.15(B)(16).

G.Wm. Brady Co., or approved equivalent, labels or the type made with a punch on plastic tape, giving the circuit number, shall be securely fastened to each branch circuit conductor within panelboards. They shall also be installed on all conductors within junction boxes, pull boxes, gutters, wireways, cabinets, or equipment where two or more wires of the same color occur.

H.Where connected under screw or bolt heads, stranded wire shall be fitted with a lug of proper size. Make solid conductor loops clockwise so as to be forced closed as screw is tightened. Only

one

solid wire loop may be held under a single screw.

I. Make all connections tight.

J. Wires within panelboards, terminal cabinets, and similar equipment shall be neatly squared.

K. Where paralleling of conductors is shown for feeders or service entrance, it is absolutely required they be exactly the same length between points of bonding together. Lay out side by side and cut to same length before drawing into raceways. Provide for each end of run a Burndy Q2A or W3A lug, or approved equal, and terminate parallels in these without cutting.

L. Individual branch circuits shall not have shared neutrals.

END OF SECTION 26 0519

SECTION 26 05 23 – CONTROL VOLTAGE ELECTRICAL POWER CABLES

PART 1 GENERAL

1.1 REQUIREMENTS

- A. Shall conform with Article 700 and 725 of NEC.

PART 2 PRODUCTS

2.1 MATERIALS

- A. Shall also conform with the following unless noted otherwise on drawings or in other sections of these Specifications:

1. Conductors shall be run in metal conduit, unless specifically stated otherwise. These shall be complete with outlet boxes, junction boxes, fittings, etc., conforming in all respects with Section 26 05 33.
 2. Conductors shall be #14 AWG minimum, stranded copper, and insulated with type THHN thermoplastic insulation rated for 600 volts unless noted otherwise in the specifications, specifically noted on the drawings, or Code requires another type.
 3. Conductors shall be colored in manufacture. Black, red, and blue shall be used only for connections of these wiring systems to proper phase in main wiring system. Color code throughout remainder of system shall be other colors selected by This Contractor, but same color shall be used between points of connection. In other words - do not change color at splices, in junction boxes, etc. White shall be reserved for neutral and green for grounding.
 4. In lieu of color coding, or in conjunction with, this Contractor shall identify each conductor using a label system, such as Brady labels, or equal. Each conductor shall be individually labeled with a distinctive number or number/letter combination at each termination point, including wire nut connections. A table shall be made identifying each conductor, its function, its origin, its final termination, etc. This table shall be typewritten and included in the final Operation and Maintenance Manuals and with a copy left in the main point of origin cabinet (such as fire alarm panel).
- B. Joints and connections shall be made as specified in Section 26 05 19.

PART 3 EXECUTION

3.1 INSTALLATION

- A. This section is not used.

END OF SECTION 26 0523

SECTION 26 05 26 – GROUNDING AND BONDING FOR ELECTRICAL SYSTEMS

PART 1 GENERAL

1.1 REQUIREMENTS

- A. All systems and equipment shall be grounded in accordance with NEC Article 250.

PART 2 PRODUCTS

2.1 MATERIALS

- A. Manufactured by Thomas & Betts, Harger Lightning Protection, Lightning Master Corporation or approved equivalent.
- B. Bonding shall be done with #3800 series insulated bonding bushings and compression type lugs.
- C. Grounding conductor shall be THHN/THWN run in heavy wall conduit, and of size shown on drawings or required by NEC.

PART 3 EXECUTION

3.1 INSTALLATION

- A. Any raceway anywhere in the system which enters a box or cabinet through part of a concentric or oversized knockout shall be fitted with an insulated bonding bushing and jumper. These bushings shall also be used wherever conduits stub into switchboards or transformer cabinets. Grounding type insulated bushings shall always be used on both ends of conduits feeding panelboards. The bonding jumper shall be sized by NEC Section 250 and lugged to the box.

EMT couplings and connectors shall be compression-gland type of malleable steel, galvanized or sherardized. Connectors shall be insulated-throat type. Set screw, indentor, or cast type fittings are not acceptable.

Attach rigid metal conduits with double locknuts - one inside and one outside - and fiber bushing, or in a threaded hub.

The raceway system shall not be relied on for ground continuity. A green grounding conductor, properly sized per NEC Table 250.122, shall be run in ALL raceways except for telecommunications, data and audio conductors raceway.

Ground all fixed and portable appliances and equipment connected under this Contract with a green grounding conductor. This wire shall be carried inside the raceway and flex from equipment to nearest grounded portion of raceway system. Connect at both ends with suitable lugs.

All grounding type receptacles shall have a green wire jumper from their grounding terminal to box in which mounted. Attach jumper to box, not plaster ring, with a bolt or grounding clip. Jumper shall be sized by NEC with #12 minimum.

END OF SECTION 26 0526

SECTION 26 05 33 – RACEWAY AND BOXES FOR ELECTRICAL SYSTEMS

PART 1 GENERAL

1.1 REQUIREMENTS

- A. All material shall be UL listed and shall be installed in conformance with the National Electrical Code.

1.2 SUBMITTALS

- A. Shop drawings for:
1. Conduits
 2. Couplings and fittings
 3. Boxes
 4. Floor boxes
 5. Conduit seals
- B. Provide list of conduit types indicating where each type is used.

PART 2 PRODUCTS

2.1 RACEWAYS

- A. Manufactured by Allied Tube & Conduit, Wheatland, Western Tube & Conduit, or approved equivalent, or as otherwise noted in the specifications.
- B. Galvanized Steel Rigid Metal Conduit (RMC):
1. Heavy wall tubing with hot dipped galvanized coating
 2. Connections shall be made with double locknuts and bushings. Bushings to be steel with integral insulator except conduits 2" and below may have high impact thermoplastic Phenolic insulating bushings.
- C. Intermediate Metal Conduit (IMC):
1. Intermediate grade metallic tubing with hot dipped galvanized coating.
 2. Connections shall be made with double locknuts and bushings. Bushings to be steel with integral insulator except conduits 2" and below may have high impact thermoplastic Phenolic insulating bushings.
- D. Electrical Metallic Tubing (EMT) Conduit:
1. Thin wall tubing with hot dipped galvanized coating.
 2. Couplings and connections shall be threaded steel, watertight gland compression type.

3. All connectors shall have insulated throat.
- E. Rigid Nonmetallic Conduit:
 1. Heavy wall rigid, type 40, listed for underground encased and above ground applications.
 2. Heavy wall rigid, type 80, listed for underground encased and above ground applications.
- F. PVC Coated Conduit:
 1. RMC or IMC Conduit
 2. 40 MIL PVC exterior coating
 3. 2 MIL Urethane coating on interior and treads
 4. Plastic tread protector caps
- G. Flexible Metal Conduit (FMC):
 1. Electro-galvanized single strip steel.
- H. Liquid Tight Flexible Metal Conduit:
 1. Electro-galvanized single strip steel with PVC coating.
- I. Stainless Steel Conduit:
 1. Type 304 or 316
 2. Standard and special radius elbows
 3. Threaded couplings
- 2.2 BOXES
 - A. Manufactured by Midland Ross/Steel City, T&B, Racor, or Appleton.
 - B. Galvanized or aluminum of gauge required by NEC.
 - C. All junction and pull boxes shall be 4 inch square by 2-1/8 inch deep minimum.
 - D. Stamped steel boxes with knockouts are not acceptable for surface mounting in finished spaces in the building.
 - E. PVC coated or stainless steel.
- 2.3 FASTENINGS AND SUPPORTS
 - A. Shall be of good quality, galvanized steel or other non-corroding material.

PART 3 EXECUTION

3.1 RACEWAY INSTALLATION

- A. All wire and cable shall be run in raceway.
- B. Minimum raceway size shall be 3/4" (interior) and 1" (below grade) unless noted otherwise. Half inch flexible conduit may be used from junction box to above ceiling light fixtures (6' maximum length).
- C. All runs of empty conduit only shall have a 100# nylon pull rope installed in the conduit.
- D. Rigid metal conduit shall be made up with full threads to which T&B "Kopre-Shield" compound has been applied, and butted in couplings.
- E. Z. Split or "Erickson" couplings where necessary.
- F. No conduit shall be run in poured concrete floors or slabs. Conduit runs shall normally be run overhead. Where it is necessary to run underneath a concrete slab poured on-grade, conduit shall be buried in trench beneath gravel base and turned up through slab. Where it is necessary to run underneath a floor above a crawl space or another floor, conduit shall be run along ceiling space under floor and stubbed through floor using appropriate methods, such as "poke-through" devices or other means U.L. approved for such purpose.
- G. Underground runs, except under concrete floor slabs, shall be encased by a minimum of three (3) inches of concrete on all sides and shall have a minimum of eighteen (18) inch (non-roadway) and twenty-four (24) inch (roadway) cover, except for raceways containing circuits above 600V, which shall have a minimum cover of 30". Backfill shall be made in six (6) inch layers - tamping each layer to a density of 95% of maximum possible. Red dye shall be applied to the top of freshly placed concrete in all underground duct banks as a warning of electrical hazard in the event of future excavation. In addition, all underground raceway shall be identified by underground line marking tape located directly above the raceway at six (6) to eight (8) inches below finish grade. Tape shall be permanent, bright-colored, continuous printed, plastic tape compound for direct burial not less than 6" wide and 4 mils thick. Printed legend shall be indicative of general type of underground line below.
- H. Where passing through a below grade wall from a conditioned interior building space, raceways shall be sealed utilizing fittings similar and equal to OZ/Gedney type "FSK" through wall fitting with "FSKA" membrane clamp adapter if required.
- I. Attach rigid metal conduits with double locknuts - one inside and one outside - and fiber bushing.
- J. Grounding type insulated bushings shall be used where raceway enters boxes with concentric or oversized knockouts. These bushings shall also be used wherever conduits stub into switchboards or transformer cabinets. Grounding type insulated bushings shall always be used on both ends of conduits feeding panelboards.
- K. Provide suitable fittings where raceway crosses building expansion joints.
- L. Securely fasten in place using approved strap or hanger within three (3) feet of each termination and not over ten feet apart in runs.

- M. Run concealed in finished areas unless otherwise noted.
- N. Make all cuts square with hacksaw. Remove any burrs or shoulders by reaming.
- O. All runs exposed and all runs above accessible ceilings shall be neat and square with building structure such as walls and ceiling/roof structures. Multiple parallel runs shall use trapeze supports where possible.
- P. "Flex" and "Sealtite" connections with T&B "Tite-Bite" and "Super-Tite" or approved equivalent fittings. Shall have insulated throats.
- Q. Where installing raceway on interior surface of exterior walls. Mount raceway ¼" from wall with clamp-backs or strut.

3.2 APPLICATION

- A. Galvanized Steel Rigid Metal Conduit (RMC) Conduit required:
 - 1. Installations below grade (and in or under slabs where approved), except where specifically noted otherwise.
 - 2. Below 6 ft AFF in exposed areas of mechanical equipment rooms, except where specifically noted otherwise.
- B. Electrical Metallic Tubing (EMT) Conduit required:
 - 1. Interior panel feeders, except where specifically noted otherwise, etc.
 - 2. Interior partitions
 - 3. Above suspended ceilings
 - 4. Above 6 ft AFF in exposed areas of mechanical equipment rooms, except where specifically noted otherwise.
 - 5. Sizes 2" and smaller except as approved, except where specifically noted otherwise.
- C. Nonmetallic Rigid Conduit required:
 - 1. Direct burial, concrete encased.
 - 2. Direct burial, in sand fill on bottom and top.
 - 3. Corrosive atmospheres, except where specifically noted otherwise.
- D. Liquid Tight Flexible Metal Conduit required, not over 4 ft in length, for final connections to:
 - 1. Equipment in wet locations.
 - 2. Equipment with vibration isolation mounting.
 - 3. Equipment housing ferromagnetic cores or with integral moving components, capable of generating noise or vibrations including transformers and motors.
 - 4. Pumps and associated equipment.
 - 5. Instruments and control devices.
 - 6. All flexible connections to equipment in fire pump room below 60" AFF.
- E. Flexible Metal Conduit required, not over 4 ft in length, for final connections to:

1. Equipment in dry locations.
 2. Equipment in dry locations with vibration isolation mounting.
- F. PVC Coated Conduit shall be used:
1. In corrosive atmospheres as noted on plans.
 2. In exterior environments needing additional protection.
- G. Stainless Steel Conduit shall be used for:
1. Exposed conduits in GMP Clean Room or Wash Down environments.
- H. Aluminum Surface Mounted Raceway (Labs)
1. Surface mounted in labs with receptacles, data outlets as required per the drawings.
 2. Provide with all necessary components for complete professionally installed system including, but not limited to, base, cover, clips, elbows, couplings, seam clips, entrance fittings, device plates, devices, etc.
- ### 3.3 BOX INSTALLATION
- A. Attach EMT with connector only.
- B. Outlet boxes shall be sized in accord with NEC Section 314. All lighting outlet boxes shall have fixture studs. Device boxes shall be sectional type or 4" square equipped with plaster rings as required to mount the device. Set edge flush with finished surface. Boxes may be installed at top or bottom of a masonry course. Raco, or approved equivalent, masonry boxes in sawed block. 1-1/4" and deeper plaster rings may be of die-cast aluminum of Steel City make, or approved equivalent.
- C. Where installed in metal stud partitions, wall boxes shall be supported from two adjacent studs using a system such as Caddy Bar Hanger Assembly, or approved equivalent. Support on a single stud is not acceptable.
- D. Fixtures weighing more than six pounds shall be supported from the fixture stud.
- E. Where not shown differently on the drawings, mount:
1. Switch boxes 46" from finished floor to center. Boxes beside doors shall be mounted so edge of trim plate is 2" from edge of door trim on strike side.
 2. Telephone boxes 18" from finished floor to center and vertical. Boxes for wall phones shall be 46" from finished floor and vertical.
 3. Bracket light boxes as indicated on plans or as directed by Engineer.
 4. Clock outlet boxes 7'-0" from finished floor, or 6" below finished ceiling, to center.
 5. Panel cans 6'-4" ($\pm 4"$ in concrete block construction) from finished floor to top of can.
 6. Fire alarm pull stations 46" from finished floor to center.
 7. Fire alarm chimes, horns, strobes, etc., 80" above finished floor or 6" below finished ceiling, whichever is lower, and shall comply with ADA requirements.
- F. Where not shown differently on the drawings, mount boxes for receptacles to receive device in a vertical position and be:

1. Centered 18" above finished floor.
 2. Centered 6" above counters, shelves, or cabinets where apparently intended to be so placed.
 3. Centered 4" above high edge of backsplashes.
 4. Where devices are to be ganged, provide boxes to receive devices trimmed with a gang plate.
- G. As soon as installed, all raceway openings shall be closed with plastic inserts to prevent entrance of foreign matter during construction. All enclosures shall be kept clean of any foreign matter. Install Jordan "Kover-All" plastic covers over outlet boxes ahead of plastering or painting.
- H. Conduit(s) from all boxes installed on exterior walls or in areas going from conditioned to unconditioned space shall have conduit(s) sealed with duct seal or equivalent to prevent moisture formation. Duct seal or equivalent shall also be installed in all raceways entering from exterior of building.

3.4 FASTENINGS AND SUPPORTS INSTALLATION

- A. Inserts in masonry shall be lead, fiber, or plastic types installed in drilled holes. Wooden plugs shall not be used. Lead only shall be used on all exterior masonry or interior masonry subject to permanent moisture. Hung raceways shall be supported from the structure with rod supports at least 5/16" in diameter.
- B. All equipment and flat raceways attached to outside wall or interior walls subject to permanent moisture shall be shimmed out with non-corrodible material so as to provide 1/4" air space between wall and equipment or raceway.
- C. All materials, whether exposed or concealed, shall be firmly and adequately held in place. Fastening and support shall afford safety factor of three or higher.
- D. All fixtures, raceways, and equipment shall be supported from the structure. Nothing may be supported on suspended ceilings, including the hanger wires, unless definitely noted so on the drawings or specifically permitted by the Engineer.
- E. Recessed fixtures shall be supported at the two (2) opposite ends to the structure. Supports shall be provided with the same type of wire as used to support the lay-in ceiling track. Attach one end of the wire to one corner of the fixture and the other end to the building's structural system. Lay-in fixtures shall also be screwed to the main runners of the lay-in ceiling track at all four corners using sheet metal screws.
- F. Recessed ceiling speakers, where specified with an enclosure, shall have the enclosure supported directly from the structure with a minimum of two 10 gauge wires run perpendicular to the ceiling and not pulling to one side. If recessed ceiling speaker is specified without an enclosure and is mounted in a suspended ceiling, the speaker shall be supported using T-Bar bridges such as Soundolier No. 81-8, or other device specifically designed for such support. In addition, each of the four corners of the ceiling grid block enclosing the speaker shall be supported from the structure using 10 gauge steel wire run perpendicular to the ceiling plane.
- G. Other devices using octagonal or 4" square ceiling boxes, such as smoke detectors, dome lights, exit signs, etc., where installed in suspended ceilings shall be supported from the ceiling system using Caddy, or other, hangers specifically designed for such support. In addition, each of the four corners of the grid block enclosing the box shall be supported from the structure using 10 gauge

steel wires run perpendicular to the ceiling plane.

- H. Support for pipe straps or clamps shall be toggle bolts on hollow masonry; metal expansion shields and machine screws, or standard pre-set inserts, on concrete or solid masonry; machine screws or bolts on metal surfaces; and wood screws on wood construction. The resulting fastening shall be completely secure.

END OF SECTION 26 0533

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SECTION 26 05 43 – UNDERGROUND DUCTS AND RACEWAYS FOR ELECTRICAL SYSTEMS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and General Conditions of the Specification sections apply to work in this section.
- B. The requirements of the 26000-Series sections govern the work specified in this section, where applicable.

1.2 DESCRIPTION OF WORK

- A. The requirements of this section apply to electrical duct systems work specified herein.
- B. The applicable requirements of this section shall apply to the use of existing underground electrical duct systems for the installation of new cable, i.e. cleaning, cable supports, racks, etc.
- C. Provide grounding as required on drawings and specified within the 26000-Series specifications.
- D. The extent of electrical duct systems work is indicated by drawings, schedules and requirements of this section.
- E. The type of electrical duct systems required for the project include concrete encased PVC schedule 40 conduit.
- F. The handholes shall be pre-cast concrete.

1.3 QUALITY ASSURANCE

- A. Manufacturers: Firms regularly engaged in manufacture of electrical raceway of types and capacities required, whose products have been in satisfactory use in similar service for not less than 3 years.
- B. NEMA Compliance: Comply with applicable portions of National Electrical Manufacturers Association standards pertaining to nonmetallic duct and fittings for underground installation.
- C. UL Labels: Provide electrical raceways which have been listed and labeled by Underwriters Laboratories.
- D. NEC Compliance: Comply with National Electrical Code as applicable to construction and installation of electrical raceways.

1.4 SUBMITTALS

- A. Electrical Duct System: Submit manufacturer's product data on electrical duct system materials including manholes, handholes, conduit, supports, spacers, underground marking tape, pull cord, handholes, manholes, covers, racks, rack arms, grounding rods, hardware, etc.

1.5 PRODUCT DELIVERY, STORAGE AND HANDLING

- A. Handle conduit and tubing carefully to prevent bending, end-damage and to avoid scoring finish. Conduit and duct shall not be stored directly on ground, provide suitable ground supports for all conduit and duct materials.
- B. Handle precast hand holes to prevent damage to product and damage to site. Storage of hand holes on site prior to installation shall be coordinated with owner and not obstruct normal operations of traffic flow on site.

1.6 UNDERGROUND UTILITY LOCATION

- A. Contractor shall contact local underground utility locating company before starting any digging, boring or excavation. All underground utilities shall be marked and identified prior to commencing of any work.
- B. Work plan shall consider the locations of all existing utilities. Notify the Engineer immediately regarding any discrepancies in underground utilities as they may affect work scope and schedule.

PART 2 - PRODUCTS

2.1 MATERIALS AND COMPONENTS

- A. General: Provide underground distribution systems, as shown on the drawings and specified here, for the following systems
 1. Power Distribution Systems
 2. Telecommunications Systems
- B. The raceway and duct systems shall be complete, including, but not necessarily limited to, raceways, ducts, handholes, manholes, pull boxes and pull cords along with all accessories to provide a complete operational system.
- C. PVC Duct: Concrete encased underground duct systems shall be constructed using UL listed rigid plastic schedule 40 PVC conduit suitable for encasement in concrete.
- D. The ductbank shall be constructed of 4" PVC conduit. The 4" PVC conduit shall be 4" rigid plastic conduit Schedule 40 PVC suitable for encasement in concrete.
- E. Duct for power circuits shall be not less than 75% polyvinyl chloride, suitable for power service with 90°C Conductors.
- F. PVC Fittings: NEMA standard to match duct type and material.

- G. Provide ductbank reinforcing or rigid steel conduit wherever ductbank crosses under roadways, parking lots and where located in unstable soil and within 10 feet of building foundations, and as otherwise indicated.
- H. Duct Elbows: All factory elbows exceeding 10 degrees shall have a minimum radius of 48 inches where used for underground encasement.
- I. Provide conduit, tubing and duct accessories including straps, spacers, expansion and deflection fittings as recommended by duct manufacturers.
- J. All power ductbank shall be dyed red.

PART 3 - EXECUTION

3.1 INSTALLATION – UNDERGROUND DUCT BANK SYSTEM

- A. System shall consist of single, roundbore conduit encased in concrete. The minimum number and size of ducts shall be indicated on the drawings. Changes in direction of runs exceeding 10 degrees shall be accomplished by using special couplings or bends manufactured for this purpose. Duct lines shall be installed so that the top of concrete or future concrete as shown is not less than 36 inches (primary) and 30 inches (secondary) below finished grade or finished grade or finished paving at any point.
- B. Ducts should be pitched to drain toward manholes and handholes and away from buildings and equipment. Minimum slope shall be 4-inches in 100-feet. Where necessary to achieve this between manholes, ducts should be sloped from a high point in the run to drain in both directions.
- C. Concrete encased non-metallic ducts shall be supported on plastic separators coordinated with duct size and spacing. Spacers shall securely support and maintain uniform spacing of the duct assembly. Provide a minimum of 3 inches above bottom of trench during the concrete pour. Support spacing shall not exceed 5 feet along lengths of duct to prevent sagging of ducts. Separators shall be secured to prevent floating during placement of concrete. Provide nonferrous tie wires to prevent displacement of the ducts during concrete pour. Tie wires shall not act as substitute for spacers. Duct separators or spacers shall be of the "Lattice" type so that concrete can flow through the spacer. Spacers shall be Underground Devices Inc. WUNPEECE or engineered approved equal by Carlon or ABB/T&B).
- D. Conduit passing under roadways, including paved parking areas, or under or through foundation walls shall be Schedule 40 conduit in steel reinforced ductbank. Reinforcing shall extend a minimum of 10 feet beyond each side of the roadway or wall.
- E. Where duct lines enter manholes or pull boxes, the conduits shall terminate in end bells. Conduit shall be thoroughly cleaned before laying. During construction and after the duct line is complete; the ends of the conduit shall be plugged to prevent water washing mud into the conduits. Particular care shall be taken to keep the conduits clean of concrete or any other substance during the course of construction.
- F.

Table 1: Separation of Underground Lines from Other Underground Utilities

Electrical	Water	Sanitary Sewer Service	Sanitary Main or lines > 8' deep	Force Main	Storm Drain	Natural Gas	Steam or Hot Water	Telecom.
<u>Minimum Separation at Perpendicular Crossing (Units in Inches)</u>								
12	18	18	18	18	18	18	24	12
<u>Minimum Separation for Parallel Crossing (Units in Inches)</u>								
12	36	36	60	36	36	60	60	12

- G. All underground raceways shall be identified by underground line marking tape located directly above the raceway at 6 to 8 inches below finished grade. Tape shall be permanent, bright-colored, continuous printed, plastic tape compounded for direct burial not less than 6 inches wide and 4 mils thick. Printed legend shall be indicative of general type of underground line below.
- H. Where it is necessary to cut a tapered end of a piece of conduit at the site, the cut shall be made with a tool or lathe designed to cut a taper to match the taper of the particular conduit to be used.
- I. All ducts should be sealed at terminations, using sealing compound and plugs, as required to withstand 15 psi hydrostatic pressure.
- J. Where underground raceways are required to turn up to cabinets, equipment, etc., and on to poles, the elbow required and the stub-up out of the slab or earth shall be of rigid steel for the last two (2) feet minimum. Where rigid steel is in direct contact with the earth, it shall be protected with asphaltum, bitumastic, or other approved moisture inhibitor. Contractor may use Schedule 40 PVC conduit into open bottom, floor mounted cabinets or equipment where permitted by NEC and specifically approved by Owner.
- K. Cleaning Ducts: For new and existing ducts to be used for new cables a mandrel not less than 12 inches long, having across section approximately one-fourth inch less than the inside cross section of the conduit shall be pulled through each conduit throughout the entire length, after which a brush with stiff bristles shall be pulled through to make certain that no particles of earth, sand, or gravel have been left in the lines. The Engineer and Owner shall witness the pulling of all mandrels. Provide 7 days notice to the Engineer prior to pulling mandrels.
- L. Installation of duct banks: Each single conduit shall be completely encased in concrete with a minimum of 3 inches between conduits and a minimum thickness of concrete encasement of 3 inches which may be increased to fit the actual shape of the trench. All concrete shall be adequately vibrated to insure concrete placement around perimeter of all ducts. Spacing assembly shall be made of non-metallic, non-decaying material. Joints in conduits shall be staggered at least 6 inches. Ducts shall be securely anchored to prevent movement during the placement of concrete.
- M. Waterproof, 130 pound tensile test marking cord shall be installed (marked at least every foot), in all ducts, including spares, after thoroughly rodding, clearing and swabbing all lines free of any and all obstructions.
- N. Installation of single conduit: Shall be completely encased in concrete. The thickness of concrete shall be not less than 3 inches on the sides, bottom and top of conduit.

- O. Concrete: Shall be plain except where reinforced concrete is specified herein or indicated on the drawings. Plain and reinforced concrete shall conform to division 3000 - concrete of these specifications and shall be 3000 psi class. Power ductbank concrete only shall be dyed red throughout.
- P. Partially Completed Duct Banks: During construction wherever a construction joint is necessary in a duct bank, prevent debris such as mud and dirt from entering ducts by providing suitable conduit plugs. Fit concrete envelope of a partially completed duct bank with reinforcing steel extending a minimum of 2 feet back into the envelope and a minimum of 2 feet beyond the end of the envelope. Provide one No. 4 steel rebar in each corner minimum and along the edge of each ductbank no further than 12 inches on center, 3 inches from the edge of the envelope. Restrain reinforcing bars from moving during pouring of concrete.
- Q. Backfill and compaction shall be in accordance with Section 260533. Where conduit lines are installed under grass plots, the sod shall be removed, stored at one side of the lot and kept watered. As soon as the trench is backfilled, this sod shall be replaced. Where conduit is installed between trees, trees and roots must be protected from damage.
- R. Handholes
 - 1. Workmanship: Underground structures shall be of precast construction as specified hereinafter. Horizontal concrete surfaces of floors shall have a smooth trowel finish. Covers shall fit the frames without undue play. The words "electric" shall be cast in the top face of all power hand hole covers, respectively. Precast units shall be the product of a manufacturer regularly engaged in the manufacture of precast concrete products, including precast manholes and handholes.
 - 2. Concrete for precast work shall have an ultimate 28-day compressive strength of not less than 5500 pounds per square inch. All structures shall be identified with the manufacturer's name embedded in, or otherwise permanently attached to, an interior wall face.
 - 3. Design for Assembled Units: Precast structures shall be designed in accordance with ACI-318 and shall be based on the following properties:
 - a. Angle of Internal Friction (Phase) = 30 degrees
 - b. Unit Weight of Soil () = 110 pcf
 - c. Lateral at Rest Earth Pressure Coefficient = 0.50
 - 4. Structure top and bottom shall be designed for full dead, superimposed dead and live load including impact. Structure sidewalls shall be designed for lateral earth and hydrostatic pressures plus live load (H20 Truck) adjacent to structure. Tops and walls of structures shall be designed for AASHTO standard H20 highway loading, with 30 percent loading added for impact, and with design load being that which produces maximum shear and moment. All dead and live loads, as well as impact loading, shall be considered in design. Walls shall be designed to withstand all soil pressures, taking into consideration the soil to be encountered and ground water level present at the site, and assuming that the H20 design vehicle will operate on surfaces adjacent to the structure. Design shall also take into consideration stresses induced in handling units. Lifting devices shall be provided for properly handling units. Calculations and shop drawings shall be submitted covering the design and manufacture of precast units, and shall bear the seal of registered professional engineer.
 - 5. Joints: Mating edges of precast components shall be provided with tongue and grooved joints where applicable. Joints shall be designed to firmly interlock adjoining components and to provide waterproof junctions. Joints shall be sealed watertight using preformed plastic strip conforming to AASHTO M198, Type B. Sealing material shall

be installed in strict accordance with the sealant manufacturer's printed instructions. Provisions shall be made for waterproofing cable entrances into structures, and at covers in the top slab.

6. Provide stainless steel hardware for mounting fasteners. Coat threads of anchor bolts with anti-seize compound immediately prior to installing nuts.
7. Drainage: Drainage sumps shall be provided in all handholes. All handholes shall be positively drained.
8. Precast Handholes Installation: Commercial precast assembly shall be set on 6 inches of level, 90 percent compacted granular fill, 3/4 inch to one inch size, extending 12 inches beyond the handhole on each side. Granular fill shall be compacted by a minimum of four passes with a plate type vibrator. Drain sumps shall be provided for precast structures.

3.2 CONSTRUCTION RECORD DRAWINGS

- A. A clean set of drawings shall be kept on site for the contractor to use for as built drawings. As built drawings shall be certified as to accuracy by the Contractor. See section 260500 for the specific requirements for record drawings.

END OF SECTION 260543

SECTION 26 05 53 – IDENTIFICATION FOR ELECTRICAL SYSTEMS

PART 1 GENERAL

1.1 NAMEPLATES

A. Furnish and install engraved laminated phenolic nameplates for all safety switches, panelboards, transformers, switchboards, motor control centers, and other electrical equipment supplied for the project for the following: identification of equipment controlled or served, phase, voltage, panel and circuit(s) feeding equipment.

Example:

1A
120/208V, 3Ø, 4W
FED FROM MDP-1

B. Furnish and install permanently mounted label on each device plate for receptacles indicating its panelboard and circuit number. Labels shall be made using electronic labeling system with black letters on clear background. Write-on labels are prohibited.

PART 2 PRODUCTS

2.1 NAMEPLATE MATERIALS

A. Nameplate material colors shall be (conforms with State Construction Office requirements):

1. Blue surface with white core for 120/208 volt equipment.
2. Black surface with white core for 277/480 volt equipment.
3. Bright red surface with white core for all equipment related to fire alarm system.
4. Brown surface with white core for all equipment related to data systems.
5. Green surface with white core for all equipment related to emergency system.

B. All empty conduit runs and conduit with conductors for future use shall be identified for use and shall indicate where they terminate. Identification shall be by phenolic tags with wire attached to conduit or outlet.

C. All outlet boxes, junction boxes and pull boxes shall have their covers and exterior visible surfaces painted with colors to match color scheme outlined above. This includes covers on boxes above all type ceilings.

PART 3 EXECUTION

3.1 NAMEPLATE INSTALLATION

A. Nameplates shall be securely attached to equipment with self-tapping stainless steel screws, if sharp end is protected; otherwise, rivets shall be used. Nameplates shall identify

equipment controlled, attached, etc. Letters shall be ½” high minimum for panel identification.
Letters for

other information shall be ¼" high minimum. Embossed, self-adhesive plastic tape is NOT acceptable for marking equipment.

END OF SECTION 26 0553

SECTION 26 05 93 – ELECTRICAL SYSTEMS FIRESTOPPING

PART 1 GENERAL

1.1 REFERENCE

- A. The work under this section is subject to the Contract Documents including General Conditions, Supplementary Conditions, and under Division 1 – General Requirements.

1.2 SCOPE

- A. Furnish and install work under this section including, but not limited, to the following:
 - 1. Penetrations through fire-resistance-rated floor, roof, walls and partitions including openings containing conduits, cables, cable bundles, cable tray and other penetrating items.

1.3 SYSTEM PERFORMANCE REQUIREMENTS

- A. Firestopping systems shall be UL Classified for the application and correspond to those indicated by reference to designations listed by UL Fire Resistance Directory.
- B. Firestopping systems and installation shall meet requirements of ASTM E-814, UL 1479 or UL 2079 tested assemblies that provide fire rating equal to that of construction being penetrated.
- C. Proposed firestop materials and methods shall conform to applicable code authority having local jurisdiction.

1.4 SUBMITTALS

- A. Manufacturer's specifications and technical data for each material including composition and limitations, documentation of UL firestop systems to be used and manufacturer's installation instructions.
- B. Material safety data sheets provided with product delivered to job-site.

1.5 QUALITY ASSURANCE

- A. Installer Qualifications: Engage an experienced Installer who has completed firestopping that is similar in material, design and intent to that indicated for Project and that has performed successfully.
- B. A manufacturer's direct representative to be on-site during initial installation firestop systems to train appropriate contractor personnel in proper selection and installation procedures.

1.6 DELIVERY, STORAGE AND HANDLING

- A. Deliver products to Project site in original, unopened containers or packages with intact and legible manufacturers' labels identifying product, type and UL label where applicable.

- B. Store materials to prevent deterioration or damage due to moisture, temperature changes, contaminants or other causes.
- C. Handle with recommended procedures, precautions or remedies described in material safety data sheets as applicable.

1.7 PROJECT CONDITIONS

- A. Do not install firestopping when ambient or substrate temperatures are outside limits permitted by firestopping manufacturer or when substrates are wet due to rain, frost, condensation or other causes.
- B. Ventilate firestopping per manufacturers' instructions by natural means or, where this is inadequate, forced air circulation.

1.8 SEQUENCING AND SCHEDULING

- A. Do not cover up those fire stopping installations that will become concealed behind other construction until authorities having jurisdiction, if required, have examined each installation.

PART 2 PRODUCTS

2.1 MANUFACTURERS

- A. 3M, Hilti, Tremco, Nelson Firestop Products, Specified Technologies, Inc, or Rectorseal Corp.

2.2 MATERIALS

- A. Use only firestop products that have been UL 1479, ASTM E-814 tested for specific fire-rated construction conditions conforming to construction assembly type, penetrating item type, annular space requirements and fire-rating involved for each separate instance.
- B. Materials shall not contain flammable solvents.

PART 3 EXECUTION

3.1 EXAMINATION

- A. Examine areas and conditions, for compliance with requirements for opening configurations, penetrating items and other conditions affecting performance of firestopping. Do not proceed with installation until unsatisfactory conditions have been corrected.

3.2 PREPERATION

- A. Clean out openings immediately prior to installing firestopping to comply with recommendations of firestopping manufacturer.
- B. Provide masking and temporary covering to prevent soiling of adjacent surfaces by firestopping materials.

- C. Comply with manufacturer's recommendations for temperature and humidity conditions before, during and after installation of firestopping.
- D. Do not proceed until unsatisfactory conditions have been corrected.

3.3 INSTALLATION

- A. Comply with "System Performance Requirements" article in Part 1 and manufacturer's installation instructions and drawings.
- B. Install forming/backing materials and other accessories of types required to support fill materials during application as required. After installing fill materials, remove forming materials and other accessories no indicated as permanent components of firestop systems.
- C. Avoid multiple penetrations of common fire barrier opening. When possible, seal each penetration in accordance with project details. When multiple penetrations are unavoidable, seal openings with appropriate UL Classified firestoppihg systems.

3.4 FIELD QUALITY CONTROL

- A. Do not proceed to enclose firestopping with other construction until reports of examinations are issued.
- B. Where deficiencies are found, repair or replace firestopping so that it complies with requirements.

3.5 CLEANING

- A. Clean surfaces adjacent to sealed holes and joints to be free of excess firestop materials and soiling as work progresses.

END OF SECTION 26 0593

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SECTION 26 24 16 – PANELBOARDS

PART 1 GENERAL

1.1 REQUIREMENTS

- A. Equipment shall be built to NEMA Standards where such standards exist.

PART 2 PRODUCTS

2.1 MATERIALS

- A. Square D panelboards are specified as a basis for design. Equivalents by Cutler-Hammer or ABB (formerly General Electric Co.) may also be quoted.
- B. Types, sizes, capacities, and characteristics shall be as shown on riser diagram or in schedules.
- C. Branch circuit panelboards shall be bolt-on type, Square D NQ or NF types, or equivalent. Distribution panelboards shall be Square D I-Line types HCN, HCM, HCW, as indicated on plans, or equivalent.
- D. All breakers shall be fully rated. Series rating are not acceptable.
- E. Any required wiring modifications or extensions shall be provided above ceiling in accessible junction boxes or troughs. No new splicing inside panelboards.

2.2 CONSTRUCTION FEATURES

- A. Housing shall be constructed of Code gauge galvanized sheet steel and shall be securely fabricated with screws, bolts, rivets or by welding. Housings for branch circuit panelboards shall be 20" wide and 5-3/4" deep. Housings for distribution panelboards shall be no larger than the panelboard specified as shown on the plans or the Contractor shall verify larger panelboard will fit and still maintain the proper Code clearances because space is at a premium.
- B. Top or bottom gutter space shall be increased six inches where feeder loops through panel. End plates shall be galvanized Code gauge (minimum) and shall be supplied without knockouts.
- C. Covers shall be constructed of high grade flat sheet steel of Code gauge minimum with the following:

1. Door flush with face and closed against a full inside trim stop. Hinges shall be inside type.
2. A combination flush latch and Yale, Corbin or equivalent, tumbler-type lock, so panel door may be held closed without being locked. All such locks on same job shall be keyed alike. Plastic lock type trims are not acceptable.

3. Finish of manufacturer's standard color of top-grade enamel over a phosphatized or other approved rust inhibitor treatment and prime coat, or as specified in Section 26 05 00.
4. Four or more cover fasteners of a type which will permit mounting plumb on box. Cover shall also have inside support studs to rest on lower edge of can while being fastened.
- D. A means of readily adjusting projection of panel interior assembly with all connections in place shall be provided. A method requiring stacking of washers is not acceptable.
- E. Interior trim shall fit neatly between interior assembly and cover - leaving no gaps between the two.
- F. Circuit breakers:
 1. Circuit breakers shall be by the same manufacturer as the panel in which mounted unless specifically stated otherwise on the plans.
 2. Breakers shall be equipped with specific accessories, such as shunt trip, handle lock, etc., as indicated on plans.
 3. Individual breakers shall be securely and tightly mounted on their supporting structure so they do not depend upon the current-carrying bus for support, unless a combination support/bus is considered adequately strong by the Engineer.
 4. Breakers in lighting and branch circuit panels shall be "Quicklag" type bolted to the supply bus. Plug-in types are not acceptable.
 5. Breakers (15-30A) in lighting and branch circuit panels shall be rated to accept two (2) conductors under one (1) terminal for copper wire sizes #14-#10. The breakers shall also be rated to accept one (1) conductor under one (1) terminal for copper or aluminum wire sizes #14-#8.
 6. Breakers in distribution panels shall be molded-case thermal-magnetic type unless specifically indicated otherwise on plans. Multi-pole breakers shall have common tripping of all poles.
 7. Breakers shall have factory installed mechanical type lugs to accept solid or stranded type conductors and shall be rated for use with wire rated at 75 degrees C.
 8. All molded-case circuit breakers shall be labeled as meeting U.L. 489.
 9. Circuit breakers 400A and greater shall be electronic trip type, molded case, individually mounted breakers, listed under U.L. 489. Breakers shall be 80% rated (unless noted as 100% rated in schedule) with field interchangeable rating plugs as stated on the drawings. U.L. listed interrupting rating shall be the same as for the main breaker.
- G. Supply lugs shall be installed on busses and neutral bar so they may be readily and securely tightened from the front with panel in place and wired. A suitable arrangement shall limit their movement out of plumb. It shall not be possible to move the lugs so that metal parts between phases are closer than 3/8".

H. All panels shall have 100% rated copper busses and neutral bar, with substantial connections where breakers bolt to busses.

I. All wiring lugs in panelboards and all breakers shall be rated for use with 75 degree conductors sized in accordance with NEC Table 310.15(B)(16).

J. All branch circuit panels shall be equipped with 100% rated copper ground busses.

K. Breakers in lighting or branch circuit power panelboards shall be physically arranged in locations shown in panel schedules and be connected to the phases shown. Any deviation shall be approved by the engineer in advance. Panelboards shall be equipped with directory cards mounted behind heavy clear plastic shields in substantial frames attached to inside face of doors. Cards shall be a minimum of three inches wide.

L. Panelboard manufacturer shall determine the flash protection boundary and the incident energy for the electrical equipment in accordance with IEEE 1584 and NFPA 70E requirements and shall provide labels for each panel with the required information accordingly.

PART 3 EXECUTION

3.1 INSTALLATION

A. Flush-mounted panel housings shall be flush with finished wall.

B. Mount equipment plumb and level.

C. Openings in boxes, cabinets, or gutters shall be cut or sawed. Burning of openings is prohibited.

D. Each lighting or branch circuit panelboard mounted flush in a wall shall have a minimum of five empty 3/4" conduits stubbed out into the ceiling space above panel for future use unless all circuits in a panel are assigned. Seal ends of conduit with caps or with UL approved fire stopping material.

E. Only one solid wire is allowable under a screw. Use lug for connecting stranded wire or more than one solid conductor.

F. Label all equipment in conformance with Section 26 05 53.

G. Panelboard directory card shall be neatly typed with circuits assigned as shown on schedules. Space typing on card so all is visible when inserted into frame. Use room names and numbers as provided by Owner, not those shown on schedule. Names and numbers on schedule relate to plans only for construction. Indicate spare breakers in pencil (not typed) so that owner can erase and change as necessary in the future.

H. Next to each breaker within main or distribution panelboards, attach a label indicating what it feeds. Wording shall be as shown on its diagram or schedule. Labeling shall also be attached to separately-mounted breakers, switches, transformers, wiring gutters and controllers of all types.

I. Centered above door on panel cover attach a label indicating panel designation - for example, "PANEL A"; voltage - "120/208 VOLTS"; and from where served - "FED FROM PANEL MDP". See Section 26 05 53 for details.

END OF SECTION 26 2416

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SECTION 26 27 26 – WIRING DEVICES

PART 1 GENERAL

1.1 WIRING METHOD FOR BRANCH CIRCUITS

- A. Outlets in the same general area are circuited together. Circuit numbers are shown as noted in symbol schedule.
- B. Unless shown differently, 120 or 277 volt branch circuits on single or three phase systems shall be limited to three phase conductors per raceway. Three phase circuits shall be limited to one circuit per raceway (three different phase wires and neutral(s) if needed).
- C. Individual neutral wires shall be provided for each circuit (no sharing of neutrals between circuits).
- D. The neutral carrying all or any part of the current of any specific load or run shall be contained in the same raceway or enclosure with the phase wire or wires also carrying that current. No split neutrals permitted.
- E. Circuits shall be connected to panels as shown in the panel schedule. Any deviation shall be approved in advance by the engineer.
- F. Under the above requirements and with required color coding system no feeder or branch circuit raceway will contain more than one wire of the same color, except for switch legs and control circuits.
- G. Conductors feeding lighting outlets may be combined in the same raceway with conductors feeding convenience receptacles; but lighting outlets and convenience receptacles shall not be put on the same circuit unless specifically indicated.
- H. Toggle switches shall be single pole, three-way, or four-way as indicated on drawings. Switches shall be of grounding type, with hex-head grounding screw, rated 20A, 120/277V, AC only. All switches shall have quiet operating mechanisms without the use of mercury switches. All switches shall be listed by an “approved” third party agency, approved for the voltage and amperage indicated.
- I. Duplex receptacles shall be of the grounding type, arranged for back and side wiring, with separate single and double grounding terminals. Receptacles shall be straight blade, rated 20A, 125V and the face configuration shall conform to the NEMA Standard WD-1, NEMA WD-6, DSCC W-C-596G and UL-498, and shall be “approved” third party listed. Self-grounding or automatic type grounding receptacles are not acceptable in lieu of receptacles with separate grounding screw lugs and a direct, green insulated conductor connection to the equipment grounding system.
- J. Receptacles shall be federal specification grade (WC-596), mounted vertically. Receptacles mounted over counters, back-splashes and where specifically noted otherwise shall be mounted horizontally.
- K. Receptacles shall not be mounted back to back.

PART 2 PRODUCTS

2.1 WIRING DEVICES

A. The color of all devices shall be white (subject to verification with Architect during submittal stage). Samples will be required prior to acceptance of any proposed equivalents not specifically mentioned above. All like devices shall be by the same manufacturer (i.e.; all switches, all duplex receptacles, etc.).

B. Unless noted or specified otherwise, device trim plates shall be type 302 stainless steel to suit device. All plates in the job shall be same make and match throughout.

C. Ground fault interrupter type duplex receptacles where used outdoors shall be the weather-resistant type. They shall have metallic extra duty rated weatherproof while-in-use protective covers (Hubbell WP26E/WP26EH series or engineer approved equal by Eaton or Intermatic).

PART 3 EXECUTION

3.1 INSTALLATION

A. Devices shall be mounted tightly to boxes and be adjusted plumb and level.

B. Receptacles are to be installed in the vertical position with the ground terminal on top.

C. Two or more devices ganged shall be trimmed with gang plate.

END OF SECTION 26 2726

SECTION 26 29 00 – LOW-VOLTAGE CONTROLLERS

PART 1 GENERAL

1.1 REQUIREMENTS

- A. Motors, controllers, and other special equipment are sometimes provided and installed by other trades. This section specifies typical connections to that equipment.
- B. All individual combination motor starters, VFD's, motor starters, or disconnects for mechanical equipment (fans, pumps, etc.) shall be furnished and installed under Divisions 23 (Mechanical Contractors) unless indicated as a part of a motor control center. Motor starters for mechanical equipment provided in motor control centers shall be furnished under Division 26 (Electrical Contractor). Under Division 26, power wiring shall be provided up to a termination point consisting of a junction box, trough, starter, VFD or disconnect switch. Under Division 26 line side terminations shall be provided. Wiring from the termination point to the plumbing or mechanical equipment, including final connections shall be provided under Divisions 23.
- C. Where electrical wiring is required by trades other than covered by Division 26, the installer shall refer to the wiring materials and methods as specified under Division 26.

PART 2 PRODUCTS

2.1 EXHAUST FANS

- A. Exhaust fans are indicated by special symbol on plans. Unless otherwise noted, they will be furnished and set by others and connected by the Mechanical Contractor. Controller will be provided by others unless controller is specified on electrical drawings. Electrical contractor shall provide a local disconnect switch at fan if unit is not provided with one.

2.2 UNIT HEATERS

- A. Unit heater, ventilator, cooler, or similar outlets - designated by special symbol - are located approximately on drawings. Exact location of outlet shall be obtained from Heating, Ventilating, and Air Conditioning Contractor. Unless indicated otherwise, outlet shall be a 4" box fitted with an oversized blank cover with 1/2" center knockout, mounted in wall or ceiling, and fed on circuit shown beside symbol. These outlets shall be located behind or within equipment cabinets where possible and still be accessible. Provide local disconnect switch if one is not provided with unit. Unless specified otherwise herein or on drawings, power connection from outlet to equipment will be by Mechanical Contractor. Control wiring will be done by the Mechanical Contractor.

2.3 TROUGHS

- A. Electrical troughs, junction boxes, switches, or breakers for air conditioning, heating, or plumbing equipment are indicated on drawings. Exact locations shall be obtained from Heating and Air Conditioning or Plumbing Contractors but Code clearances shall be maintained. Unless specifically noted otherwise, all power wiring for equipment and controllers beyond these points

will be done by Heating and Air Conditioning or Plumbing Contractors. Control wiring will be by Heating and Air Conditioning or Plumbing Contractors.

2.4 OTHER

- A. Other equipment connections are generally indicated on drawings by a circled black triangle with a letter suffix. These are then defined in notes or details. Where catalog numbers, models, or types, and manufacturer's name are given, these items of equipment shall be furnished and installed by the Electrical Contractor, unless specifically noted otherwise.
- B. Junction box - designated as a circled J. Size of such boxes is generally noted on drawings. Where this is not done, they shall be sized in accord with NEC and purpose evidently intended.
- C. Where unscheduled junction boxes are used by Contractor to facilitate wiring or to comply with limits of elbows and bends, they shall be concealed if at all possible to do so and still be left accessible. If this is impossible, they shall be recessed in walls or ceilings and provided with an oversized cover which shall be painted out to match adjacent surfaces. If it is necessary to mount such boxes exposed, the location shall be approved by the Engineer.
- D. All contactors, motor starters and combination type starters specified under this contract shall be equipped with Hand-Off-Automatic switches, pilot (run indicating) light, 120 volt control transformer, and two sets of auxiliary contacts. The switch and light shall be located on the unit cover. Starters shall be Square D, Cutler-Hammer, General Electric Co., or equivalent by others.
- E. All safety switches shall be heavy-duty type, NEMA 1 for indoor and NEMA 3R for outdoor use unless specifically stated otherwise. They shall be fused type unless specifically indicated otherwise on plans. Fused type (600 volts or less) shall be equipped with the following: Service Entrance and Feeder Circuits over 600A – Class L, UL Listed, current limiting with 200K interrupting rating; Service Entrance and Feeder Circuits 600A and less – Class RK1 or J, UL Listed, current limiting with 200K interrupting rating; Motor, Motor Controller and Transformer Circuits – Class RK5, UL Listed, current limiting time delay with 200K interrupting rating; and individual Equipment where fault current does not exceed 50kA – Class K5, UL Listed, with 50K interrupting rating. Fusible safety switches with short circuit withstand rating of 100K or 200K shall include Class R or Class J rejection fuse block feature. Switches shall be equipped with defeatable door interlocks and padlocking provisions in the on and off positions. Padlocks shall be provided for switches located in public areas. Switches shall be by Square D, Cutler-Hammer, General Electric Co., or equivalent by others. In addition, safety switches shall be provided with the following requirements or features:
 - 1. Safety switches shall be third party listed.
 - 2. Switches shall have door interlocks that prevent the door from opening when the operating handle is in the “on” position.
 - 3. Switches shall have handles whose positions are easily recognizable in the “on” or “off” position. For safety reasons, padlock shall be provided for switches unless they are located in a locked electrical room.
 - 4. Switches shall have positive quick make-quick break mechanisms.
 - 5. Switches shall be properly labeled. Refer to Specification 260553.
 - 6. The Electrical contractor is to provide to the Owner as spares, 10% of the quantity of fuses used of each type and rating, with a minimum of one (1) set of each type.
- F. All safety switches, motor starters, or other boxes or panels, designated as NEMA 3R or otherwise intended for outdoor use or use in wet areas, shall use raintight conduit hub fittings with bonding screw.

G. Control wiring shall not be installed in the same raceways as power wiring.

PART 3 EXECUTION

THIS SECTION NOT USED

END OF SECTION 26 2900

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FORM OF PROPOSAL

Project: McLeod Hall, HVAC Replacement
Fayetteville State University
SCO-ID # 21-24131-01A

Contract: Single Prime
Bidder: _____
Date: _____

The undersigned, as bidder, hereby declares that the only person or persons interested in this proposal as principal or principals is or are named herein and that no other person than herein mentioned has any interest in this proposal or in the contract to be entered into; that this proposal is made without connection with any other person, company or parties making a bid or proposal; and that it is in all respects fair and in good faith without collusion or fraud. The bidder further declares that he has examined the site of the work and the contract documents relative thereto and has read all special provisions furnished prior to the opening of bids; that he has satisfied himself relative to the work to be performed. The bidder further declares that he and his subcontractors have fully complied with NCGS 64, Article 2 in regards to E-Verification as required by Section 2.(c) of Session Law 2013-418, codified as N.C. Gen. Stat. § 143-129(j).

The Bidder proposes and agrees if this proposal is accepted to contract with the
State of North Carolina through Fayetteville State University

in the form of contract specified below, to furnish all necessary materials, equipment, machinery, tools, apparatus, means of transportation and labor necessary to complete the construction of

McLeod Hall HVAC Replacement in full complete accordance with the plans, specifications and contract documents, to the full and entire satisfaction of the State of North Carolina, Fayetteville State University and McKim & Creed Inc.

with a definite understanding that no money will be allowed for extra work except as set forth in the General Conditions and the contract documents, for the sum of:

SINGLE PRIME CONTRACT:

Base Bid: _____ Dollars(\$)

General Subcontractor: _____
_____ Lic _____

Plumbing Subcontractor: _____
_____ Lic _____

Mechanical Subcontractor: _____
_____ Lic _____

Electrical Subcontractor: _____
_____ Lic _____

GS143-128(d) requires all single prime bidders to identify their subcontractors for the above subdivisions of work. A contractor whose bid is accepted shall not substitute any person as subcontractor in the place of the subcontractor listed in the original bid, except (i) if the listed subcontractor's bid is later determined by the contractor to be non-responsible or non-responsive or the listed subcontractor refuses to enter into a contract for the complete performance of the bid work, or (ii) with the approval of the awarding authority for good cause shown by the contractor.

ALTERNATES:

Should any of the alternates as described in the contract documents be accepted, the amount written below shall be the amount to be "added to" or "deducted from" the base bid.

GENERAL CONTRACT:

Alternate No. M1: Replace Insulation/Repair Existing HW Pipes

Dollars(\$)

Alternate No. M2: Replace Chillers

Dollars(\$)

Alternate No. M3: Replace Isolation Valves Throughout

Dollars(\$)

Alternate No. M4: Replace Bathroom Exhaust Inlets

Dollars(\$)

Alternate No. M5: Replace Exhaust Fans

Dollars(\$)

Alternate will be selected on life cycle cost. Attached LCCA form must be filled out and submitted with the bid.

The bidder further proposes and agrees hereby to commence work under this contract on a date to be specified in a written order of the designer and shall fully complete all work thereunder within the time specified in the Supplementary General Conditions Article 23. Applicable liquidated damages amount is also stated in the Supplementary General Conditions Article 23.

MINORITY BUSINESS PARTICIPATION REQUIREMENTS

Provide with the bid - Under GS 143-128.2(c) the undersigned bidder shall identify **on its bid** (Identification of Minority Business Participation Form) the minority businesses that it will use on the project with the total dollar value of the bids that will be performed by the minority businesses. **Also** list the good faith efforts (Affidavit **A**) made to solicit minority participation in the bid effort.

NOTE: A contractor that performs all of the work with its own workforce may submit an Affidavit (**B**) to that effect in lieu of Affidavit (**A**) required above. The MB Participation Form must still be submitted even if there is zero participation.

After the bid opening - The Owner will consider all bids and alternates and determine the lowest responsible, responsive bidder. Upon notification of being the apparent low bidder, the bidder shall then file within 72 hours of the notification of being the apparent lowest bidder, the following:

An Affidavit (**C**) that includes a description of the portion of work to be executed by minority businesses, expressed as a percentage of the total contract price, which is equal to or more than the 10% goal established. This affidavit shall give rise to the presumption that the bidder has made the required good faith effort and Affidavit **D** is not necessary;

*** OR ***

If less than the 10% goal, Affidavit (**D**) of its good faith effort to meet the goal shall be provided. The document must include evidence of all good faith efforts that were implemented, including any advertisements, solicitations and other specific actions demonstrating recruitment and selection of minority businesses for participation in the contract.

<p>Note: Bidders must always submit <u>with their bid</u> the Identification of Minority Business Participation Form listing all MB contractors, <u>vendors and suppliers</u> that will be used. If there is no MB participation, then enter</p>
--

none or zero on the form. Affidavit A **or** Affidavit B, as applicable, also must be submitted with the bid. Failure to file a required affidavit or documentation with the bid or after being notified apparent low bidder is grounds for rejection of the bid.

Proposal Signature Page

The undersigned further agrees that in the case of failure on his part to execute the said contract and the bonds within ten (10) consecutive calendar days after being given written notice of the award of contract, the certified check, cash or bid bond accompanying this bid shall be paid into the funds of the owner's account set aside for the project, as liquidated damages for such failure; otherwise the certified check, cash or bid bond accompanying this proposal shall be returned to the undersigned.

Respectfully submitted this day of _____

(Name of firm or corporation making bid)

WITNESS:

By: _____
Signature

(Proprietorship or Partnership)

Name: _____
Print or type

Title _____
(Owner/Partner/Pres./V.Pres)

Address _____

ATTEST:

By: _____

License No. _____

Title: _____
(Corp. Sec. or Asst. Sec. only)

Federal I.D. No. _____

Email Address: _____

(CORPORATE SEAL)

Addendum received and used in computing bid:

Addendum No. 1 _____ Addendum No. 3 _____ Addendum No. 5 _____ Addendum No. 6 _____

Addendum No. 2 _____ Addendum No. 4 _____ Addendum No. 6 _____ Addendum No. 7 _____

Identification of HUB Certified/ Minority Business Participation

I, _____
(Name of Bidder)

do hereby certify that on this project, we will use the following HUB Certified/ minority business as construction subcontractors, vendors, suppliers or providers of professional services.

Firm Name, Address and Phone #

Work Type

*Minority
Category

****HUB**
Certified
(Y/N)

[illegible]

*Minority categories: Black, African American (**B**), Hispanic (**H**), Asian American (**A**) American Indian (**I**), Female (**F**) Socially and Economically Disadvantaged (**D**)

**** HUB Certification with the state HUB Office required to be counted toward state participation goals.**

The total value of minority business contracting will be (\$)_____.

State of North Carolina AFFIDAVIT A – Listing of Good Faith Efforts

County of _____

(Name of Bidder)

Affidavit of _____

I have made a good faith effort to comply under the following areas checked:

Bidders must earn at least 50 points from the good faith efforts listed for their bid to be considered responsive. (1 NC Administrative Code 30 I.0101)

- ☐ **1 – (10 pts)** Contacted minority businesses that reasonably could have been expected to submit a quote and that were known to the contractor, or available on State or local government maintained lists, at least 10 days before the bid date and notified them of the nature and scope of the work to be performed.
- ☐ **2 --(10 pts)** Made the construction plans, specifications and requirements available for review by prospective minority businesses, or providing these documents to them at least 10 days before the bids are due.
- ☐ **3 – (15 pts)** Broken down or combined elements of work into economically feasible units to facilitate minority participation.
- ☐ **4 – (10 pts)** Worked with minority trade, community, or contractor organizations identified by the Office of Historically Underutilized Businesses and included in the bid documents that provide assistance in recruitment of minority businesses.
- ☐ **5 – (10 pts)** Attended prebid meetings scheduled by the public owner.
- ☐ **6 – (20 pts)** Provided assistance in getting required bonding or insurance or provided alternatives to bonding or insurance for subcontractors.
- ☐ **7 – (15 pts)** Negotiated in good faith with interested minority businesses and did not reject them as unqualified without sound reasons based on their capabilities. Any rejection of a minority business based on lack of qualification should have the reasons documented in writing.
- ☐ **8 – (25 pts)** Provided assistance to an otherwise qualified minority business in need of equipment, loan capital, lines of credit, or joint pay agreements to secure loans, supplies, or letters of credit, including waiving credit that is ordinarily required. Assisted minority businesses in obtaining the same unit pricing with the bidder's suppliers in order to help minority businesses in establishing credit.
- ☐ **9 – (20 pts)** Negotiated joint venture and partnership arrangements with minority businesses in order to increase opportunities for minority business participation on a public construction or repair project when possible.
- ☐ **10 - (20 pts)** Provided quick pay agreements and policies to enable minority contractors and suppliers to meet cash-flow demands.

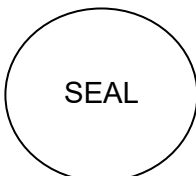
The undersigned, if apparent low bidder, will enter into a formal agreement with the firms listed in the Identification of Minority Business Participation schedule conditional upon scope of contract to be executed with the Owner. Substitution of contractors must be in accordance with GS143-128.2(d) Failure to abide by this statutory provision will constitute a breach of the contract.

The undersigned hereby certifies that he or she has read the terms of the minority business commitment and is authorized to bind the bidder to the commitment herein set forth.

Date: _____ Name of Authorized Officer: _____

Signature: _____

Title: _____



State of _____, County of _____

Subscribed and sworn to before me this _____ day of _____ 20____

Notary Public _____

My commission expires _____

State of North Carolina --AFFIDAVIT B-- Intent to Perform Contract with Own Workforce.

County of _____

Affidavit of _____
(Name of Bidder)

I hereby certify that it is our intent to perform 100% of the work required for the _____
_____ contract.
(Name of Project)

In making this certification, the Bidder states that the Bidder does not customarily subcontract elements of this type project, and normally performs and has the capability to perform and will perform all elements of the work on this project with his/her own current work forces; and

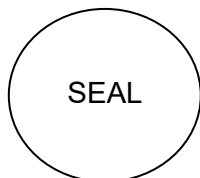
The Bidder agrees to provide any additional information or documentation requested by the owner in support of the above statement. The Bidder agrees to make a Good Faith Effort to utilize minority suppliers where possible.

The undersigned hereby certifies that he or she has read this certification and is authorized to bind the Bidder to the commitments herein contained.

Date: _____ Name of Authorized Officer: _____

Signature: _____

Title: _____



State of _____, County of _____

Subscribed and sworn to before me this _____ day of _____ 20____

Notary Public _____

My commission expires _____

State of North Carolina - AFFIDAVIT C - Portion of the Work to be Performed by HUB Certified/Minority Businesses

County of _____

(Note this form is to be submitted only by the apparent lowest responsible, responsive bidder.)

If the portion of the work to be executed by HUB certified/minority businesses as defined in GS143-128.2(g) and 128.4(a),(b),(e) is equal to or greater than 10% of the bidders total contract price, then the bidder must complete this affidavit.

This affidavit shall be provided by the apparent lowest responsible, responsive bidder within **72 hours** after notification of being low bidder.

Affidavit of _____ I do hereby certify that on the
(Name of Bidder)

(Project Name)
Project ID# _____ Amount of Bid \$ _____

I will expend a minimum of _____% of the total dollar amount of the contract with minority business enterprises. Minority businesses will be employed as construction subcontractors, vendors, suppliers or providers of professional services. Such work will be subcontracted to the following firms listed below.

Attach additional sheets if required

Name and Phone Number	*Minority Category	**HUB Certified Y/N	Work Description	Dollar Value

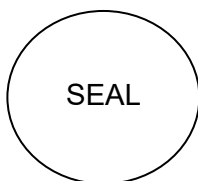
*Minority categories: Black, African American (**B**), Hispanic (**H**), Asian American (**A**) American Indian (**I**), Female (**F**) Socially and Economically Disadvantaged (**D**)

**** HUB Certification with the state HUB Office required to be counted toward state participation goals.**

Pursuant to GS143-128.2(d), the undersigned will enter into a formal agreement with Minority Firms for work listed in this schedule conditional upon execution of a contract with the Owner. Failure to fulfill this commitment may constitute a breach of the contract.

The undersigned hereby certifies that he or she has read the terms of this commitment and is authorized to bind the bidder to the commitment herein set forth.

Date: _____ Name of Authorized Officer: _____



Signature: _____

Title: _____

State of _____, County of _____

Subscribed and sworn to before me this _____ day of _____ 20____

Notary Public _____

My commission expires _____

State of North Carolina AFFIDAVIT D – Good Faith Efforts

County of _____

(Note this form is to be submitted only by the apparent lowest responsible, responsive bidder.)

If the goal of 10% participation by HUB Certified/ minority business **is not** achieved, the Bidder shall provide the following documentation to the Owner of his good faith efforts:

Affidavit of _____ I do hereby certify that on the _____
(Name of Bidder)

Project ID# _____ (Project Name) Amount of Bid \$ _____

I will expend a minimum of _____% of the total dollar amount of the contract with HUB certified/ minority business enterprises. Minority businesses will be employed as construction subcontractors, vendors, suppliers or providers of professional services. Such work will be subcontracted to the following firms listed below. (Attach additional sheets if required)

Name and Phone Number	*Minority Category	**HUB Certified Y/N	Work Description	Dollar Value

*Minority categories: Black, African American (**B**), Hispanic (**H**), Asian American (**A**) American Indian (**I**), Female (**F**) Socially and Economically Disadvantaged (**D**)

**** HUB Certification with the state HUB Office required to be counted toward state participation goals.**

Examples of documentation that may be required to demonstrate the Bidder's good faith efforts to meet the goals set forth in these provisions include, but are not necessarily limited to, the following:

- Copies of solicitations for quotes to at least three (3) minority business firms from the source list provided by the State for each subcontract to be let under this contract (if 3 or more firms are shown on the source list). Each solicitation shall contain a specific description of the work to be subcontracted, location where bid documents can be reviewed, representative of the Prime Bidder to contact, and location, date and time when quotes must be received.
- Copies of quotes or responses received from each firm responding to the solicitation.
- A telephone log of follow-up calls to each firm sent a solicitation.
- For subcontracts where a minority business firm is not considered the lowest responsible sub-bidder, copies of quotes received from all firms submitting quotes for that particular subcontract.
- Documentation of any contacts or correspondence to minority business, community, or contractor organizations in an attempt to meet the goal.
- Copy of pre-bid roster
- Letter documenting efforts to provide assistance in obtaining required bonding or insurance for minority business.
- Letter detailing reasons for rejection of minority business due to lack of qualification.
- Letter documenting proposed assistance offered to minority business in need of equipment, loan capital, lines of credit, or joint pay agreements to secure loans, supplies, or letter of credit, including waiving credit that is ordinarily required.

Failure to provide the documentation as listed in these provisions may result in rejection of the bid and award to the next lowest responsible and responsive bidder.

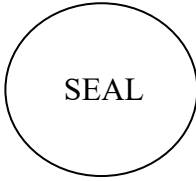
Pursuant to GS143-128.2(d), the undersigned will enter into a formal agreement with Minority Firms for work listed in this schedule conditional upon execution of a contract with the Owner. Failure to fulfill this commitment may constitute a breach of the contract.

The undersigned hereby certifies that he or she has read the terms of this commitment and is authorized to bind the bidder to the commitment herein set forth.

Date: _____ Name of Authorized Officer: _____

Signature: _____

Title: _____



State of _____, County of _____

Subscribed and sworn to before me this _____ day of _____ 20____

Notary Public _____

My commission expires _____

FORM OF BID BOND

KNOW ALL MEN BY THESE PRESENTS THAT _____

_____ as
principal, and _____, as surety, who is
duly licensed to act as surety in North Carolina, are held and firmly bound unto the State of
North Carolina through _____ as
obligee, in the penal sum of _____ DOLLARS, lawful money of
the United States of America, for the payment of which, well and truly to be made, we bind
ourselves, our heirs, executors, administrators, successors and assigns, jointly and
severally, firmly by these presents.

Signed, sealed and dated this ____ day of ____ 20__

WHEREAS, the said principal is herewith submitting proposal for
and the principal desires to file this bid bond in lieu of making
the cash deposit as required by G.S. 143-129.

NOW, THEREFORE, THE CONDITION OF THE ABOVE OBLIGATION is such, that
if the principal shall be awarded the contract for which the bid is submitted and shall
execute the contract and give bond for the faithful performance thereof within ten days after
the award of same to the principal, then this obligation shall be null and void; but if the
principal fails to so execute such contract and give performance bond as required by G.S.
143-129, the surety shall, upon demand, forthwith pay to the obligee the amount set forth in
the first paragraph hereof. Provided further, that the bid may be withdrawn as provided by
G.S. 143-129.1

_____(SEAL)

_____(SEAL)

_____(SEAL)

_____(SEAL)

_____(SEAL)

FORM OF CONSTRUCTION CONTRACT

(ALL PRIME CONTRACTS)

THIS AGREEMENT, made the _____ day of _____ in the year of 20__ by and between _____

hereinafter called the Party of the First Part and the State of North Carolina, through the _____

_____ hereinafter called the Party of the Second Part.

WITNESSETH:

That the Party of the First Part and the Party of the Second Part for the consideration herein named agree as follows:

1. Scope of Work: The Party of the First Part shall furnish and deliver all of the materials, and perform all of the work in the manner and form as provided by the following enumerated plans, specifications and documents, which are attached hereto and made a part thereof as if fully contained herein: advertisement; Instructions to Bidders; General Conditions; Supplementary General Conditions; specifications; accepted proposal; contract; performance bond; payment bond; power of attorney; workmen's compensation; public liability; property damage and builder's risk insurance certificates; approval of attorney general; certificate by the Office of State Budget and Management, and drawings, titled:

Consisting of the following sheets: _____

Dated: _____ and the following addenda:

Addendum No. _____ Dated: _____ Addendum No. _____ Dated: _____

Addendum No. _____ Dated: _____ Addendum No. _____ Dated: _____

Addendum No. _____ Dated: _____ Addendum No. _____ Dated: _____

Addendum No. _____ Dated: _____ Addendum No. _____ Dated: _____

2. That the Party of the First Part shall commence work to be performed under this agreement on a date to be specified in a written order of the Party of the Second Part and

shall fully complete all work hereunder within _____ consecutive calendar days from said date. For each day in excess thereof, liquidated damages shall be as stated in Supplementary General Conditions. The Party of the First Part, as one of the considerations for the awarding of this contract, shall furnish to the Party of the Second Part a construction schedule setting forth planned progress of the project broken down by the various divisions or part of the work and by calendar days as outlined in Article 14 of the General Conditions of the Contract.

3. The Party of the Second Part hereby agrees to pay to the Party of the First Part for the faithful performance of this agreement, subject to additions and deductions as provided in the specifications or proposal, in lawful money of the United States as follows:

_____. (\$ _____).

Summary of Contract Award:

4. In accordance with Article 31 and Article 32 of the General Conditions of the Contract, the Party of the Second Part shall review, and if approved, process the Party of the First Party's pay request within 30 days upon receipt from the Designer. The Party of the Second Part, after reviewing and approving said pay request, shall make payments to the Party of the First Part on the basis of a duly certified and approved estimate of work performed during the preceding calendar month by the First Party, less five percent (5%) of the amount of such estimate which is to be retained by the Second Party until all work has been performed strictly in accordance with this agreement and until such work has been accepted by the Second Party. The Second Party may elect to waive retainage requirements after 50 percent of the work has been satisfactorily completed on schedule as referred to in Article 31 of the General Conditions.

5. Upon submission by the First Party of evidence satisfactory to the Second Party that all payrolls, material bills and other costs incurred by the First Party in connection with the construction of the work have been paid in full, final payment on account of this agreement shall be made within thirty (30) days after the completion by the First Party of all work covered by this agreement and the acceptance of such work by the Second Party.

6. It is further mutually agreed between the parties hereto that if at any time after the execution of this agreement and the surety bonds hereto attached for its faithful performance, the Second Party shall deem the surety or sureties upon such bonds to be unsatisfactory, or if, for any reason, such bonds cease to be adequate to cover the performance of the work, the First Party shall, at its expense, within five (5) days after the receipt of notice from the Second Party so to do, furnish an additional bond or bonds in such form and amount, and with such surety or sureties as shall be satisfactory to the Second Party. In such event no further payment to the First Party shall be deemed to be due under this agreement until such new or additional security for the faithful performance of the work shall be furnished in manner and form satisfactory to the Second Party.

7. The Party of the First Part attest that it and all of its subcontractors have fully complied with all requirements of NCGS 64 Article 2 in regards to E-Verification as required by Section 2.(c) of Session Law 2013-418, codified as N.C. Gen. Stat. § 143-129(j).

IN WITNESS WHEREOF, the Parties hereto have executed this agreement on the day and date first above written in _____ counterparts, each of which shall without proof or accounting for other counterparts, be deemed an original contract.

Witness:

Contractor: (Trade or Corporate Name)

(Proprietorship or Partnership)

By: _____

Title: _____
(Owner, Partner, or Corp. Pres. or Vice Pres. only)

Attest: (Corporation)

By: _____

Title: _____
(Corp. Sec. or Asst. Sec. only)

The State of North Carolina through*

(CORPORATE SEAL)

(Agency, Department or Institution)

Witness:

By: _____

Title: _____

FORM OF PERFORMANCE BOND

Date of Contract: _____

Date of Execution: _____

Name of Principal
(Contractor) _____

Name of Surety: _____

Name of Contracting
Body: _____

Amount of Bond: _____

Project _____

KNOW ALL MEN BY THESE PRESENTS, that we, the principal and surety above named, are held and firmly bound unto the above named contracting body, hereinafter called the contracting body, in the penal sum of the amount stated above for the payment of which sum well and truly to be made, we bind, ourselves, our heirs, executors, administrators, and successors, jointly and severally, firmly by these presents.

THE CONDITION OF THIS OBLIGATION IS SUCH, that whereas the principal entered into a certain contract with the contracting body, identified as shown above and hereto attached:

NOW, THEREFORE, if the principal shall well and truly perform and fulfill all the undertakings, covenants, terms, conditions and agreements of said contract during the original term of said contract and any extensions thereof that may be granted by the contracting body, with or without notice to the surety, and during the life of any guaranty required under the contract, and shall also well and truly perform and fulfill all the undertakings, covenants, terms, conditions and agreements of any and all duly authorized modifications of said contract that may hereafter be made, notice of which modifications to the surety being hereby waived, then, this obligation to be void; otherwise to remain in full force and virtue.

IN WITNESS WHEREOF, the above-bounden parties have executed this instrument under their several seals on the date indicated above, the name and corporate seal of each corporate party being hereto affixed and these presents duly signed by its undersigned representative, pursuant to authority of its governing body.

Executed in _____ counterparts.

Witness:

(Proprietorship or Partnership)

Attest: (Corporation)

By: _____

Title: _____
(Corp. Sec. or Asst. Sec. only)

(Corporate Seal)

Contractor: (Trade or Corporate Name)

By: _____

Title: _____
(Owner, Partner, or Corp. Pres. or Vice
Pres. only)

Witness:

Countersigned:

(N.C. Licensed Resident Agent)

Name and Address-Surety Agency

Surety Company Name and N.C.
Regional or Branch Office Address

(Surety Company)

By: _____

Title: _____
(Attorney in Fact)

(Surety Corporate Seal)

FORM OF PAYMENT BOND

Date of Contract: _____

Date of Execution: _____

Name of Principal
(Contractor) _____

Name of Surety: _____

Name of Contracting
Body: _____

Amount of Bond: _____

Project _____

KNOW ALL MEN BY THESE PRESENTS, that we, the principal and surety above named, are held and firmly bound unto the above named contracting body, hereinafter called the contracting body, in the penal sum of the amount stated above for the payment of which sum well and truly to be made, we bind ourselves, our heirs, executors, administrators, and successors, jointly and severally, firmly by these presents.

THE CONDITION OF THIS OBLIGATION IS SUCH, that whereas the principal entered into a certain contract with the contracting body identified as shown above and hereto attached:

NOW, THEREFORE, if the principal shall promptly make payment to all persons supplying labor/material in the prosecution of the work provided for in said contract, and any and all duly authorized modifications of said contract that may hereafter be made, notice of which modifications to the surety being hereby waived, then this obligation to be void; otherwise to remain in full force and virtue.

IN WITNESS WHEREOF, the above-bounden parties have executed this instrument under their several seals on the date indicated above, the name and corporate seal of each corporate party being hereto affixed and these presents duly signed by its undersigned representative, pursuant to authority of its governing body.

Executed in _____ counterparts.

Witness:

(Proprietorship or Partnership)

Attest: (Corporation)

By: _____

Title: _____
(Corp. Sec. or Asst. Sec.. only)

(Corporate Seal)

Witness:

Countersigned:

(N.C. Licensed Resident Agent)

Name and Address-Surety Agency

Surety Company Name and N.C.
Regional or Branch Office Address

Contractor: (Trade or Corporate Name)

By: _____

Title _____
(Owner, Partner, or Corp. Pres. or Vice
Pres. only)

(Surety Company)

By: _____

Title: _____
(Attorney in Fact)

(Surety Corporate Seal)

Sheet for Attaching Power of Attorney

Sheet for Attaching Insurance Certificates

APPROVAL OF THE ATTORNEY GENERAL

**CERTIFICATION BY THE OFFICE OF STATE
BUDGET AND MANAGEMENT**

Provision for the payment of money to fall due and payable by the

under this agreement has been provided for by allocation made and is available for the purpose of carrying out this agreement.

This _____ day of _____ 20____.

Signed _____
Budget Officer

STATE OF NORTH CAROLINA
COUNTY SALES AND USE TAX REPORT
SUMMARY TOTALS AND CERTIFICATION

CONTRACTOR: _____

Page 1 of _____

PROJECT: _____

FOR PERIOD: _____

	TOTAL FOR COUNTY OF:	TOTAL FOR COUNTY OF:	TOTAL FOR COUNTY OF:	TOTAL FOR COUNTY OF:	TOTAL FOR COUNTY OF:	TOTAL FOR COUNTY OF:	TOTAL ALL COUNTIES
CONTRACTOR							
SUBCONTRACTOR(S)*							
COUNTY TOTAL							

* Attach subcontractor(s) report(s)

** Must balance with Detail Sheet(s)

I certify that the above figures do not include any tax paid on supplies, tools and equipment which were used to perform this contract and only includes those building materials, supplies, fixtures and equipment which actually became a part of or annexed to the building or structure. I certify that, to the best of my knowledge, the information provided here is true, correct, and complete.

Sworn to and subscribed before me,

This the _____ day of _____, 20____

Signed

Notary Public

My Commission Expires: _____

Print or Type Name of Above

Seal

NOTE:

This certified statement may be subject to audit.

STATE OF NORTH CAROLINA SALES AND USE TAX REPORT DETAIL

CONTRACTOR: _____

Page 2 of

SUBCONTRACTOR _____

FOR PERIOD: _____

PROJECT: _____

PURCHASE DATE	VENDOR NAME	INVOICE NUMBER	TYPE OF PROPERTY	INVOICE TOTAL	COUNTY TAX PAID	COUNTY OF SALE *
				\$	\$	
				TOTAL:	\$	

* If this is an out-of-state vendor, the County of Sale should be the county to which the merchandise was shipped.