



THE UNIVERSITY
of NORTH CAROLINA
at CHAPEL HILL

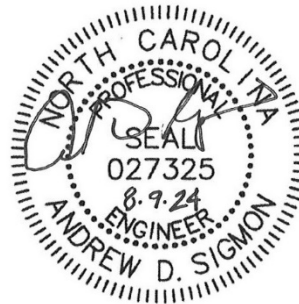
The University of North Carolina at Chapel Hill

COASTAL PROCESS ENVIRONMENTAL HEALTH LAB

MOREHEAD CITY, NC

SCO ID NO. 23-26296-01A

DATE: August 9, 2024



MCKIM & CREED

4300 Edwards Mill Road, Suite 200

Raleigh, North Carolina 27612

919-233-8091

NC License # F1222

M&C Project No. 01488-0083

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**Advertisement For Bids
&
Notice of Public Meeting for Proposed Alternate Bids for Preferred Products**

Sealed proposals will be received until 2:00 PM on Friday, September 13, 2024 in UNC-CH Institute of Marine Science, in Conference Room 127, Coastal Processes Health Building, 3431 Arendell Street, Morehead City, NC 28557 and immediately thereafter publicly opened and read for the furnishing of labor, material and equipment for the construction of:

University of North Carolina at Chapel Hill
Coastal Process Environmental Health Lab – Morehead City, NC
SCO ID No. 23-26296-01A

Bids will be received for **single prime bid** contracts. All Proposals will be lump sum. **Contactors shall have general classification for General Contractor.**

An electronic copy of the complete plans and specifications for this project for prime contractors can be obtained by contacting McKim & Creed, 4300 Edwards Mill Road, Suite 200, Raleigh NC 27612, by e-mail: (Allison (Ally) Jurgens (AJurgens@mckimcreed.com) or Andy Sigmon (asigmon@mckimcreed.com) beginning August 9, 2024. A signed electronic file disclaimer is required. A hard copy is also available. The hard copies will require a plan deposit of \$200 made payable to McKim & Creed by Certified Check. The plan deposit will be refunded to all bidders and non-bidders, provided the plans are returned bound, in order, and in good condition no later than 10 days following the bid date.

Bid documents will also be available for examination in the plan rooms of Associated General Contractors (Carolinas Branch), North Carolina offices of McGraw-Hill Dodge Corporation, Eastern Regional Office of Reed Construction Data in Norcross, GA, and in Minority Plan Rooms:

Hispanic Contractors Association of the Carolinas (HCAC) in Winston-Salem, Charlotte, and Raleigh areas
704-583-4184
East Coast Digital (ECD) Plan Room, Minority Plan Room Provider, 210 E 14th Street, Suite D, Greenville, NC 27858

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

The University of North Carolina-Chapel Hill has an affirmative policy of fostering, promoting and conducting business with minority owned enterprises. Minority contractors are encouraged to participate in the bidding process.

Pre-Bid Meeting and Notice of Public Meeting for Proposed Alternate Bids for Preferred Products

A pre-bid meeting and public meeting will be held for all interested bidders on Tuesday, August 27 at 10:00 AM and 11:00 AM, respectively, in Conference Room 127, Coastal Processes Health Building, 3431 Arendell Street Morehead City, NC 28557. The meeting will address project specific questions and issues for preferred brand products. An onsite walk-through will follow the pre-bid meeting.

In accordance with GS133-3, Section 64. (C) and State Construction Office procedures the following preferred brand items are being considered as Alternates by the Owner for this project:

Alternate #M-01: Provide Annexair Biocomposite as manufacturer for AHU-1

Alternate #M-02A: Furnish and install a BACnet based building automation system by Johnson Controls Incorporated (JCI).

Alternate #M-02B: Furnish and install a BACnet based building automation system by Schneider Electric (SE).

Alternate #M-02C: Furnish and install a BACnet based building automation system by Siemens.

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

Owner:

University of North Carolina – Chapel Hill

103 Airport Drive

Chapel Hill, NC 27599

Contact:

Nathan.harms@fac.unc.edu

919-452-5420 (C)

NOTICE TO BIDDERS

Sealed proposals will be received by the University of North Carolina at Chapel Hill, Department of Facilities Planning and Design up to 2:00 PM on Friday, September 13, 2024 at UNC-CH Institute of Marine Science, in Conference Room 127, Coastal Processes Health Building, 3431 Arendell Street, Morehead City, NC 28557 for the furnishing of labor, material and equipment entering into the construction of:

University of North Carolina at Chapel Hill – Coastal Process Environmental Health Lab – Morehead City, NC

The Work consists of the following: Replacement of condenser water control valve for cooling tower for Coastal Process building; repair of existing Siemens Insite DDC control panel for Coastal Process building; Replacement of AHU and associated equipment for Fisheries building; and replacement of the switchboard and associated equipment for Coker Hall building.

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

ADDITIONAL BID OPENING PROCEDURES

- Bid time will be officially closed at 2:00 PM and all hand-delivered bids shall be dropped off at Coastal Process building, in front lobby in the designated location.
- Bidders shall sign across the sealed flap on the envelope to ensure no tampering prior to the bid opening.

Pre-Bid Meeting

A pre-bid meeting and public meeting for proposed alternate bids for preferred products will be held for all interested bidders on Tuesday, August 27 at 10:00 AM and 11:00 AM respectively, in Conference Room 127, Coastal Processes Health Building, 3431 Arendell Street Morehead City, NC 28557. The meeting will address project specific questions, issues, bidding procedures and bid forms. An onsite walk-through will follow the pre-bid meeting.

An electronic copy of the complete plans and specifications for this project for prime contractors can be obtained by contacting McKim & Creed, 4300 Edwards Mill Road, Suite 200, Raleigh NC 27612, by e-mail: (Allison (Ally) Jurgens (AJurgens@mckimcreed.com) or Andy Sigmon (asigmon@mckimcreed.com) beginning August 9, 2024. A signed electronic file disclaimer is required. A hard copy is also available. The hard copies will require a plan deposit of \$200 made payable to McKim & Creed by Certified Check. The plan deposit will be refunded to all bidders and non-bidders, provided the plans are returned bound, in order, and in good condition no later than 10 days following the bid date.

Bid documents will also be available for examination in the plan rooms of Associated General Contractors (Carolinas Branch), North Carolina offices of McGraw-Hill Dodge Corporation, Eastern Regional Office of Reed Construction Data in Norcross, GA, and in Minority Plan Rooms:

Hispanic Contractors Association of the Carolinas (HCAC) in Winston-Salem, Charlotte, and Raleigh areas 704-583-4184

East Coast Digital (ECD) Plan Room, Minority Plan Room Provider, 210 E 14th Street, Suite D, Greenville, NC 27858.

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.

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.

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 Building IV
Raleigh, NC 27606
919-233-8091

Owner:
University of North Carolina at Chapel Hill

**INSTRUCTIONS TO BIDDERS
AND
GENERAL CONDITIONS OF THE CONTRACT**

STANDARD FORM FOR CONSTRUCTION PROJECTS

**UNIVERSITY OF NORTH CAROLINA
SYSTEM OFFICE**

Sixth Edition – June 2021

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 bidders 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 with appropriate attachments to 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 the 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 owner.

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.
- 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 information may 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 of completed work. 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 University of North Carolina, and is distributed by, through and at the discretion of UNC System Office, Chapel Hill, 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 drawings 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 university attorney; 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 and designer and approved by the owner 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, and owner .
- 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 of 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 cannot 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 the approval of the 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 with 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 North Carolina Building Codes.
- aa. **Beneficial Occupancy** is requested by the owner and is occupancy or partial occupancy of the building or project after all life safety items have been completed as determined by the State Construction Office. Life safety items include but are not limited to fire alarm, sprinkler, egress and exit lighting, fire rated walls, egress paths and security.
- bb. **Final Acceptance** is the date on which the State Construction Office approves the project as complying with the North Carolina Building Codes and the owner accepts the construction as totally complete. This includes certification by the Designer that all punch list items are completed.

ARTICLE 2 - INTENT AND EXECUTION OF DOCUMENTS

- a. The drawings and specifications are complementary, one to the other. 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 the 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 two (2) copies (one for the Designer, one for the owner) 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, the 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 State of North Carolina. 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 approve.

- e. The designer is the judge of equality for proposed substitution of products, materials or equipment.
- f. 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 by 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.
- c. 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.

- d. Projects involving local funding may be subject also to county and municipal building codes and inspection by local authorities. The Contractor shall pay the cost of these permits and inspections as noted in the specifications.

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 member 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 correction of 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 correction of damage caused by 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 the designer, special inspector and/or State Construction Office prior to being covered by the contractor. Contractor shall give a minimum notice of two weeks unless otherwise agreed to by all parties. If inspection fails, after the first

re-inspection all costs associated with additional inspections 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 and 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 project conference. The owner will determine the 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 punch list(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 punch list(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.

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 biweekly 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 owner and other prime contractors. The designer shall determine the contractor(s) who caused the delays 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 expediter'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 time commitment of the project superintendent to the project shall be such as to insure satisfactory construction

progress & coordination as determined by the project designer and owner and may be as stipulated in the Supplementary General Conditions.

ARTICLE 15 - SEPARATE CONTRACTS AND CONTRACTOR RELATIONSHIPS

- a. Public contracts may be delivered by the following construction 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 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 and to the owner 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, the designer shall submit his reasons for disapproval in writing to the owner for the owner's consideration with a copy to the contractor. If the owner concurs with the designer's recommendation, the contractor shall submit a substitute for approval. The designer 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.

- 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. They 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 an approved change order or written field order from the designer, countersigned by the owner. No claim for adjustments of the contract price shall be valid unless this procedure is followed.
A field order, transmitted by fax 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 below under either c.1 or 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 and owner, the value of the change shall be computed by application of unit prices based on quantities, estimated or actual as agreed on 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 c.2. above, the allowances for overhead and profit combined shall be as follows: all contractors (the single contracting entity (prime), his subcontractors (first tier), or their subcontractors (second tier, third tier, etc.) shall be allowed a maximum of ten percent (10%) on work they each self-perform; the prime contractor shall be allowed a maximum of five percent (5%) on contracted work of his first tier subcontractor; first tier, second tier, third tier, etc. subcontractors shall be allowed a maximum of two and one-half percent (2.5%) on the contracted work of their subcontractors. Under c.1. no additional allowances shall be made for overhead and profit. In the case of deductible change orders, under c.2. and 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; vehicles; 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 a lack of proper submittal by the contractor of all required supporting data shall not constitute grounds for a time extension or basis for 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 approval. The owner shall approve and execute the change order within seven (7) days of receipt. 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 extra 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 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 the 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 c. above. Without prejudice, nothing in this paragraph shall preclude the owner from performing or having 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. 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 by the contractor that complies with the requirements of (a) above be denied by the designer or owner, and cannot be resolved by a representative of The University of North Carolina System Office, the contractor may request a mediation in connection with G.S. 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 claims as a result of mediation, the contractor may pursue his claim in accordance with the provisions of G.S. 143-135.3 and the following:
 1. A contractor who has not completed a contract with an institution of The University of North Carolina and who has not received the amount he claims is due under the contract may submit a verified written claim to the Associate Vice President for Finance & University Property Officer of The University of North Carolina System Office for the amount the contractor claims is due. If the claim remains unresolved after review by the Associate Vice President for Finance, the contractor may submit the 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 an institution of University of North Carolina 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 Associate Vice President for Finance & University Property Officer of The University of North Carolina System Office for the amount the contractor claims is due. If the claim remains unresolved after review by the Associate Vice President for Finance, the contractor may submit the 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 Associate Vice President'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 owner, 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, fires, 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 delay. 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 with copies to the owner within twenty (20) days following cause of delay. In case of continuing cause for delay, the contractor shall notify the designer in writing with copies to the owner of the

delay within twenty (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 completion of the project.
- b. Should the owner request a utilization of the building or portion thereof, the designer shall perform a designer final inspection of the 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, 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 owner and State Construction Office, in such areas the following will be established:
 - 1. The beginning of guarantees and warranties period for the equipment necessary to provide support in the area.
 - 2. The owner assumes all responsibilities for utility costs for the entire building
 - 3. Contractor will obtain consent of surety.
 - 4. 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 owner and SCO final inspection. Prior to owner & 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, the owner and State Construction Office representatives shall make one of the following determinations:

1. That the project is completed and accepted.
 2. That the project will be accepted subject to 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.
 3. 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.
- e. 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.
- f. Prior to issuance of final acceptance date, the contractor shall have his authorized representatives visit the project and give full instructions to the owner's designated personnel regarding operating, maintenance, care, and adjustment of all equipment and special construction elements. In addition, the contractor shall provide 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. The contractor shall correct or make good any defects due thereto and repair any damage resulting therefrom 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 ten (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 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 and the owner 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 and owner 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 and the owner 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 any time. Bond, security and insurance protection shall continue to be the responsibility of the contractor(s).
- e. On projects requiring a Critical Path Method (CPM) construction schedule, the project expeditor will submit with each monthly pay application to the designer a current CPM schedule in a computerized precedence network format on a compact disc. The schedule will include all construction activities to be accomplished during the project to be properly sequenced and coordinated with elements of the work. The schedule shall be assembled from input presented and mutually coordinated by all the contractors (and/or subcontractors) and integrated into a single, overall schedule. The project expeditor will show all the scheduled work activities, including their subcontractors, and the sequence and interdependence (predecessors and successors) of the activities. The schedule shall show the total project duration including milestone dates. The critical path shall be clearly indicated. The schedule shall be in such a format that it can be read (imported) in Microsoft Project or Primavera P6. Failure to submit the construction schedule on compact disc media in an acceptable format will result in the pay application being denied.
- f. In the event of beneficial occupancy, retainage of funds due the contractor(s) may be reduced with the approval of the owner 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 are 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 subcontractors 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 owner 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 owner 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 the contractor's general conditions costs set forth in the approved schedule of values if the contractor has failed to comply with: (1) a request to access its records by the owner's internal auditors pursuant to Article 52; (2) a request for a plan of action and/or recovery schedule under Article 14j; (3) a request to provide electronic copies of contractor's baseline schedule and/or updates with all logic used to create schedules in the original format of the scheduling software; and (4) contractor's failure to have its superintendent on the project as provided in Article 14.1 and/or as stipulated in the Supplementary General Conditions.
- 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 coverage 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 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 may be 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 unless stipulated otherwise in the project specifications. The 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 unless otherwise stipulated. 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 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 General Contractor 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 the 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 acceptance of work by the State Construction Office and owner, 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 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 General Contractor 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 General Contractor 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 General Contractor 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 General Contractor's bid.
 - l. The General Contractor 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 General Contractor. The General Contractor shall provide an onsite 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 General Contractor shall broom clean the building as required to minimize dust and dirt accumulation.
- b. The General Contractor 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 therefrom, 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 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 contractors 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 business 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 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 General Statute 133-32, it is unlawful for any vendor or contractor (i.e. architect, bidder, contractor, construction manager, design professional, engineer, subcontractor, supplier, etc.) to make gifts or give favors to any State employee. This prohibition covers those vendors and contractors who: (1) have a contract with a government agency; or (2) have performed under such a contract during 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 General Statute 133-32.

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 employees that may have any involvement, influence, responsibilities, oversight, management and/or duties that pertain to and/or relate to the construction administration, financial administration and/or disposition of claims arising from and/or relating to the contract and/or the project.

ARTICLE 52 – AUDITING – ACCESS TO PERSONS AND RECORDS

In accordance with General Statute.147-64.7, the State Auditor shall have access to the contractor's officers, employees, agents and/or other persons in control of and/or responsible for the contractor's records that relate to this contract 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 lost 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 the owner and/or the owner's project representatives.

ARTICLE 53 – NORTH CAROLINA FALSE CLAIMS ACT

The North Carolina False Claims Act (NCFCA), General Statute 1-605 through 1-618, applies to this contract. The contractor should familiarize itself with the entire NCFCA and its applicability to any requests, demands and/or claims for payment submitted to the State through the contracting university or affiliate.

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 NCFCA may arise from, but not be 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 lost 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 for claims, and/or any other request for payment from the state through the contracting state agency, institution or university. 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 by 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©.)

Finally, the contracting university or affiliate 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

- a. The owner may, at any time and for any reason terminate the contractor's services and work at the owner's convenience. Upon receipt of such notice, the contractor shall, unless the notice directs otherwise, immediately discontinue the work and placing orders for materials, facilities and supplies in connection with the performance of this agreement.
- b. Upon such termination, the 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 the contractor as are permitted by the prime contract and approved by the 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 the contractor prior to the date of the termination of this agreement. The contractor shall not be entitled to any claim or claim of lien against the owner for any additional compensation or damages in the event of such termination and payment.

**SUPPLEMENTARY GENERAL CONDITIONS (SGC's)
OF THE CONTRACT**

STANDARD FORM FOR CONSTRUCTION CONTRACTS

UNIVERSITY OF NORTH CAROLINA AT CHAPEL HILL

UNC-CH Supplementary General Conditions

SUPPLEMENTARY GENERAL CONDITIONS (SGC's) OF THE CONTRACT

This document supplements but does not alter in any way the requirements of the General Conditions of the Contract.

UNC-CH Supplementary General Conditions

1. SCOPE OF WORK

See attached Technical Specifications and Drawings for scope of work including UNC-CH General Requirements.

2. 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 the date specified in the Notice to Proceed.

For each day in excess of the above number of days, the Contractor(s) shall pay the Owner liquidated damages in the amount of \$250 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.

3. CONSTRUCTION SCHEDULE

The Contractor shall start work immediately 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 as required to meet deadlines and outage schedules. All working hours shall be coordinated a minimum of one (1) week in advance with the Facilities Manager on site. 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 including the extended outage to replace the AHU and switchboard. The Owner reserves the right to request other 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.

ALLOWABLE OUTAGE RESTRICTIONS:

To be confirmed/coordinated with Owner.

4. 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, roads and pedestrian walks. Disruptions shall be planned well in advance of the work and the work shall be executed in a manner to provide reasonably continuous

UNC-CH Supplementary General Conditions

service throughout the construction period. Interruptions of service shall be coordinated with the Contract Administrator a minimum of seven (7) days in advance.

5. SECURITY

Contractor shall coordinate security requirements with the UNC-CH Construction Manager.

6. 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), or on University Day.

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 UNC's Facilities Manager 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 shall be coordinated with UNC's Facilities Manager. Walks, streets, and drives are most congested with pedestrians at the top of the hour, when making deliveries the carrier shall be made aware of this and plan his deliveries accordingly.

A minimum five (5) working days' notice must be given to UNC's Facilities Manager to block parking spaces, drives, roads, streets and pedestrian walks.

Roads, streets, drives, fire lanes shall remain open at all times. Adequate clearance shall 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 shall be covered with fabric screening unless it blocks the view of oncoming traffic. Construction gates will swing into the construction area. The construction fences shall not obstruct pedestrian or vehicle traffic unless alternate ways were designed in the site drawings and approved by UNC's Facilities Manager.

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

The Contractor's scheduling and staging requirements shall be coordinated with, and approved by, the UNC-CH Construction Manager.

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Work shall be performed as required to meet deadlines and outage schedules. All working hours shall be coordinated a minimum of one (1) week in advance with the Facilities Manager on site. 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 and outages schedules. 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.

Contractors working for the University are required to comply with The University of North Carolina at Chapel Hill "No Smoking Policy", which is provided herein and hereby incorporated and made a part of this contract.

Fire Safety – Policy on Fire Protection System Impairments:

Policy Statement:

An impairment of a fire protection system poses a risk to students, faculty and staff. This policy describes required actions to be taken by the University if a required fire protection system is impaired or taken out of service due to construction, alteration, malfunction, a special event, or an emergency condition.

Definitions:

- **Fire protection system:** Approved devices, equipment and systems or combinations of systems used to detect a fire, activate an alarm, extinguish or control a fire, control or manage smoke and products of a fire or any combination thereof.
- **Fire watch:** A temporary measure to ensure continuous and systematic surveillance of a building or portion thereof by one or more qualified individuals for the purposes of identifying and controlling fire hazards, detecting early signs of unwanted fire conditions, raising the alarm of fire and notifying the fire department via 911 as soon as possible.
- **Impairment:** A shutdown, in whole or in part, of a fire protection system.

Audience:

This policy applies to all employees of UNC-Chapel Hill and outside contractors who will be working on University property.

Roles and Responsibilities

- **University Fire Marshal:** Shall be the University's designated Impairment Coordinator as defined in the North Carolina Fire Prevention Code

Reason for Policy:

The University has an obligation to provide a safe and healthful environment to all students, faculty, staff and visitors located in University buildings. Functioning fire protection systems play a key role in maintaining life safety for building occupants. This policy establishes procedures to mitigate life safety risk in the event of an impairment of a building fire protection system.

Compliance:

Failure to implement actions required by the North Carolina Fire Code during fire protection system impairments could expose the University to liability or significant property loss in the event of a fire.

Procedures:

Impairments of fire protection systems may be classified as planned or unplanned. A planned impairment is when a fire protection system is placed out of service due to work that has been planned in advance, such as construction or maintenance. Special events requiring the impairment of a fire protection system are also considered planned. Unplanned impairments include, but are not limited to, the malfunction of a fire protection system or the restoration of a fire protection system after an emergency. In any case, an impairment of a fire protection system requires the implementation of compensatory measures to maintain life safety during the period of impairments. Examples of compensatory measures include, but are not limited to:

- Reduction of activities within the impaired area or building
- Closure of the impaired area or building
- Implementation of a fire watch

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Planned Impairments for Special Events:

Planned impairments for special events will be approved by the University Fire Marshal or designee. Individuals or groups requesting planned impairments for a special event shall submit a "Special Event/Assembly Fire Safety Permit" (Appendix A) to the University Fire Marshal no less than seven days prior to the event. The individual or group requesting the impairment shall be responsible for any cost or charges associated for the provision of an approved fire watch. See *Fire Watch Requirements*, below, for further guidance. Planned impairments for special events shall not require the notifications described in *Notifications*, below.

Planned Impairments for Maintenance or Construction:

Individuals requesting planned impairments for construction or maintenance shall coordinate directly with [Facilities Services](#). If any impairment is planned for a building operated by the Department of Housing and Residential Education (DHRE), Facilities Services shall immediately notify the University Fire Marshal (See Appendix B for a list of buildings operated by DHRE). Planned impairments in other buildings exceeding four hours in duration for a fire alarm system or ten hours in duration for a water-based fire protection system require the notification of the University Fire Marshal by Facilities Services. A required notification shall include:

- The extent and expected duration of the impairment
- Whether the areas or buildings involved have been inspected
- Whether the fire protection system has been tagged
- Whether employees in the area have been notified of the impairment
- Recommendations regarding the implementation of a fire watch or other compensatory measure

Upon notification, the University Fire Marshal or designee shall determine whether a fire watch is required, or if another compensatory measure is acceptable for the duration of the fire protection system impairment. The costs or charges associated with providing a fire watch under this section are to be determined at the time of initiation. See [Fire Watch Requirements](#), below for further guidance.

The University Fire Marshal shall also complete the notifications required in [Notifications](#), below.

Unplanned Impairments:

In general, an unplanned impairment occurs due to a malfunction that renders a fire protection system inoperable. Any unplanned impairments in a building operated by the Department of Housing and Residential Education require the immediate notification of the University Fire Marshal.

Unplanned impairments in other buildings exceeding four hours in duration for a fire alarm system or ten hours in duration for a water-based fire protection system require the notification of the University Fire Marshal. A required notification shall include:

- The extent and expected duration of the impairment
- Whether the areas or buildings involved have been inspected
- Whether the fire protection system has been tagged
- Whether employees in the affected area have been notified of the impairment
- Recommendations regarding the implementation of a fire watch or other compensatory measure

Upon notification, the University Fire Marshal or designee shall determine whether a fire watch is required, or if another compensatory measure is acceptable for the duration of the fire protection system impairment. The costs or charges associated with providing a fire watch under this section are to be determined at the time of initiation. See [Fire Watch Requirements](#), below for further guidance.

The University Fire Marshal shall also complete the notifications required in [Notifications](#), below.

Tagging and Signage of Impaired Fire Protection System:

The provisions of this section shall only apply to impairments exceeding four hours in duration for a fire alarm system or ten hours in duration for a water-based fire protection system.

Tags indicating that a fire protection system, or portion thereof, has been impaired or placed out of service shall be located at each fire department connection, system control valve, fire alarm control unit, fire alarm annunciator and fire command center indicating which system, or part thereof, is impaired.

Additionally, when a fire alarm system is impaired for more than four hours, a sign shall be placed at each entrance of the building advising occupants of the impairment and directing them to contact 911 in the event of an emergency.

Restoring Fire Protection Systems:

UNC-CH Supplementary General Conditions

Once a fire protection system has been restored to complete operation, Facilities Services shall notify the University Fire Marshal. This notification shall include:

- Verification that any necessary inspections and tests have been conducted to ensure that all fire protection systems are operational.
- Whether employees in the affected area have been notified of the restoration of the fire protection system.
- Whether the impairment tags have been removed from the fire protection system.

Upon receiving confirmation that the fire protection system has been restored, the University Fire Marshal shall also complete the notifications required in *Notifications*, below.

Fire Watch:

Chapter Nine of the North Carolina Fire Prevention Code states that fire watches shall “be provided with at least one approved means for notification of the fire department, and their only duty shall be to perform constant patrols of the premises and keep watch for fires.” All persons assigned to a fire watch under this policy must be approved by the University Fire Marshal and must be dedicated exclusively to the duties described in this section. **Fire watch personnel for all planned impairments associated with maintenance and construction or for unplanned impairments will be contract security guards coordinated and vetted through [UNC Police](#).**

Individuals conducting a fire watch under this policy shall:

- Be trained in the University’s fire watch procedure and fire reporting procedure.
- Be responsible, non-impaired, alert and awake at all times.
- Know the location of fire protection devices, including the fire alarm panel, pull stations and fire extinguishers.
- Have a reliable means to contact 911 available at all times. For the purposes of this policy, a cellular telephone is an approved means for notification of the fire department.
- Have access to all areas of the building with keys to all secured areas.
- Have a functioning flashlight.
- For buildings operated by the Department of Housing and Residential Education: Continuously and systematically patrol all affected, common areas of the building throughout the fire watch.
- For all other buildings: Systematically patrol all affected areas of the building every 30 minutes.
- Maintain a log indicating the times and areas of patrol within the building and conditions observed. Each entry shall have a time, date and signature. An approved log is in Appendix C of this policy.

Notifications:

Where a notification to the University Fire Marshal is required under this policy, the University Fire Marshal shall also notify the following individuals/groups:

- Chapel Hill Fire Department
- UNC-Chapel Hill E-911 Center
- Director, Environment, Health and Safety
- Assistant Director, Environment, Health and Safety
- Risk Management Division, Office of the State Fire Marshal

Notifications shall include all information provided to the University Fire Marshal. Additionally, notifications shall include the nature of any required compensatory measures.

Applicable Regulations, Statutes, and Related Policies:

- North Carolina Fire Prevention Code
- NFPA 25: Standard for the Inspection, Testing and Maintenance of Water-Based Fire Protection Systems
- NFPA 72: National Fire Alarm and Signaling Code
- NFPA 101: Life Safety Code

7. SUBCONTRACTING

UNC-CH Supplementary General Conditions

All subcontractors shall be identified in writing and approved by the Owner prior to the start of work.

8. SEDIMENTATION POLLUTION CONTROL ACT OF 1973

Any land-disturbing activity performed by the Contractor 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).

Upon receipt of notice that a land-disturbing activity is in violation of said Act, the Contractor shall be responsible for ensuring that all steps or actions necessary to bring the project in compliance with said Act are promptly taken.

The Contractor 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 section.

To the fullest extent permitted by law, the Contractor shall indemnify and hold harmless the Owner, the Contract Administrator and the agents, consultants and employees of the Owner and Contract Administrator, 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 section.

9. SUBMITTAL DATA

The submittal requirements are described in Section 5 of the General Conditions. Items for which submittals are required are listed below:

Pre-Submittals:

- All items referenced in Technical Specifications and Drawings

Post-Submittals:

- All previously submitted documents revised to show as-built condition.
- O&M Manuals for any equipment requiring a submittal.

Data on the following items shall be sent to the Project Manager for review and approval. The submittal process is described in Section 5 of the General Terms and Conditions. Refer to "Technical Specifications" for required submittals. All Pre-Submittals shall be delivered to the Project Manager no later than the Preconstruction Meeting. The Project Manager shall receive all Post-Submittals within 30 (30) days of work completion. The final pay request shall be included with Post-Submittals.

10. DEFINITIONS

UNC-CH Supplementary General Conditions

As defined in Article 1 of the General Conditions, the Supplementary General Conditions as well as the UNC-CH General Requirements are considered part of the contract documents.

The Owner is the State of North Carolina through the University of North Carolina at Chapel Hill.

Provide shall mean purchase, deliver, install, new, clean, completely operational, fully tested and ready for use.

UNC-CH Supplementary General Conditions

UNC-CH GENERAL REQUIREMENTS

1. Owners' Representative

The UNC-CH Department of Construction Management represents the Owner in all matters pertaining to contract construction. The Department will designate a Construction Manager, who will be the single spokesperson for the University. All official contact, decisions, direction, problem resolution and coordination to/from the University will be through the assigned Construction Manager and the Designer. This does not alleviate any of the Designers' responsibilities as stated in the General Conditions.

2. Inspections and Testing

The University will arrange for independent testing agencies to make tests and conduct inspections of work in progress. The contractors will give reasonable notice of construction activities to be tested/inspected so that the testing agency may be present.

In addition to the normally-anticipated inspections, the University intends to conduct the following inspections, which contractors should allow for in their schedules: above-ceiling inspections, pre-final inspections, 100% test of fire protection systems, and final inspections. Any of these inspections which are not completed satisfactorily will be repeated at no cost to the owner and without time extension.

Above-Ceiling Inspections: The above-ceiling inspection will be conducted by the University after above-ceiling systems have been completed and verified by the Designer. The following general guidelines will apply to this inspection:

- a. All above ceiling systems will be completed including, but not limited to, controls, insulation, labeling of systems, wiring, light fixtures, diffusers, ductwork, piping, fire proofing, and sealing of wall penetrations through fire walls.
- b. Framing for hard ceiling will be completed and access door locations will be framed to assure accessibility to control valves, equipment requiring maintenance, etc. Ceiling grid will be in place and equipment (light fixtures, diffusers, etc.) will be in place in the grid.
- c. Under no circumstances will any ceiling area be covered up until this inspection is done by the owner. The contractor shall give the Designer and the University two weeks notice to assure owner personnel is available.

Fire Protection Systems: The installation contractor must conduct a 100% performance test, which shall be ensured by the designer/engineer. When this test is completed and deficiencies corrected, the owner will conduct a 100% test of the system, which shall be scheduled through the University's Construction Manager. At least three days prior to the owner's test; the contractor will furnish the completed NFPA Record of Completion, with a printout of the installed database and a floor plan with database information and room numbers. These documents shall be updated and reissued prior to each additional test and final inspection.

3. Construction Schedule

Tentative dates for interruption of utilities services and traffic disruptions shall be incorporated into the project schedule. The schedule will show UNC and State inspections, punch list correction, cleanup, and final inspection, and shall anticipate 5-year-average

weather delay and the extra restrictions required for University operations as outlined in SGC Paragraph 4 below.

The schedule will also include the time allotted for commissioning the MEP systems. Unless otherwise stipulated in the project construction documents the schedule will indicate 100% commissioning of the MEP systems. The schedule will include all necessary activities and contractor and subcontractor resources to support commissioning, as well as, time and resources for correction of contract required punchlist items generated by the commissioning agent.

4. Working Hours

The contractor may establish a work schedule of his own choosing. The contractor shall submit to the UNC Construction Manager and to the designer his regular daily work schedule, and shall notify the Construction Manager in advance of any deviations from the schedule. The University reserves the right to limit the contractors' activities when they conflict with University operations.

For most situations, the University will require the contractor to comply with the Town of Chapel Hill Noise Ordinance.

Extra restrictions will be enforced by the University during certain periods of the year. The contractors must allow for these restrictions in their project schedule. No time extensions will be granted for these restrictions. In general, these periods are:

- a. During examination periods, generally occurring in December and April for two weeks each, and June and August for four days each.
- b. Graduation, generally on a Sunday in mid-May and a Sunday in mid-December
- c. Approximately 15 home basketball games per year
- d. Approximately 7 home football games per year
- e. University Day, October 12
- f. Student move-in/move-out days, generally twice a year for one week each.

Examples of the extra restrictions include, but are not limited to:

- a. During examination periods the contractor will restrict noise-making activities to the hours of 8:00am - 5:00pm. If the project involves work in or near a residence hall or a building in which an examination is being conducted, the contractor will be required to restrict further those operations which are disturbing to students, to include stopping work if necessary.
- b. Work will not be permitted on Graduation Day, nor the preceding day (Saturday), nor on University Day. Extra cleanup and warning signs and barricades will be provided by the contractor.

- c. Work is normally permitted on the days of sporting events and concerts, but traffic is extremely heavy on those days, and contractors may have difficulty and experience delays getting to and from the job site.
- d. Work is normally permitted on student move-in/move-out days, but traffic is heavier than normal, parking is restricted, and some campus roads are temporarily closed or designated one-way.

5. Underground Utilities

Each contractor who does excavation work will be responsible for locating underground utilities prior to excavation. The contractor may obtain the services of a commercial utilities locator and/or call the various utility companies who may have lines in the area. In addition, they should notify UNC Facilities Services at least 5 days prior to excavation. The contractor will be responsible for utility interruptions caused by excavation.

All underground utilities locate requests must call 811 and the EDS Main Phone Number: 919-962-8394. Contractor must allow at least three (3) days for all locate requests to be processed.

The General Statutes of North Carolina requires contractors to notify NOCUTS at least two days but not more than 10 days prior to excavation on a public right of way.

6. Temporary Interruptions of Utilities and Traffic Movement

Procedures for making temporary disruptions to existing utilities, 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. Connections shall be made only at times approved by the University. For interruption of service in major utility systems, the Contractor must submit to the UNC Construction Manager a step-by-step sequence of operations planned to accomplish the work. Outline must show tentative dates and times of day for shut-off and restoration of services. Upon approval of the planned operations, the Construction Manager will make arrangements with appropriate University personnel for interruption of services.

Road and sidewalk cuts shall be scheduled in advance, and made only after they have been approved by the University. Contractors shall plan and coordinate their work to minimize the duration of such disruptions. Appropriate detours shall be planned, subject to the approval of the University, giving consideration to the handicapped. Warning barricades and signs shall be installed by the contractor, as well as informational signs indicating detours. Neither service disruptions nor excavations may be made until barricades and signs are in place to protect the public. If the nature of the site does not allow barricades to be in place prior to excavation, the barricade materials must be physically present on site before excavation begins, in order that they may be erected as soon as it is possible to do so.

Barricades and signs must meet OSHA, NCDOT, and University approval, and be substantial enough to deter bypassing, vandalizing or theft. In addition to meeting all applicable codes and regulations, signs must be neat and legible at all times. Hand-made signs are not acceptable.

Caution to Bidders: Bidders are cautioned that the University will probably schedule interruption of services at times other than the contractors' normal working hours and that only designated University personnel are authorized to interrupt services. Frequently, outages are scheduled to reduce disruption of classes and special events.

Contractors are reminded of the presence on campus of handicapped students, staff, and faculty: particularly mobility impaired, visually impaired, and hearing impaired. All barricades, temporary walkways, excavation, and stockpiles of materials shall be formed in such a manner as to accommodate access, adequately warn and prevent injury to this segment of the University population.

7. Temporary Utilities

The Owner shall directly pay for all temporary and final utility consumption costs throughout the life of the project's construction and use. Owner will establish any accounts necessary to directly receive bills and shall pay for any metering devices, tap fees, or similar items as necessary. Therefore, any meters shall be listed in the Owner's name upon establishment of any temporary and permanent utility at the site and the Owner shall pay for consumption costs of utilities such as water, sewer, electricity, steam, chilled water, etc.

8. Parking and Storage

Parking is extremely limited at the University of North Carolina at Chapel Hill. Contractors must confine their parking and storage to that which they can accommodate within the limits of the construction site. There will be no parking spaces provided in the vicinity of the project for construction workers. Contractors are encouraged to locate fringe parking areas and shuttle their workers to and from the job site. If a construction fence has been erected the contractor may allow his employees to park inside the fence.

Parking for large storage trailers is limited to within the construction site.

9. Cleanliness and Site Maintenance

Campus streets, parking lots, walks and grounds connecting to the project area shall be protected from deposits of mud, sand, stone, litter, or debris in any form, and this protection shall be the responsibility of the Contractors. All mud collected on vehicle wheels must be cleaned off before leaving the construction area. Should any mud or debris collect on the streets from the construction project, this shall be removed immediately before becoming a traffic hazard or being carried into the surrounding buildings.

Where equipment must cross walks, lawns, and other transitional areas used by pedestrian and vehicular traffic, the Contractor shall provide minimum 3/4" thick plywood protective sheets for equipment to roll over.

The construction site including adjacent campus areas will be kept free of trash, litter or debris at all times. Trash cans/dumpsters shall be emptied and the contents removed from campus before they overflow.

Grass and other vegetation on the construction site shall be trimmed/mowed to maintain a neat appearance. A landscape protection area shall extend to at least the drip line of any trees or shrubs that are to remain. The landscape protection fence shall be installed prior to the initial

stage of grading, excavation or tree removal. No storage, access or activity of any kind will be permitted in the landscape protection areas. The Contractor shall give the Designer two (2) weeks notification in advance for the Owner to remove trees and shrubs that will be retained by the Owner for use elsewhere.

10. Request for Payment

The first sentence only of Article 31a, General Conditions, is revised to read as follows: "Not later than the last day of the month, the contractors shall submit to the Designer a request for payment for work done through the 25th day of the month. The Owner will make payment by the end of the following calendar month, as described in Articles 31 through 33, General Conditions."

The financing arrangements on some projects require that pay applications from all vendors be submitted simultaneously and only once per calendar month. Therefore, failure to follow the above schedule may result in a contractor not being paid until the next pay application period. The only way to insure timely payment is to submit complete, accurate and timely pay applications with all supporting documents.

11. Stored Materials

Add the following sentence to Article 31d, General Conditions: "No payment may be made for stored materials which are stored outside the State of North Carolina."

12. Selection of Brick or Cast Panel for Exterior Walls

The manufacturers shall present samples to the designer for his selection from which sample patterns are to be erected or shown on the job site, after consultation with the Facilities Planning Office. The Construction Management Department will notify the architect's representative where to locate these panels. The University Buildings and Grounds Committee will review these panels and make the selection. At the time the brick panels are viewed by the committee, the contractor shall also have available samples of all significant exterior materials, including but not limited to pre-cast stone or limestone, window and door frames, glass and metal panels. The Construction Management Office will notify the designer of the final selection. In the case of cast stone panels, small samples may be submitted for selection purposes.

Completed panels must cure for at least three weeks before they are reviewed by the Building and Grounds and Committee. In addition, three weeks are required to schedule this review. Therefore the panels must be completed by the contractor a minimum of six weeks before the brick selection is needed.

13. Owner's Right To Do Work

Notwithstanding the notification requirements of the General Conditions, Article 28, should the contractor fail to respond within 24 hours, or such other time as may be prescribed by the designer or by the University's assigned Construction Manager (see paragraph 1 above), to correct a deficiency which the University determines to be endangering trees or other landscaping; or to correct any other defects where time is of the essence to prevent further damage or ensure personal safety; or to correct any impediment to University operations including access by handicapped, fire department, or operational personnel; then the owner

may immediately take corrective action to prevent further endangerment or damage. The cost of the work performed by the owner shall be deducted from any amount due or to become due to the contractor, as provided for in GC, Article 28. Verbal notice shall be provided to the contractor's superintendent or project manager, followed by written confirmation.

14. Commissioning

Unless otherwise stated in the contract documents the project will include 100% commissioning of the MEP systems. The Owner will provide a third party commissioning agent for the oversight of the commissioning process. See contract documents for detailed commissioning requirements. See paragraph 3 above for scheduling requirements of the contractor for the executing the commissioning work.

15. Erosion Control Inspections for General Permit NCG010000 – Land Disturbing Activities

Where an erosion permit is required for the project the contractor will keep on file a record of the required inspection reports filled out two times a week (twice because UNC is on 303(d) listed stream) or within 24 hours of a rain event or as the permit requires and provide one copy of each report to the Universities' EH&S (Geologist) representative (919-962-9752) in addition to the other agencies as the permit may require.

16. Construction Manager at Risk

The payment of the General Conditions costs to the Construction Manager at Risk will terminate 30 days after project completion and acceptance. During this 30 day period all punchlist items shall be completed and stipulated in Article 25 of the General Conditions of the contract. The time for completion and liquidating damages will be as stipulated in the Form of Construction Manager at Risk Contract and Supplementary General Conditions of the contract.

17. O&M Manuals

All required O&M manuals and attic stock shall be approved by the designer and submitted to the Owner before final inspection and acceptance of the project. Approved O&M manuals shall be available for use during the commissioning and training for the project.

18. No Smoking Policy

Contractors working for the University will be required to comply with The University's no smoking policy. A copy of the policy follows for your reference.
The University of North Carolina at Chapel Hill No Smoking Policy

I. POLICY STATEMENT

The University of North Carolina at Chapel Hill (the "University") is dedicated to maintaining a healthy work and learning environment. While the University already prohibits smoking inside its buildings and facilities, beginning January 1st, 2008, the policy will expand to prohibit smoking in State-owned vehicles and in the outdoor according to the map (see below).

Specifically, this policy is intended to eliminate the potential for exposure to secondhand smoke and the practical effect of this policy is that the campus is smoke free. The University supports employees' and students' efforts to quit smoking and offers resources for smoking cessation as indicated on both the Environmental Health & Safety website (<http://www.ehs.unc.edu>) and Campus Health Services website (<http://campushealth.unc.edu>).

II. APPLICABILITY

This policy applies to all University visitors, patients, students, and employees, including faculty, EPA non-faculty, staff, and student employees. It is the responsibility of every member of the University community to conduct himself/herself in compliance with this policy.

III. SIGNAGE

The University will post signs about the policy appropriately throughout campus. Additional information can be printed from the websites listed above and shared with anyone who has questions about this policy.

IV. ENFORCEMENT

Smoking must not occur within the no smoking areas designated by signage. All smoking materials must be disposed of in the appropriate receptacles.

Visitors, patients, and students who violate the no smoking policy should be reminded of the policy and asked to comply by putting out the lighted tobacco product. If a student refuses to comply with the policy, the Dean of Students' office should be contacted. That office will follow up with the student regarding the policy and available resources.

Any University employee who violates the no smoking policy should be reminded of the policy and asked to comply by putting out the lighted tobacco product. If an employee refuses to comply with the policy, the departmental representative will notify the immediate supervisor of the noncompliant employee. The immediate supervisor will follow-up with the employee to remind him/her about the policy and available resources. Continuing violations may also result in appropriate corrective action under the applicable disciplinary policy.

V. DEPARTMENTAL PROCEDURES

All University departments and work units must establish procedures that include identification of the employee(s) responsible for understanding the policy, being able to educate visitors, patients, students, and employees, and assisting in enforcement, as needed. The Office of Human Resources can assist departments in developing their procedures.

VI. EFFECTIVE DATE

This policy is effective January 1, 2008.

19. Cost of Work

All labor burden by the CM shall be charged at 40% applied to each employees total billable labor cost.

Items that are ordered from and billed to CM's main office for specific use at the project site shall be approved as valid reimbursable costs and shall be billed to line items in the CM's general conditions.

Builder's risk deductibles in the event of a loss on the project, due to no fault of the CM, shall be a reimbursable cost of the work.

**GUIDELINES FOR
RECRUITMENT AND SELECTION OF MINORITY BUSINESSES
FOR PARTICIPATION IN THE UNIVERSITY OF NORTH CAROLINA
CONSTRUCTION CONTRACTS**

In accordance with G.S. 116-31.11 and G.S. 143-128.2 these guidelines establish goals for minority participation in single-prime bidding, separate-prime bidding, construction manager at risk, design-build, public-private partnership, and alternative contracting methods, on University of North Carolina construction projects in the amount of \$100,000 to \$4,000,000. The legislation provides that the State, including the University of North Carolina System, 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 through The University of North Carolina, its constituent institutions, and/or affiliates (hereafter The University of North Carolina) as awarding authorities 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 business, minority person, and socially and economically disadvantaged individual - G.S. 143-128 (g) includes the following definitions. Any changes to G.S. 143-128 (g) are incorporated herein upon enactment:
 - (1) The term "minority business" means a business:
 - a. In which at least fifty-one percent (51%) is owned by one or more minority persons or socially and economically disadvantaged individuals, 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.
 - (2) The term "minority person" means 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, or the Pacific Islands;
 - d. American Indian, that is, a person having origins in any of the original Indian peoples of North America; or
 - e. Female.
 - (3) The term "socially and economically disadvantaged individual" means the same as defined in 15 U.S.C. 637.
2. Public Entity – The State of North Carolina and all public subdivisions and local governmental units.
3. Owner - The State of North Carolina, through the constituent institution named in the contract.

4. Designer – Any person, firm, partnership, or corporation, which has contracted with the State of North Carolina to perform architectural or engineering, work.
5. Bidder - Any person, firm, partnership, corporation, association, or joint venture seeking to be awarded a public contract or subcontract.
6. 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.
7. 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.
8. Subcontractor - A firm under contract with the prime contractor, construction manager at risk, design-builder, or private developer under public-private partnerships 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 University of North Carolina 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. The University of North Carolina System Office: The University of North Carolina System Office will be responsible for the following:

- a. Reviewing the apparent low bidders' statutory compliance with the requirements listed in the proposal prior to award of construction contracts within their awarding authority. The State through The University of North Carolina, reserves the right to reject any or all bids and to waive informalities.
 - b. Assisting constituent institutions in monitoring of contractors' compliance with minority business requirements in the contract documents during construction.
 - c. Consulting and advising institutions and affiliates regarding changes in HUB statutes, executive orders, or state procedures.
 - d. Resolving any protest and disputes arising on projects within The University of North Carolina System Office award authority.
3. Constituent Institutions and Affiliates of The University of North Carolina: Before awarding a contract, the constituent institution shall do the following:
- a. Implement The University of North Carolina HUB plan.
 - 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 its efforts 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 University of North Carolina.
 - g. Evaluate documentation to determine good faith effort has been achieved for minority business utilization prior to recommendation of award to University of North Carolina.
 - h. Review prime contractors' pay applications for compliance with minority business utilization commitments prior to payment.
 - i. Document evidence of implementation of Owner's responsibilities.
4. Designer
Under the single-prime bidding, separate prime bidding, construction manager at risk, design-build, public-private partnership, 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), including the 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.
- f. Make documentation showing evidence of implementation of Designer’s responsibilities available for review by The University of North Carolina System Office and HUB Office, upon request.

5. Prime Contractor(s), CM at Risk, Design-Builder, Public-Private Partnership developer and Its First-Tier Subcontractors: Under all construction delivery 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. 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. 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.
- 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 Subcontractor responsibilities available for review by the University of North Carolina System 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 B) indicating bidder’s 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) and has all material and supplies required for the project. Bidder may be asked to provide additional documentation in support of the claim of self-performance and regarding the Good Faith Effort to utilize minority suppliers where possible. (2) 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; (3) if the percentage is not equal to the applicable goal, then documentation of all good faith efforts taken to meet the goal (Affidavit D). 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 for formal contracts (>\$500,000) as required in Article 31 of the General Conditions of the Contract to facilitate payments to the subcontractors.
- i. The contractor(s) on formal contracts (>\$500,000) shall submit with each monthly pay request(s) and final payment(s), “MBE Documentation for Contract Payment” – (Appendix E), for designer’s review. This documentation is also required for contracts under informal bidding, but these projects, typically of shorter duration, may have a single payment request at project completion.
- j. During the construction of a project, at any time, if it becomes necessary to replace a minority business subcontractor, immediately advise the owner, The University of North Carolina System 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 that these requirements apply to all contractors and first tier subcontractor under any of the approved construction delivery methods permitted 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 D: 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 E: EFFECTIVE DATE

These guidelines shall apply upon promulgation on university construction projects. Copies of these guidelines may be obtained from The University of North Carolina System Office
website:<https://www.northcarolina.edu/offices-and-services/finance-and-administration/capital-design-and-construction/>.

SECTION F: FORMS

In addition to these guidelines, there will be issued with each construction bid package provisions for contractual compliance providing MBE participation in State, through The University of North Carolina, building projects. An explanation of the process follows, titled "MINORITY BUSINESS CONTRACT PROVISIONS (CONSTRUCTION)" along with relevant forms for its implementation ("Identification of Minority Business Participation" form, Affidavits A, B, C, D, and Appendix E).

MINORITY BUSINESS CONTRACT PROVISIONS (CONSTRUCTION)

APPLICATION:

The **Guidelines for Recruitment and Selection of Minority Businesses for Participation in University of North Carolina 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 University of North Carolina System Office website: <https://www.northcarolina.edu/offices-and-services/finance-and-administration/capital-design-and-construction/>

MINORITY BUSINESS SUBCONTRACT GOALS:

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

The bidder must identify on its bid (by using the "Identification of Minority Business Participation" form provided in the bid document), 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).

Failure to submit these documents is grounds for rejection of the bid. Bid amounts from rejected bids shall not be read aloud at public bid openings.

The lowest responsible, responsive bidder must provide:

Affidavit C, if the portion of work to be performed by minority firms is equal to or greater than 10% of the bidder's total contract price. Affidavit C includes a description of the portion of work to be executed by minority businesses, expressed as a percentage of the total contract price, and lists the participating minority firms with the dollar value of their contracts.

OR

Affidavit D, if the portion of work to be performed by minority firms is less than 10% of the bidder's total contract price. Affidavit D includes a description of the portion of work to be executed by minority businesses, expressed as a percentage of the total contract price, lists the participating minority firms with the dollar value of their contracts, and must include adequate **documentation of Good Faith Effort**.

AND

Affidavit B (with bid), if the bidder does not customarily subcontract work on this type project and has all material and supplies required for the project. Bidder may be asked to provide additional documentation in support of the claim of self-performance and regarding the Good Faith Effort to utilize minority suppliers where possible.

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

Summary of required submissions: Use check boxes to assist in ensuring that all appropriate forms are submitted.

ALL BIDDERS MUST SUBMIT TWO FORMS WITH THEIR BID:

- “Identification of Minority Business Participation” form

AND EITHER

- Affidavit A – “Listing of Good Faith Efforts”

OR

- Affidavit B – “Intent to Perform Contract with Own Workforce”

The above information must be provided as required. Failure to submit these documents is grounds for rejection of the bid. Bid amounts from rejected bids shall not be read aloud at public bid openings.

=====
IN ADDITION, THE APPARENT LOWEST RESPONSIVE, RESPONSIBLE BIDDER SUBMITS:

- Affidavit C** – “Portion of the Work to be Performed by Minority Firms” if the percentage of work to be performed by minority firms is 10% or more. This form is to be submitted within 72 calendar hours of notification of being low bidder.

OR

- Affidavit D** – “Good Faith Efforts” if the percentage of work to be performed by minority firms is less than 10%. This form is to be submitted within 72 calendar hours of notification of being low bidder.

The above information is mandatory. 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 (The University of North Carolina) 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 (The University of North Carolina) 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 (The University of North Carolina) whether to terminate the contract for breach.

In determining whether a contractor has made a Good Faith Effort, the University of North Carolina 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 were 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.

FORM OF PROPOSAL

UNC-CH Coastal Process
Environmental Health Lab
University of North Carolina at Chapel
Hill
SCO-ID 23-26296-01A

Contract: _____
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 University of North Carolina 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 University of North Carolina Chapel Hill – Coastal Process Environmental Health Lab – Morehead City, NC in full in complete accordance with the plans, specifications and contract documents, to the full and entire satisfaction of the State of North Carolina, and the University of North Carolina at Chapel Hill 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.

Alternate No. M-01: Provide Annexair Biocomposite as manufacturer for AHU-1.

(Add) _____ Dollars(\$)

Alternate No. M-02A: Furnish and install a BACnet based building automation system by JCI.

(Add) _____ Dollars(\$)

Alternate No. M-02B: Furnish and install a BACnet based building automation system by Schneider Electric.

(Add) _____ Dollars(\$)

Alternate No. M-02C: Furnish and install a BACnet based building automation system by Siemens.

(Add) _____ Dollars(\$)

Alternate No. E-01: Electrical feeder from 'MSB' to 'ATS-EM1'.

(Add) _____ Dollars(\$)

Alternate No. E-02: Electrical feeder from 'MSB' to 'Elevator'.

(Add) _____ Dollars(\$)

Alternate No. E-03: Electrical feeder from 'MSB' to 'PD & LG'.

(Add) _____ Dollars(\$)

Alternate No. E-04: Electrical feeder from 'MSB' to 'Chiller'.

(Add) _____ Dollars(\$)

Alternate No. E-05: Electrical feeder from 'MSB' to 'L1A'.

(Add) _____ Dollars(\$)

Alternate No. E-06: Electrical feeder from 'MSB' to 'L2A'.

(Add) _____ Dollars(\$)

Alternate No. E-07: Electrical feeder from 'MSB' to 'L1C'.

(Add) _____ Dollars(\$)

Alternate No. E-08A: Provide new electrical service from utility transformer to panel 'MSB' per drawings E1.1 and E3.2.

(Add) _____ Dollars(\$)

Alternate No. E-08B: Same as Alternate E-08A except provide service entrance rated enclosed circuit breaker in NEMA 4X stainless steel enclosure in lieu of fused disconnect.

(Add) _____ Dollars(\$)

Alternate No. E-09A: Provide new electrical service from utility transformer to panel 'MSB' per drawings E1.2 and E3.3.

(Add) _____ Dollars(\$)

Alternate No. E-09B: Same as Alternate E-08A except provide service entrance rated enclosed circuit breaker in NEMA 4X stainless steel enclosure in lieu of fused disconnect.

(Add) _____ Dollars(\$)

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:

Affidavit C, if the portion of work to be performed by minority firms is equal to or greater than 10% of the bidder's total contract price. Affidavit C includes a description of the portion of work to be executed by minority businesses, expressed as a percentage of the total contract price, and lists the participating minority firms with the dollar value of their contracts.

OR

Affidavit D, if the portion of work to be performed by minority firms is less than 10% of the bidder's total contract price. Affidavit D includes a description of the portion of work to be executed by minority businesses, expressed as a percentage of the total contract price, lists the participating minority firms with the dollar value of their contracts, and must include adequate **documentation of Good Faith Effort**.

AND

Affidavit B (with bid), if the bidder does not customarily subcontract work on this type project and has all material and supplies required for the project. Bidder may be asked to provide additional documentation in support of the claim of self-performance and regarding the Good Faith Effort to utilize minority suppliers where possible.

Note: Bidders must always submit **with their bid** the Identification of Minority Business Participation Form listing all MB contractors, vendors and suppliers that will be used. If there is no MB participation, then enter 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:

(Proprietorship or Partnership)

By: _____
Signature

Name: _____
Print or type

Title _____
(Owner/Partner/Pres./V.Pres)

Address _____

ATTEST:

By: _____

Title: _____
(Corp. Sec. or Asst. Sec. only)

License No. _____

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 _____

Attach to bid

Attach to bid

Attach to bid

Attach to bid

Attach to bid

Identification of HUB Certified/ Minority Business Participation

I, _____, do hereby certify that on
(Name of Bidder)
 this project (_____), we will use the following HUB Certified/ minority
(Name of Project)
 business(es) as construction subcontractors, vendors, suppliers, or providers of professional services.

Firm Name, Address and Phone Number	Work Type	*Minority Category	**HUB Certified
			Y / N
			Y / N
			Y / N
			Y / N
			Y / N
			Y / N
			Y / N
			Y / N
			Y / N

*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 (\$)_____.

Attach to bid (as appropriate)

Attach to bid (as appropriate)

Attach to bid(as appropriate)

AFFIDAVIT A

Listing of Good Faith Efforts

(The University of North Carolina)

County of _____

Affidavit of _____ for _____

(Name of Bidder)

(Name of Project)

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.

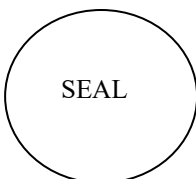
The undersigned hereby certifies that he or she has read the terms of the minority business commitment and is authorized to bind the bidder to the commitment herein set forth.

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 _____

Attach to bid (as appropriate)

Attach to bid (as appropriate)

Attach to bid (as appropriate)

AFFIDAVIT B
Intent to Perform Contract with Own Workforce
(The University of North Carolina)

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.

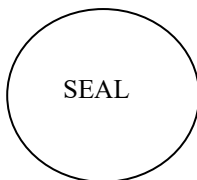
The undersigned hereby certifies that he or she has read this certification and is authorized to bind the Bidder to the commitments herein contained.

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 _____

Do not submit with bid

Do not submit with bid

Do not submit with bid

Do not submit with bid

AFFIDAVIT C

Portion of the Work to be Performed by HUB Certified/Minority Businesses (The University of North Carolina)

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 bidder's 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.

County of _____

Affidavit of _____ I do hereby certify that on the
(Name of Bidder)

_____ contract.
(Name of Project)

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	Work Description	Dollar Value
		Y / N		
		Y / N		
		Y / N		
		Y / N		
		Y / N		
		Y / N		

* 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 is 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.

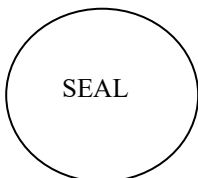
The undersigned hereby certifies that he or she has read the terms of this commitment and is authorized to bind the bidder to the commitment herein set forth.

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 _____

AFFIDAVIT D Good Faith Efforts

(The University of North Carolina)

This affidavit shall be provided by the apparent lowest responsible, responsive bidder within **72 hours** after notification of being low 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:

County of _____

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 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	Work Description	Dollar Value
		Y / N		
		Y / N		
		Y / N		
		Y / N		
		Y / N		

*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:

- A. 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.
- B. Copies of quotes or responses received from each firm responding to the solicitation.
- C. A telephone log of follow-up calls to each firm sent a solicitation.
- D. 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.
- E. Documentation of any contacts or correspondence to minority business, community, or contractor organizations in an attempt to meet the goal.
- F. Copy of pre-bid roster
- G. Letter documenting efforts to provide assistance in obtaining required bonding or insurance for minority business.

- H. Letter detailing reasons for rejection of minority business due to lack of qualification.
- I. 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.

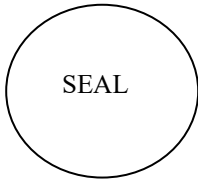
The undersigned hereby certifies that he or she has read the terms of this commitment and is authorized to bind the bidder to the commitment herein set forth.

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 _____

****THIS DOCUMENT MUST BE SUBMITTED WITH EACH PAY REQUEST & FINAL PAYMENT****

**APPENDIX E
MBE DOCUMENTATION FOR CONTRACT PAYMENTS**

Prime Contractor/Architect: _____

Address & Phone: _____

Project Name: _____

Pay Application #: _____ Period: _____

The following is a list of payments to be made to minority business contractors 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**) Socially and Economically Disadvantaged (**D**)

Date: _____

Approved/Certified By: _____

Name

Title

Signature

Signature certifies that any minority firms not previously verified in the bid/award process have been appropriately verified, services have been rendered, and payment is due as processed.

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)

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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:

Base Bid	
Alternate(s)	
Alternate(s)	
Total Contract	

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)

(Surety Company)

Witness:

By: _____

Title: _____
(Attorney in Fact)

Countersigned:

(N.C. Licensed Resident Agent)

Name and Address-Surety Agency

Surety Company Name and N.C.
Regional or Branch Office Address

(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.

UNC CHAPEL HILL - APPENDIX E

Campus Location	UNC Chapel Hill
Project Title	
Pay Application #	
Pay App / Report Date	
UNC Project Number	
SCO Number	
GMP Date	
Notice to Proceed	
Completion Date	

	Contract Amount	Contract %	Amount Paid	Percent Paid
American Indian	\$ -	0.00%	\$ -	0.00%
Asian	\$ -	0.00%	\$ -	0.00%
Black	\$ -	0.00%	\$ -	0.00%
Disadvantaged	\$ -	0.00%	\$ -	0.00%
Female	\$ -	0.00%	\$ -	0.00%
Hispanic	\$ -	0.00%	\$ -	0.00%
Minority Totals	\$ -	0.00%	\$ -	0.00%

Company Contact:	
Telephone Number:	
Email Address:	
Project Manager:	

BID PACKAGE #	CONTRACTOR NAME	ADDRESS & PHONE	TRADE (1st Tier/2nd Tier)	PACKAGE/TRAD E TYPE	CONTRACT DATE	HUB CERTIFIED	HUB TYPE	ORIGINAL CONTRACT AMOUNT	INCREASES / DECREASES TO ORIGINAL CONTRACT	CURRENT TOTAL CONTRACT AMOUNT	TOTAL PAID TO DATE	TOTAL INVOICED TO DATE	CURRENT PAY APPLICATION \$
Prime/CMR			Prime/CMR										
										\$ -			
										\$ -			
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BID PACKAGE #	CONTRACTOR NAME	ADDRESS & PHONE	TRADE (1st Tier/2nd Tier)	PACKAGE/TRADE TYPE	CONTRACT DATE	HUB CERTIFIED	HUB TYPE	ORIGINAL CONTRACT AMOUNT	INCREASES / DECREASES TO ORIGINAL CONTRACT	CURRENT TOTAL CONTRACT AMOUNT	TOTAL PAID TO DATE	TOTAL INVOICED TO DATE	CURRENT PAY APPLICATIONS
										\$ -			

SECTION 01 05 00 - GENERAL CONSTRUCTION GUIDELINES AND REQUIREMENTS

1.0 PURPOSE

- A. The following guidelines apply to University of North Carolina at Chapel Hill (“UNC-CH”) requirements specific to the needs of UNC-CH. It is the goal of UNC-CH to identify specific needs relevant to working on a public university campus or satellite facility that will help the Contractor gain more knowledge and be fully aware of UNC-CH’s expectations while working on campus or satellite facility.

2.0 GENERAL REQUIREMENTS

- A. The Owner’s Representative - UNC-CH will designate a Construction Manager to act as the Owner’s Representative in all matters pertaining to construction contracts. All official contacts, decisions, directions, problem resolution, coordination and other liaison activities required from UNC-CH will be through the Construction Manager. This requirement does not modify the responsibilities of the Designer as stated in the General Conditions of the Contract.
- B. Behavior policy - All construction personnel shall be respectful of all members of the UNC-CH community. Any incidents of disrespect, verbal abuse, threatening statements, unwelcome comments, unwelcome interaction or any form of harassment from any construction personnel toward any member of UNC-CH community is strictly prohibited. Any such act shall constitute sufficient cause for UNC-CH to remove any individual permanently from the project and all UNC-CH property. In addition, any of the Contractor(s) project personnel who ignore or refuse to take action on any requirements of the contract documents or ignore or refuse to take immediate action to correct any endangerment to the health and safety of the public (as solely determined by UNC-CH) shall be permanently removed from the project and UNC-CH property. If in the sole determination of UNC-CH it is in the best interest of the project and UNC-CH to have any of the Contractor(s) personnel removed from the project, then the Contractor shall do so upon request by UNC-CH. Such actions taken by UNC-CH shall not constitute grounds for a delay claim. UNC-CH will not be responsible for any delays caused to the project due to any individual being removed from the project by UNC-CH.
- C. Protection of Work, Property, and Public:
 - 1. The single prime Contractor, henceforth referred to as “the Contractor,” shall ensure that campus streets connecting to the project are protected from mud, sand, and stones/gravel. Streets and adjacent property sites shall be kept free from run-off, litter and/or debris in any form from the project site. Mud, litter and/or debris from the construction site that appears on adjacent property sites shall be removed immediately. All mud collected on vehicle tires shall be removed before leaving the construction area. Should any mud or debris from the project site collect on the streets, it shall be removed immediately to prevent any hazards to vehicular or pedestrian traffic as well as from entering the storm sewer system. In any event, all streets and property sites adjacent to the project site shall be cleaned of construction related debris, dust, litter and mud daily. The Contractor, in the preparation of bids, shall account for the daily cleaning of

adjacent streets and property sites. The Contractor(s) is prohibited from discharging any waste products from concrete trucks or from concrete coring work, or any other unsuitable materials, fluids or other products on the site or into the storm sewer system. Should the Contractor fail to comply with these requirements, UNC-CH reserves the right, with twenty-four (24) hours prior notice to the Contractor, to clean and or remove mud, trash, litter, debris or any unauthorized discharge from the project site and/or the adjacent streets or properties. In such case, the cost of the cleaning and/or removal or mobilization for cleaning and/or removal shall be deducted from the Contractor's contract.

2. The Contractor shall repair any damage (including but not limited to: scratches, cuts, dings, holes, track marks, etc.) of any kind made to existing hardscapes (asphalt/concrete roadway and drives, curb and gutter, brick sidewalks, etc.) by heavy equipment or other causes. Repairs shall consist of a complete, full depth removal and replacement of the affected asphalt, concrete or brick hardscapes at the Contractor's expense, or as otherwise determined by the Owner, to include the full width of the road, parking lot, walk or curb that is affected. The Contractor is strongly encouraged to be mindful of this while working around and off-loading equipment in areas of new construction adjacent to existing areas, which are not in the original scope of work to be renovated or repaved. In general, equipment shall be off-loaded inside of assigned staging areas, and the Contractor shall take protective measures as needed, including protective plywood or other means to prevent damage of the hardscape surface. The slightest damage will result in full hardscape replacement at the Contractor's expense.
3. Blasting on UNC-CH property is prohibited.
4. Each Contractor doing excavation work is responsible for locating all existing underground utilities prior to commencing excavation. The Contractor shall be responsible for the associated cost of any utility interruption and repair due to his excavation if utility location was not requested, location procedures performed and followed prior to commencing excavation. The Contractor shall immediately notify UNC-CH and restore the service of any utility disrupted due to excavation or any Contractor action whatever the circumstance. UNC-CH reserves the right to immediately restore the service of any utility disrupted due to actions of the Contractor and deduct the cost of such restoration from the Contractor's contract.
5. For emergency situations during construction, the Contractor shall furnish UNC-CH with the names, pager numbers, and telephone numbers (day and night) of the Contractor's project manager and superintendent prior to beginning work. The numbers shall remain current or be updated as required for the duration of the project. The Contractor shall contact UNC-CH via cell phone immediately in the event of an emergency. UNC-CH will only provide security, as it deems prudent and necessary for its own protection. The Contractor shall be responsible for the security and safety of the project within the project limits. UNC-CH must approve any "watchman" service instituted by the Contractor.
6. UNC-CH will conduct normal operations during the duration of the project. The Contractor shall coordinate with UNC-CH to minimize any disruptions to the functions of UNC-CH.

3.0 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 Contactor 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), or on University Day.

- A. Deliveries shall be between 8A-4P.
- B. Contractors will not have access to facility restrooms. Contractor shall provide porta-johns as necessary.
- C. Notify Facility Manager 48 hours in advance for work inside buildings. Coordinate all building entry with Facility Manager.
- D. Meetings - The contractor shall at a minimum conduct weekly coordination meeting to review construction progress and any issues that need to be resolved. Contractor shall invite UNC-CH and Designer as well as any required subcontractors.

Inspection of the work - UNC-CH will conduct the following inspections, as applicable, which shall be included in the construction schedule: in-wall inspections, above ceiling inspections, generator test, pre-final inspections, and a final inspection for project acceptance. Any inspections that are not satisfactory shall be repeated at no cost to UNC-CH and shall not be cause for a time extension. All inspections will be conducted by UNC-CH at the same time as the Designer's inspection and a punch list generated. The Contractor shall give the Designer and UNC-CH a minimum of fourteen (14) calendar days prior notice that the systems have been verified by the Contractor to be complete, fully functional and ready for inspection. All punch list items generated from the inspections shall be completed by the Contractor and verified by the Designer and UNC-CH. Any re-inspection costs, including but not limited to Designer, UNC-CH, State Construction Office (SCO) or third party personnel, that result from punch list items not being 100% complete shall be at the expense of the Contractor.

- E. Use of the Premises - Parking – Will be detailed in addendum.
- F. Utilities - It is imperative that all campus utilities and all other campus services are maintained at all times except for scheduled interruptions. Required utility interruptions shall be scheduled with and requested through UNC-CH at least fourteen (14) days in advance for minor outages and thirty (30) days in advance for major outages. UNC-CH is the sole determiner of the utility outage being major or minor. Major outages include but are not limited to those that affect an entire floor of a building, all of a building, all or parts of several buildings, all or parts of an area, and any high voltage outage. No utility interruption, regardless of the advance notice given, shall be undertaken without expressed, specific approval from UNC-CH. If requested by UNC-CH, utility outages shall be performed after hours and/or at night, or over the weekend, or during holidays. No extra payment will be made for such work. UNC-CH personnel will perform certain activities in connection with utility outages such as operating existing electrical switches, turning existing water and steam valves, placing existing building systems back in

operation, operating existing fire alarm systems, etc. UNC-CH will bear the expense of the work of their personnel. When the Contractor requires an additional or extra outage to complete their work because of a shortage of or improper materials, shortage of labor, poor coordination, failure to finish the work during the outage scheduled length of time, the Contractor will pay all expenses incurred for UNC-CH's services for an additional outage(s). No service disruptions shall take place until barricades (if applicable) and signs are in place to notify and/or protect the public. Barricades must be maintained at all times and signs shall be neat and legible, hand-made signs are not acceptable. Signs for utility outage notice shall be written and placed as directed by UNC-CH seven (7) workdays prior to the outage. UNC-CH may determine the utility service cannot be interrupted for the length of time or frequency requested by the Contractor. In such case the Contractor shall include in his bid provisions for temporary utility services for the duration of the outage at no cost to UNC-CH.

- G. Survey of New and Existing Sub-surface Utilities - Perform field location surveys of new utilities installed as well as existing utilities uncovered during the construction phase. Conventional survey standards are to be utilized during the collection of field data. All work shall be performed by qualified personnel under the supervision of a Professional Land Surveyor, and the documents submitted shall bear the Surveyors seal and certification. Accuracy Standards: horizontal and vertical location shall be +/- 0.25'. Survey (NAD83-North Carolina State Plane Coordinates) shall tie to UNC-CH's horizontal & vertical control monuments. A Mylar copy and digital file of the location surveys are to be provided in AutoCAD 2008 or later format and a PDF file format. Use AutoCAD layers, line types, layer names, symbols, scale, etc. as directed by owner (a spreadsheet can be provided for required layer naming conventions and their descriptions. Line types, colors, symbols, etc. can be provider standard practices. All lines shall be continuous poly-lines (no splines), and all polygons (building footprints, etc.) need to be closed poly-lines. No custom SHX features in CAD files. AutoCAD blocks can be used for point features and paper space title blocks only). Drawing shall note all dimensions and elevations in feet and hundredths of feet. Angular measurements will be in degrees, minutes, and seconds. Drawing sheet shall be trim size 24" x 36" unless otherwise authorized by owner. Computer file shall be at 1 to 1 (example 10.75 = 10'-9"). X, Y, Z coordinates at points where shots were taken on utility structures. Provide owner with a excel file of point numbers, and the associated coordinates. Locations shall be taken at the center of a utility structure where possible. When locating piping, note size and the materials used. North shall be N C Grid. Locate North at the top of the page. Media for all electronic files shall be CD or DVD and shall be labeled with UNC-CH Project Number and short description of contents.
- H. The following outline lists the utilities to be located and the data to be collected.
1. Water Lines - (Domestic, Fire Main, Chilled & Hot Water)
 - a) Locations, size and elevations at the top of installed water lines, including changes in direction.
 - b) Locations of valves and a valve type designation, meters, fire department connections, post indicator valves, hydrants, reducers, manholes, and backflow device.
 - c) Provide digital photographs of bends and valves.

2. Electric and Communication Duct Banks and Direct Buried Conduit
 - a) Location and elevations of the duct bank top and bottom.
 - b) Location and elevations of conduit runs in the duct bank.
 - c) Location and elevations of any direct buried conduit.
 - d) Location and elevations of manhole rims, transformers, pedestals, switches, poles, overhead lines, junction boxes, panels, generators, and meter boxes.
 3. Gas
 - a) Location and elevations of top of pipe and any change in direction.
 - b) Location and elevations of meters, pressure reducing stations, test stations, generators, and valves.
 4. Storm and Sanitary Sewer
 - a) Provide invert elevations for incoming and outgoing piping at manholes.
 - b) Provide top elevation of manhole cover.
 - c) Note if manhole rims are in the center of the structure or not. Measure the offset, pipe sizes, material types and the direction of the flow.
 - d) Provide digital photographs of structures if needed for clarification.
 5. Existing Utilities
 - a) Locate and provide elevations consistent with new utility requirements of any existing utilities exposed during excavation of trenches for new utilities.
 - b) Provide digital photographs of the crossing or conflict.
 6. Deliverables for Surveys
 - a) The subsurface location data and platting shall be continuous throughout the project.
 - b) All data and plats are due to UNC-CH within two-weeks of the backfilling of utilities or completion of the associated construction task.
- I. Traffic Movement and Interruptions - Road and sidewalk blockages shall be scheduled fourteen (14) days in advance and made only after UNC-CH has approved them. Appropriate detours shall be planned, subject to approval by UNC-CH, giving consideration to the handicapped access. No excavations shall take place prior to placing proper barricades, lighting, and other devices as shall be required. The Contractor shall install warning signs, barricades and detour information signs to maintain traffic flow as directed by UNC-CH. If required, flagmen shall direct traffic around the construction area or detour area. Contractors are reminded of the presence on campus of handicapped students, staff and faculty. All barricades, temporary walkways, excavations, and stockpiled materials shall be placed and/or constructed in such a manner as to accommodate, adequately warn, and protect this segment of the campus population. The Contractor shall make requests for approval for any street, alley, driveway or any access way to be closed at least ten (10) work days prior to the date for the desired closing. The Contractor shall close no street, alley, driveway or access-way without prior approval by UNC-CH. Pedestrian and vehicle traffic way-finding around the construction limits must be maintained in a clean and safe condition at all times.

- J. Cleanliness and Site Maintenance - The Contractor(s) shall be responsible for keeping the project limits area, the project site, and the project itself clean and free of accumulated construction debris and trash. To that extent, the Contractor(s) shall be responsible for cleaning their work areas weekly at a minimum and the proper disposal of their construction debris and trash. The construction site and staging areas shall be cleaned as previously noted; however, should trash, litter or debris from the project site migrate to any adjacent campus areas it shall be removed immediately. Grass in the construction site shall be mowed as often as required to maintain a neat appearance or as requested by UNC-CH but in no case less than once per month. Should the Contractor(s), in the sole judgment of UNC-CH fail to comply with these requirements, then UNC-CH reserves the right to proceed with cleaning within the project limits area, immediate project site, the interior of the project or, if applicable, the adjacent areas to the project as it deems necessary. The cost of the cleaning and/or the mobilization cost of cleaning will be deducted from the Contractor(s) contract.
- K. Storage of construction materials and equipment - Storage of construction materials and equipment shall be limited to the staging area. Should the Contractor fail to remove any material stored or equipment outside the staging area within twenty-four (24) hours of notification received from UNC-CH, UNC-CH shall have the right to remove and dispose of such materials from the campus. UNC-CH will deduct the cost of such removal and disposal from the Contractor(s) contract. The offending Contractor(s) shall be responsible for any delay to the project resulting from UNC-CH having to remove and dispose of such materials or equipment.
- L. Inspection and Audit - Contractor's "records" shall, upon reasonable notice, be open to inspection and subject to audit and/or reproduction during normal business working hours. An UNC-CH representative or an outside representative engaged by UNC-CH may perform such audits. UNC-CH or its designee may conduct such audits or inspections throughout the term of this contract and for a period of three years after final payment or longer if required by law.
1. Contractor's records as referred to in this contract shall include any and all information, materials and data of every kind and character, including without limitation, records, books, documents, subscriptions, recordings, agreements, purchase orders, leases, contracts, commitments, arrangements, notes, daily diaries, superintendent reports, drawings, receipts, vouchers and memoranda, and any and all other agreements, sources of information and matters that may in UNC-CH's judgment have any bearing on or pertain to any matters, rights, duties or obligations under or covered by any Contract Document. Such records shall include (hard copy, as well as computer readable data if it can be made available): written policies and procedures; time sheets; payroll registers; payroll records; cancelled payroll checks; subcontract files (including proposals of successful and unsuccessful bidders, bid recaps, etc.); original estimates; estimating work sheets; correspondence; change order files (including documentation covering negotiated settlements); back charge logs and supporting documentation; invoices and related payment documentation; general ledger entries detailing cash and trade discounts earned; insurance rebates and dividends; and any other Contractor records which may have a bearing on matters of interest to UNC-CH in connection with the Contractor's dealings with

UNC-CH (all foregoing hereinafter referred to as “records”) to the extent necessary to adequately permit evaluation and verification of:

- a) Contractor compliance with contract requirements,
- b) Compliance with UNC-CH’s business ethics policies, and
- c) Compliance with provisions for pricing change orders, invoices or claims submitted by the Contractor or any of his payees.

M. Changes in the Work - Overhead shall also include all general conditions of the contract and all general requirements such as project management, scheduling, home office expense, engineering and layout, reproduction expenses, shop drawing processing and coordination, supervision, coordination, small tools, all vehicle expenses, temporary facilities, safety provisions, as built drawings, estimating, and general overhead.

1. The change order cost break down shall include: labor (number of hours and \$/hr) and material (quantity and \$/unit), including such breakdowns for work performed by the general contractor and all subcontractors. Unit prices shall only be allowed as stipulated in Article 19 of the contract General Conditions. Cost extensions shall be clearly shown for the labor and material prior to any mark-ups. The cost extensions shall be added into a labor and material subtotal. The labor shall then show a percentage for labor burden, while the materials shall show the applicable sales tax. These subtotals shall then be shown as a total for labor and material costs. The labor and material cost shall then show the allowed mark-up, and a final total. Subcontractor quotes shall be presented in the same format on the subcontractor's letterhead. Each item totaled on the Contractor’s summary sheet shall be separated in the back up documentation by a colored sheet of paper. For change orders that delete any part of the work within the change order and/or contain deductive costs, the back up shall show the original material and labor for the deleted work or costs. If the change order contains both adds and deducts for the same type of work then the material unit and labor unit costs shown on the back up for the deleted work and the added work shall be the same and the net difference shown. Deductive change orders shall show the proper reduction in OH&P and the bond. The Contractor shall also provide HUB utilization information on UNC-CH’s Hub Utilization form. Failure by the Contractor to provide the information requested in this paragraph shall result in rejection of the change order by the designer and a request for re-submittal. Delay in the processing of the change order due to lack of proper submittal by the Contractor in accordance with this paragraph, or due to errors in the change order calculations shall not constitute grounds for a time extension or basis for a claim.
2. For all proposed 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 and as required in General Condition Article 19 – Changes in the Work, paragraph “c”, “d”, and “e”. The designer shall verify correctness and determine that the Contractor’s proposed costs are equitable. After receipt of the Contractor’s proposal and if the proposal is correct and it is agreed to by the designer and UNC-CH that the cost is equitable then UNC-CH shall prepare a change order and forward it to the Contractor for his signature. If the change order proposal is incorrect, or the cost has not been agreed upon by the designer and UNC-CH then the designer shall

- notify the Contractor that the proposal is rejected and the proposal shall be re-submitted. If the proposal is rejected because the cost are deemed not to be equitable then the contracting parties shall negotiate and agree upon the equitable value of the change and the proposal shall be resubmitted with costs determined under General Condition Article 19 – Changes in the Work Paragraph “e”.
3. Once proposed change orders have been reviewed and approved by the Contractor, Designer and UNC-CH, the change order shall be processed for signatures electronically through the State Construction Office (SCO) web-based Interscope program. Directions for using Interscope shall be provided at the Pre-construction Conference.
 4. If for whatever reason Interscope cannot be used for processing change orders, change orders shall be processed in hard copy format in accordance with General Condition Article 19 – Changes in the Work. The change order shall contain a brief description of the work on the 1st page of the SCO form and again on the second sheet of the form under “DESCRIPTION OF CHANGE”. On the second sheet there shall also be a brief description of the reason for the change along with a cause code listed. Each item totaled on the Contractor’s summary sheet shall be separated in the back up documentation by a colored sheet of paper. 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 UNC-CH for signature. UNC-CH shall execute the change order and forward to the State Construction Office for final approval. The State Construction Office shall review and upon approval execute the change order and keep one copy. The remaining copies are sent to the designer for distribution to UNC-CH (two copies with original signatures) and to the Contractor (two copies). The Contractor shall forward a copy to his Surety. In the case of an emergency or extenuating circumstances, the approval of the changes may be obtained verbally by telephone or field order approved by all parties.
 5. The Contractor shall also provide HUB utilization information on UNC-CH’s Hub Utilization form.
 6. Failure by the Contractor to provide the information requested in this paragraph shall result in rejection of the change order by the designer and a request for re-submittal. Delay in the processing of the change order due to lack of proper submittal by the Contractor in accordance with this paragraph or due to errors in the change order calculations shall not constitute grounds for a time extension or basis for a claim.
- N. Time extensions due to Weather - A rain day is defined as any day that rain exceeds one tenth of one inch (0.1"). The Contractor may only be entitled to extension of the contract period for the number of rain days that exceed the normal number of rain days for any given month. For the purpose of determining extent of delay attributable to unusual weather, a determination shall be made by comparing the weather for the contract period with the preceding five (5) year climatic range average during the same time interval based on statistics kept at UNC-CH's Marine, Earth and Atmospheric Sciences department located on UNC-CH's campus and on daily weather logs kept on the jobsite by the Contractor, reflecting the effect of the weather on progress of the work and initialed by the designer’s representative. Time extensions for weather delays do not

entitle the Contractor to “extended overhead” recovery and are in all other ways non-compensable.

Notwithstanding the immediately preceding paragraph, not all rain days above the normal number of rain days will warrant a contract time extension. Justification for the request for rain related contract time extensions must also be based on the effect of the rain on critical path work activity in progress during the period of the request and additionally be predicated on the Contractor’s diligent prosecution of the work. No additional rain days shall be granted for building projects after the building has been “dried-in” as determined by the designer. The contract time extension request must incorporate work logs kept at the jobsite by the project superintendent showing the effect of the weather on the progress of the critical path work and the critical path schedule, both initialed by the designer’s project representative.

Requests for contract time extensions based on rain days must be received by the designer on or before the 20th day of the month immediately following the month in which the rain occurred. The request must include all required documentation. All parties to this contract agree that the Contractor has no right to claim a contract time extension if the request is not received by the designer in strict accordance with the procedure set forth in this paragraph.

For other types of weather delays, the Contractor is granted one (1) day of contract extension for each day UNC-CH is closed due to weather.

O. Final Inspection and Acceptance

1. In addition to all other contract inspection requirements, the following items shall be completed prior to scheduling a final inspection:
 - a) Training of UNC-CH's Facilities Operations personnel shall be conducted with approved Operation and Maintenance Manuals (O&M's) provided at the training sessions.
 - b) Deliver to UNC-CH one copy of all approved shop drawings (submittals) for the project.

P. Request for Payment – In addition to General Conditions Article 31 – Requests for Payments, Contractor payment applications shall have the following information clearly shown on the front page: UNC-CH project number, Code & Item, State Construction Office Project Identification Number. No payment may be made for stored materials that are not stored within the project limits or on property owned by the State of North Carolina. Exception may be considered for material stored in a third-party, bonded warehouse with all appropriate documentation provided to UNC-CH. Designer must verify that material is stored in a bonded warehouse and that the stored material is identified as UNC-CH property. No payment shall be certified/approved by the Designer and forwarded to UNC-CH for payment if not accompanied by the following:

1. A letter from the surety company consenting to the progress payment in the amount requested. The amount of the payment shall be shown on the letter.
2. A completed sales tax statement and form.
3. MBE Appendix “E” Form with accurate subcontract amounts and amounts paid.

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4. UNC-CH project code, item number, project number and the State Construction Office ID number on the 1st sheet.
5. Pay applications without the information listed shown shall be considered incomplete and cannot be approved.
6. "Schedule of values" shall include payment line items for various commissioning activities.

No final payment shall be approved by the Designer and/or forwarded to UNC-CH if not accompanied by the following:

7. Certificate of Compliance signed by the Designer of Record.
8. Certificate of Completion signed by the Designer of Record.
9. Completed Tax Statement and Form.
10. Consent of Surety for Final Payment.
11. Contractor's Affidavit of Payment of Debts and Claims.
12. Contractor's Affidavit for Release of Liens.
13. Contractor's General Guarantee.
14. Contractor's statement of any special or extended warranties.
15. MBE Appendix "E" Form with accurate subcontract amounts and amounts paid.

* UNC-CH shall have 30 days from the time that correct and complete payment requests are received to pay the Contractor.

END OF SECTION

SECTION 01 10 00 – SUMMARY OF WORK

PART 1 - GENERAL

1.1 SUMMARY

- A. This Section includes the following:
1. Work covered by the Contract Documents.
 2. Work phases.
 3. Work under other contracts.
 4. Use of premises.
 5. Owner's occupancy requirements.
 6. Specification conventions.

1.2 WORK COVERED BY CONTRACT DOCUMENTS

- A. Project Identification: **University of North Carolina Chapel Hill – Coastal Process Environmental Health Lab.**
1. SCO ID: **23-26296-01A**
 2. UNC-CH Project No: **CIP-21432**
 3. Project Location: **University of North Carolina at Chapel Hill, Institute of Marine Science, 3431 Arsenal Street, Morehead City, NC 28557**
- B. Owner: **University of North Carolina at Chapel Hill**
- C. Owner's Representative:
1. **Joel Witherow – UNC-CH Construction Management Office**
- D. Engineer (Prime Designer): **McKim & Creed, 1730 Varsity Drive, Suite 500, Raleigh, N.C. 27606**
- E. Project will be constructed under a single prime contract. The contract shall be a licensed general contractor.
- F. The Work of the Project is defined by the Contract Documents.

1.3 USE OF PREMISES

- A. General: Contractor shall have limited use of premises for construction operations as indicated on Drawings and Specifications.
- B. Use of Site: Limit use of premises to areas within the Contract limits indicated. Do not disturb portions of Project site beyond areas in which the Work is indicated.

1. Owner Occupancy: Allow for Owner occupancy of Project site and use by the public as directed.
2. Driveways and Entrances: Keep driveways, streets, 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 storage of materials.
 - a. Schedule deliveries to minimize use of driveways and entrances.
 - b. Schedule deliveries to minimize space and time requirements for storage of materials and equipment on-site.

1.4 OWNER'S OCCUPANCY REQUIREMENTS

- A. Full Owner Occupancy: Owner will occupy site and existing, adjacent buildings 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.
 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.

1.5 SPECIFICATION FORMATS AND 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. Abbreviated Language: Language used in the Specifications and other Contract Documents is abbreviated. Words and meanings shall be interpreted as appropriate. Words implied, but not stated, shall be inferred as the sense requires. Singular words shall be interpreted as plural, and plural words shall be interpreted as singular where applicable as the context of the Contract Documents indicates.
 2. Imperative mood and streamlined language are generally used in the Specifications. Requirements expressed in the imperative mood are to be performed by Contractor. Occasionally, the indicative or subjunctive mood may be used in the Section Text for clarity to describe responsibilities that must be fulfilled indirectly by Contractor or by others when so noted.
 - a. 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.

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PART 2 - PRODUCTS (Not Used)

PART 3 - EXECUTION (Not Used)

END OF SECTION

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SECTION 01 23 00 - ALTERNATES

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division-1 specification sections, apply to work of this section.

1.2 SUMMARY

This section specifies administrative and procedural requirements for Alternates.

- A. GENERAL NOTE: The drawings generally indicate the work which will be included if the alternate bids are accepted. These portions of the work described in the alternates will not be included in the base bid.
- B. Definition: An Alternate is an amount proposed by Bidders and stated on the Bid form for certain construction activities defined in the Bidding Requirements that may be added to the Base bid amount if the Owner decides to accept a corresponding change in either the amount of construction to be completed, or in the products, materials, equipment, systems or installation methods described in Contract Documents.
- C. Coordination: Coordinate related Work and modify or adjust adjacent work as necessary to ensure that Work affected by each accepted alternate is complete and fully integrated into the project.
- D. Notification: Immediately following the award of the Contract, prepare and distribute to each party involved notification of the status of each alternate. Indicate whether alternates have been accepted, rejected, modified or deferred for consideration at a later date. Include a complete description of negotiated modifications to alternates and other contract documents. Record this information on the project set of drawings in the job site construction trailer.
- E. Schedule: A "Schedule of Alternates" is included at the end of this Section. Specification Sections referenced in the Schedule contain requirements for materials and methods necessary to achieve the Work described under each alternate.
- a. Include as part of each Alternate, miscellaneous devices, accessory objects and similar items incidental to or required for a complete installation whether or not mentioned as part of the alternate.

PART 2 - PRODUCTS

See PART 3.

PART 3 - EXECUTION

SCHEDULE OF ALTERNATES

Preferred Brand Alternates

Alternate #M-01: Provide Annexair Biocomposite as manufacturer for AHU-1

Alternate #M-02A: Furnish and install a BACnet based building automation system by Johnson Controls Incorporated (JCI).

Alternate #M-02B: Furnish and install a BACnet based building automation system by Schneider Electric (SE).

Alternate #M-02C: Furnish and install a BACnet based building automation system by Siemens.

Other Alternates:

Alternate No. E-01: Electrical feeder from 'MSB' to 'ATS-EM1'.

Alternate No. E-02: Electrical feeder from 'MSB' to 'Elevator'.

Alternate No. E-03: Electrical feeder from 'MSB' to 'PD & LG'.

Alternate No. E-04: Electrical feeder from 'MSB' to 'Chiller'.

Alternate No. E-05: Electrical feeder from 'MSB' to 'L1A'.

Alternate No. E-06: Electrical feeder from 'MSB' to 'L2A'.

Alternate No. E-08A: Provide new electrical service from utility transformer to panel 'MSB' per drawings E1.1 and E3.2.

Alternate No. E-08B: Same as Alternate E-08A except provide service entrance rated enclosed circuit breaker in NEMA 4X stainless steel enclosure in lieu of fused disconnect.

Alternate No. E-09A: Provide new electrical service from utility transformer to panel 'MSB' per drawings E1.2 and E3.3.

Alternate No. E-09B: Same as Alternate E-08A except provide service entrance rated enclosed circuit breaker in NEMA 4X stainless steel enclosure in lieu of fused disconnect.

END OF SECTION

SECTION 013300 - SUBMITTAL PROCEDURES

PART 1 - GENERAL

1.1 SUMMARY

- A. Section includes requirements for the submittal schedule and administrative and procedural requirements for submitting Shop Drawings, Product Data, Samples, and other submittals.
- B. Related Requirements:
 - 1. Section 017823 "Operation and Maintenance Data" for submitting operation and maintenance manuals.
 - 2. Section 017839 "Project Record Document" for submitting record drawings and record specifications and record product data.

1.2 SUBMITTAL REQUIREMENTS

- A. Shop Drawings:
 - 1. Prepare drawings in a clear and thorough manner.
 - 2. Identify details by reference to sheet and detail, schedule or room numbers on the Contract Drawings.
- B. Product Data:
 - 1. Preparation:
 - a. Clearly mark each copy to identify pertinent products or models.
 - b. Show performance characteristics and capacities.
 - c. Show dimensions and clearances required.
 - d. Show wiring diagrams and controls where applicable.
 - 2. Manufacturer's standard schematic drawings and diagrams:
 - a. Delete information from drawings and diagrams which is not applicable to the Work.
 - b. Supplement standard information to provide information specific to the Work.
- C. Samples: Provide samples of sufficient size and quantity to clearly illustrate:
 - 1. Functional characteristics of the product, with integrally related parts and attachment devices.
 - 2. Full range of color, texture and pattern.

1.3 SUBMISSION REQUIREMENTS

- A. Make submittals promptly in accordance with approved schedule, and in such sequence as to cause no delay in the Work.
- B. Number of submittals required:
 - 1. Shop Drawings: Submit one (1) electronic copy of each shop drawing or similar document. Submit one additional copy of Shop Drawings that require review by Architect's consultants.
 - 2. Product Data: Submit one (1) electronic copy. Submit additional copies on Products that require review by Architect's consultants.

3. Material Samples: Unless otherwise specified, submit physical copy in triplicate.

C. Submittal Contents:

1. The date of submission and the dates of any previous submissions.
2. The Project title and number.
3. Contract identification.
4. The names of:
 - a. Supplier/Subcontractor
 - b. Manufacturer
5. Identification of the product, with the specification section number.
6. Clearly identify field dimensions.
7. Relation to adjacent or critical features of the Work or materials.
8. Applicable standards, such as ASTM or Federal Specification Numbers.
9. Identification of deviations from Contract Documents.
10. Identification of revisions on resubmittals.
11. Contractor's stamp, initialed or signed, certifying his review of submittal in accordance with requirements of the General Conditions.

PART 2 - PRODUCTS (Not Used)

PART 3 - EXECUTION

3.1 SUBMITTAL PROCEDURES

- A. General Submittal Procedure Requirements: Prepare and submit submittals required by individual Specification Sections. Types of submittals are indicated in individual Specification Sections.

3.2 ENGINEER/ARCHITECT ACTION

- A. The Engineer or Architect will stamp each submittal to be returned with a uniform, self-explanatory action stamp, appropriately marked and executed to indicate the status of the submittal.
- B. The Engineer or Architect will endeavor to take action and process submittals with reasonable speed so as not to delay the progress of the work. However, the Contractor shall allow sufficient time for handling for proper review and resubmittal, if required.

3.3 RESUBMISSION REQUIREMENTS

- A. Make any corrections or changes in the submittals required by the Engineer or Architect and re-submit, as specified for initial submittals, until approved.

3.4 DISTRIBUTION

- A. Distribute approved reproductions of Shop Drawings and copies of Product Data to:
 1. Job Site
 2. Affected Trade Contractors
 3. Consultant, when applicable.

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- B. Copy all transmittals to Owner's Representative.

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.

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 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 specific manufacturer's product is named and accompanied by the words "basis-of-design product," including make or model number or other designation, to establish the significant qualities related to type, function, dimension, in-service performance, physical properties, appearance, and other characteristics for purposes of evaluating comparable products of additional manufacturers named in the specification.

1.3 ACTION SUBMITTALS

- A. Comparable Product Requests: Submit request for consideration of each comparable product. Identify 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 one week 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 seven days of receipt of additional information or documentation, whichever is later.
 - a. Form of Approval: 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.
7. Provide a secure location and enclosure at Project site for storage of materials and equipment by Owner's construction forces. Coordinate location with Owner.

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.

- C. Submittal Time: Comply with requirements in Section 017700 "Closeout Procedures."

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 not in conflict with 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.
 - 6. Or Equal: For products specified by name and accompanied by the term "or equal," or "or approved equal," or "or approved," comply with requirements in "Comparable Products" Article to obtain approval for use of an unnamed product.

- B. Product Selection Procedures:
 - 1. 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.
 - 2. 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.
 - 3. Products:
 - a. Restricted List: 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 not be considered unless otherwise indicated.
 - b. Nonrestricted List: Where Specifications include a list of names of both available manufacturers and products, provide one of the products listed, or an unnamed product, that complies with requirements. Comply with requirements in "Comparable Products" Article for consideration of an unnamed product.

4. Manufacturers:
 - a. Restricted List: 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 not be considered unless otherwise indicated.
 - b. Nonrestricted List: Where Specifications include a list of available manufacturers, provide a product by one of the manufacturers listed, or a product by an unnamed manufacturer, that complies with requirements. Comply with requirements in "Comparable Products" Article for consideration of an unnamed manufacturer's product.
 5. 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.
- 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 of the Contract Documents concerning "substitutions" for proposal of comparable 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: 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 the proposed product does not require revisions to the Contract Documents, that it is consistent with the Contract Documents and will produce the indicated results, and that it is compatible with other portions of the Work.
 2. Detailed comparison of significant qualities of proposed product with those named in the Specifications. Significant qualities include attributes such as performance, weight, size, durability, visual effect, and specific features and requirements indicated.
 3. Evidence that proposed product provides specified warranty.
 4. List of similar installations for completed projects with project names and addresses and names and addresses of architects and owners, if requested.
 5. Samples, if requested.

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PART 3 - EXECUTION (Not Used)

END OF SECTION 016000

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. Final cleaning.
 - 2. Repair of the Work.

1.2 ACTION SUBMITTALS

- A. Product Data: For cleaning agents.

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 MAINTENANCE MATERIAL SUBMITTALS

- A. Schedule of Maintenance Material Items: For maintenance material submittal items specified in other Sections.

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. Construction Waste Disposal: Comply with waste disposal requirements in compliance with local requirements.

3.2 REPAIR OF THE WORK

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

- B. Repair or remove and replace damaged construction. Repairing includes 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.
 - 1. Remove and replace chipped, scratched, and broken glass, reflective surfaces, and other damaged transparent materials.
 - 2. Touch up and otherwise repair and restore marred or exposed finishes and surfaces. Replace finishes and surfaces that already show evidence of repair or restoration.
 - a. Do not paint over "UL" and other required labels and identification, including mechanical and electrical nameplates. Remove paint applied to required labels and identification.
 - 3. Replace parts subject to operating conditions during construction that may impede operation or reduce longevity.
 - 4. Replace burned-out bulbs, bulbs noticeably dimmed by hours of use, and defective and noisy starters in fluorescent and mercury vapor fixtures to comply with requirements for new fixtures.

END OF SECTION 017700

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.
 - 2. Emergency manuals.
 - 3. Operation manuals for systems, subsystems, and equipment.
 - 4. Product maintenance manuals.
 - 5. Systems and equipment maintenance manuals.
- B. Related Requirements:
 - 1. Section 013300 "Submittal Procedures" for submitting copies of submittals for operation and maintenance manuals.

1.2 DEFINITIONS

- A. System: An organized collection of parts, equipment, or subsystems united by regular interaction.
- B. Subsystem: A portion of a system with characteristics similar to a system.

1.3 CLOSEOUT SUBMITTALS

- A. Manual Content: Operations and maintenance manual content is specified in individual Specification Sections to be reviewed at the time of Section submittals. Submit reviewed manual content formatted and organized as required by this Section.
 - 1. Architect will comment on whether content of operations and maintenance submittals are acceptable.
 - 2. Where applicable, clarify and update reviewed manual content to correspond to revisions and field conditions.
- B. Format: Submit operations and maintenance manuals in the following format:
 - 1. PDF electronic file. Assemble each manual into a composite electronically indexed file. Submit on digital media acceptable to Architect.
 - a. Name each indexed document file in composite electronic index with applicable item name. Include a complete electronically linked operation and maintenance directory.
 - b. Enable inserted reviewer comments on draft submittals.
 - 2. Four paper copies. Include a complete operation and maintenance directory. Enclose title pages and directories in clear plastic sleeves.
- C. Initial Manual Submittal: Submit draft copy of each manual at least 30 days before commencing demonstration and training. Architect will comment on whether general scope and content of manual are acceptable.

- D. Final Manual Submittal: Submit each manual in final form prior to requesting inspection for Substantial Completion and at least days before commencing demonstration and training. Architect will return copy with comments.
 - 1. Correct or revise each manual to comply with Architect's comments. Submit copies of each corrected manual within 15 days of receipt of Architect's comments and prior to commencing demonstration and training.

PART 2 - PRODUCTS

2.1 OPERATION AND MAINTENANCE DOCUMENTATION DIRECTORY

- A. Directory: Prepare a single, comprehensive directory of emergency, operation, and maintenance data and materials, listing items and their location to facilitate ready access to desired information. Include a section in the directory for each of the following:
 - 1. List of documents.
 - 2. List of systems.
 - 3. List of equipment.
 - 4. Table of contents.
- B. List of Systems and Subsystems: List systems alphabetically. Include references to operation and maintenance manuals that contain information about each system.
- C. List of Equipment: List equipment for each system, organized alphabetically by system. For pieces of equipment not part of system, list alphabetically in separate list.
- D. Tables of Contents: Include a table of contents for each emergency, operation, and maintenance manual.
- E. Identification: In the documentation directory and in each operation and maintenance manual, identify each system, subsystem, and piece of equipment with same designation used in the Contract Documents. If no designation exists, assign a designation according to ASHRAE Guideline 4, "Preparation of Operating and Maintenance Documentation for Building Systems."

2.2 REQUIREMENTS FOR EMERGENCY, OPERATION, AND MAINTENANCE MANUALS

- A. Organization: Unless otherwise indicated, organize each manual into a separate section for each system and subsystem, and a separate section for each piece of equipment not part of a system. Each manual shall contain the following materials, in the order listed:
 - 1. Title page.
 - 2. Table of contents.
 - 3. Manual contents.
- B. Title Page: Include the following information:
 - 1. Subject matter included in manual.
 - 2. Name and address of Project.
 - 3. Name and address of Owner.
 - 4. Date of submittal.
 - 5. Name and contact information for Contractor.
 - 6. Name and contact information for Architect.

7. Names and contact information for major consultants to the Architect that designed the systems contained in the manuals.
 8. Cross-reference to related systems in other operation and maintenance manuals.
- C. Table of Contents: List each product included in manual, identified by product name, indexed to the content of the volume, and cross-referenced to Specification Section number in Project Manual.
1. If operation or maintenance documentation requires more than one volume to accommodate data, include comprehensive table of contents for all volumes in each volume of the set.
- D. Manual Contents: Organize into sets of manageable size. Arrange contents alphabetically by system, subsystem, and equipment. If possible, assemble instructions for subsystems, equipment, and components of one system into a single binder.
- E. Manuals, Electronic Files: Submit manuals in the form of a multiple file composite electronic PDF file for each manual type required.
1. Electronic Files: Use electronic files prepared by manufacturer where available. Where scanning of paper documents is required, configure scanned file for minimum readable file size.
 2. File Names and Bookmarks: Enable bookmarking of individual documents based on file names. Name document files to correspond to system, subsystem, and equipment names used in manual directory and table of contents. Group documents for each system and subsystem into individual composite bookmarked files, then create composite manual, so that resulting bookmarks reflect the system, subsystem, and equipment names in a readily navigated file tree. Configure electronic manual to display bookmark panel on opening file.
- F. Manuals, Paper Copy: Submit manuals in the form of hard copy, bound and labeled volumes.
1. Binders: Heavy-duty, three-ring, vinyl-covered, loose-leaf binders, in thickness necessary to accommodate contents, sized to hold 8-1/2-by-11-inch paper; with clear plastic sleeve on spine to hold label describing contents and with pockets inside covers to hold folded oversize sheets.
 - a. If two or more binders are necessary to accommodate data of a system, organize data in each binder into groupings by subsystem and related components. Cross-reference other binders if necessary to provide essential information for proper operation or maintenance of equipment or system.
 - b. Identify each binder on front and spine, with printed title "OPERATION AND MAINTENANCE MANUAL," Project title or name, and subject matter of contents. Indicate volume number for multiple-volume sets.
 2. Dividers: Heavy-paper dividers with plastic-covered tabs for each section of the manual. Mark each tab to indicate contents. Include typed list of products and major components of equipment included in the section on each divider, cross-referenced to Specification Section number and title of Project Manual.
 3. Protective Plastic Sleeves: Transparent plastic sleeves designed to enclose diagnostic software storage media for computerized electronic equipment.
 4. Supplementary Text: Prepared on 8-1/2-by-11-inch white bond paper.
 5. Drawings: Attach reinforced, punched binder tabs on drawings and bind with text.
 - a. If oversize drawings are necessary, fold drawings to same size as text pages and use as foldouts.

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

2.3 EMERGENCY MANUALS

- A. Content: Organize manual into a separate section for each of the following:
 1. Type of emergency.
 2. Emergency instructions.
 3. Emergency procedures.
- B. 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.
- C. 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.
- D. 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.

2.4 OPERATION MANUALS

- A. Content: In addition to requirements in this Section, include operation data required in individual Specification Sections and the following information:
 1. System, subsystem, and equipment descriptions. Use designations for systems and equipment indicated on Contract Documents.
 2. Performance and design criteria if Contractor has delegated design responsibility.
 3. Operating standards.
 4. Operating procedures.
 5. Operating logs.
 6. Wiring diagrams.
 7. Control diagrams.
 8. Piped system diagrams.
 9. Precautions against improper use.
 10. License requirements including inspection and renewal dates.

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

- C. Operating Procedures: Include the following, as applicable:
 - 1. Startup procedures.
 - 2. Equipment or system break-in procedures.
 - 3. Routine and normal operating instructions.
 - 4. Regulation and control procedures.
 - 5. Instructions on stopping.
 - 6. Normal shutdown instructions.
 - 7. Seasonal and weekend operating instructions.
 - 8. Required sequences for electric or electronic systems.
 - 9. Special operating instructions and procedures.

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

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

2.5 PRODUCT MAINTENANCE MANUALS

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

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

- C. Product Information: Include the following, as applicable:
 - 1. Product name and model number.
 - 2. Manufacturer's name.
 - 3. Color, pattern, and texture.
 - 4. Material and chemical composition.
 - 5. Reordering information for specially manufactured products.

- D. Maintenance Procedures: Include manufacturer's written recommendations and the following:
 - 1. Inspection procedures.

2. Types of cleaning agents to be used and methods of cleaning.
 3. List of cleaning agents and methods of cleaning detrimental to product.
 4. Schedule for routine cleaning and maintenance.
 5. Repair instructions.
- E. Repair Materials and Sources: Include lists of materials and local sources of materials and related services.
- F. Warranties and Bonds: Include copies of warranties and bonds and lists of circumstances and conditions that would affect validity of warranties or bonds.
1. Include procedures to follow and required notifications for warranty claims.

2.6 SYSTEMS AND EQUIPMENT MAINTENANCE MANUALS

- A. Content: For each system, subsystem, and piece of equipment not part of a system, include source information, manufacturers' maintenance documentation, maintenance procedures, maintenance and service schedules, spare parts list and source information, maintenance service contracts, and warranty and bond information, as described below.
- B. Source Information: List each system, subsystem, and piece of equipment included in manual, identified by product name and arranged to match manual's table of contents. For each product, list name, address, and telephone number of Installer or supplier and maintenance service agent, and cross-reference Specification Section number and title in Project Manual and drawing or schedule designation or identifier where applicable.
- C. Manufacturers' Maintenance Documentation: Manufacturers' maintenance documentation including the following information for each component part or piece of equipment:
1. Standard maintenance instructions and bulletins.
 2. Drawings, diagrams, and instructions required for maintenance, including disassembly and component removal, replacement, and assembly.
 3. Identification and nomenclature of parts and components.
 4. List of items recommended to be stocked as spare parts.
- D. Maintenance Procedures: Include the following information and items that detail essential maintenance procedures:
1. Test and inspection instructions.
 2. Troubleshooting guide.
 3. Precautions against improper maintenance.
 4. Disassembly; component removal, repair, and replacement; and reassembly instructions.
 5. Aligning, adjusting, and checking instructions.
 6. Demonstration and training video recording, if available.
- E. Maintenance and Service Schedules: Include service and lubrication requirements, list of required lubricants for equipment, and separate schedules for preventive and routine maintenance and service with standard time allotment.
1. Scheduled Maintenance and Service: Tabulate actions for daily, weekly, monthly, quarterly, semiannual, and annual frequencies.
 2. Maintenance and Service Record: Include manufacturers' forms for recording maintenance.

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- F. Spare Parts List and Source Information: Include lists of replacement and repair parts, with parts identified and cross-referenced to manufacturers' maintenance documentation and local sources of maintenance materials and related services.
- G. Maintenance Service Contracts: Include copies of maintenance agreements with name and telephone number of service agent.
- H. Warranties and Bonds: Include copies of warranties and bonds and lists of circumstances and conditions that would affect validity of warranties or bonds.
 - 1. Include procedures to follow and required notifications for warranty claims.

PART 3 - EXECUTION

3.1 MANUAL PREPARATION

- A. Operation and Maintenance Documentation Directory: Prepare a separate manual that provides an organized reference to emergency, operation, and maintenance manuals.
- B. Emergency Manual: Assemble a complete set of emergency information indicating procedures for use by emergency personnel and by Owner's operating personnel for types of emergencies indicated.
- C. Product Maintenance Manual: Assemble a complete set of maintenance data indicating care and maintenance of each product, material, and finish incorporated into the Work.
- D. Operation and Maintenance Manuals: Assemble a complete set of operation and maintenance data indicating operation and maintenance of each system, subsystem, and piece of equipment not part of a system.
 - 1. Engage a factory-authorized service representative to assemble and prepare information for each system, subsystem, and piece of equipment not part of a system.
 - 2. Prepare a separate manual for each system and subsystem, in the form of an instructional manual for use by Owner's operating personnel.
- E. Manufacturers' Data: Where manuals contain manufacturers' standard printed data, include only sheets pertinent to product or component installed. Mark each sheet to identify each product or component incorporated into the Work. If data include more than one item in a tabular format, identify each item using appropriate references from the Contract Documents. Identify data applicable to the Work and delete references to information not applicable.
 - 1. Prepare supplementary text if manufacturers' standard printed data are not available and where the information is necessary for proper operation and maintenance of equipment or systems.
- F. Drawings: Prepare drawings supplementing manufacturers' printed data to illustrate the relationship of component parts of equipment and systems and to illustrate control sequence and flow diagrams. Coordinate these drawings with information contained in record Drawings to ensure correct illustration of completed installation.
 - 1. Do not use original project record documents as part of operation and maintenance manuals.
 - 2. Comply with requirements of newly prepared record Drawings in Section 017839 "Project Record Documents."

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

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.
 - 4. Miscellaneous record submittals.
- B. Related Requirements:
 - 1. Section 017700 "Closeout Procedures" for general closeout procedures.
 - 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 three sets of marked-up record prints.
- B. Record Specifications: Submit three paper copies of Project's Specifications, including addenda and contract modifications.
- C. Record Product Data: Submit one paper copy 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.

PART 2 - PRODUCTS

2.1 RECORD DRAWINGS

- A. Record Prints: Maintain one set of marked-up paper copies of the Contract Drawings and Shop Drawings, incorporating new and revised drawings as modifications are issued.
 - 1. Preparation: Mark record prints to show the actual installation where installation varies from that shown originally. Require individual or entity who obtained record data, whether individual or entity is Installer, subcontractor, or similar entity, to provide information for preparation of corresponding marked-up record prints.
 - a. Give particular attention to information on concealed elements that would be difficult to identify or measure and record later.
 - b. Accurately record information in an acceptable drawing technique.
 - c. Record data as soon as possible after obtaining it.
 - d. Record and check the markup before enclosing concealed installations.
 - 2. 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. Revisions to routing of piping and conduits.
 - d. Revisions to electrical circuitry.
 - e. Actual equipment locations.
 - f. Duct size and routing.
 - g. Locations of concealed internal utilities.
 - h. Changes made by Change Order or Construction Change Directive.
 - i. Changes made following Architect's written orders.
 - j. Details not on the original Contract Drawings.
 - k. Field records for variable and concealed conditions.
 - l. 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. Format: Identify and date each record Drawing; include the designation "PROJECT RECORD DRAWING" in a prominent location.
1. Record Prints: Organize record prints and newly prepared record Drawings into manageable sets. Bind each set with durable paper cover sheets. Include identification on cover sheets.
 2. Identification: As follows:
 - a. Project name.
 - b. Date.
 - c. Designation "PROJECT RECORD DRAWINGS."
 - d. Name of Architect.
 - e. Name of Contractor.

2.2 RECORD SPECIFICATIONS

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

2.3 RECORD PRODUCT DATA

- A. 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.
- B. Format: Submit record Product Data as paper copy.
 - 1. Include record Product Data directory organized by Specification Section number and title, electronically linked to each item of record Product Data.

2.4 MISCELLANEOUS RECORD SUBMITTALS

- A. Assemble miscellaneous records required by other Specification Sections for miscellaneous record keeping and submittal in connection with actual performance of the Work. Bind or file miscellaneous records and identify each, ready for continued use and reference.

PART 3 - EXECUTION

3.1 RECORDING AND MAINTENANCE

- A. Recording: Maintain one copy of each submittal during the construction period for project record document purposes. Post changes and revisions to project record documents as they occur; do not wait until end of Project.
- B. Maintenance of Record Documents and Samples: Store record documents and Samples in the field office apart from the Contract Documents used for construction. Do not use project record documents for construction purposes. Maintain record documents in good order and in a clean, dry, legible condition, protected from deterioration and loss. Provide access to project record documents for Architect's reference during normal working hours.

END OF SECTION 017839

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SECTION 23 01 00 - 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 LEED PROJECT REQUIREMENTS

- A. This is a LEED certified project. Refer to specification section 01 10 10 Sustainable Design Requirements for additional information and contractor responsibilities.

3.2 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.

3.3 INSTALLATION

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

3.4 COMMISSIONING REQUIREMENTS

- A. This project will require commissioning support from the contractor to verify control sequences and test and balance data (include minimum of 5 days for controls technician and test and balance technician support; refer to specification 23 08 01-BAS SYSTEM COMMISSIONING for additional information).

3.5 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.

3.6 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.

3.7 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.

3.8 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.

3.9 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.

3.10 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

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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

3.11 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.

3.12 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.

3.13 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.

3.14 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.

3.15 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.

3.16 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.

3.17 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 23 01 00

SECTION 23 02 00 - 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 23 07 00, 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

Not Used

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 Costing: Cost 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.

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- 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 23 02 00

SECTION 23 03 00 - 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.

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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 23 03 00

SECTION 23 05 00 - 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 23 05 00

SECTION 23 05 13 – VARIABLE 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. Schneider
- B. ABB
- C. Danfoss

2.2 EQUIPMENT REQUIREMENTS

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- 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 2014 (or most recent version) 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						
Iso/IL	Individual Harmonic Order (Odd Harmonics)					TDD
	<11	11 ≤ sn <17	17 ≤ sn <23	23 ≤ sn <35	35 <sn	
<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:

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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.

D. VFD to Motor Wiring

1. Intent of the VFD to Motoring Wiring Standard is:
 - a. Load side wiring shall be shielded.
 - b. Load side wiring shall resist corona discharge.
 - c. Low impedance grounding shall be provided for conducting high frequency ground currents that commonly occur in load-side VFD wiring.
 - d. Load side wiring shall not induce currents in instrumentation wiring.
 - e. Special inspections are required for load-side wiring.
 - f. Two grounding systems shall be provided.
2. Acceptable load-side wiring:
 - a. Individual conductors
 - b. Approved VFD cable
 - c. See below for requirements
3. Conductor insulation
 - a. The use of THHN wire is prohibited.
4. Shielding
 - a. The power conductors and primary ground conductors shall be encased in a continuous electrical shield.
 - b. The ends of the shielding system shall be grounded to the VFD ground bar and the motor conduit box.
 - c. Shielding shall be provided by either metallic raceway or shielded VFD cable.

- d. When utilizing metallic raceways as the shield, continuous shield continuity shall be provided between the terminations at each end. To maintain continuous continuity, raceway components shall be connected with grounding bushings, grounding straps or other wiring techniques.
 - e. Bonding of primary ground conductors to the shield system is prohibited except at the VFD ground bar and motor. Ground conductors shall not be bonded to load-side junction boxes.
5. Grounding
- a. Two separate grounds shall be provided.
 - 1) The primary ground is shielded (as described above) and is installed between the VFD ground bar and the motor ground termination. The shield is bonded to the ground at both ends.
 - 2) A secondary ground is required and will be installed to bond the motor frame or skid framing to the building ground system such the ground bar within a panel or building steel. When using the skid as the ground termination, the motor frame shall be bonded to the skid. The secondary ground system may daisy chain between multiple motors and skids.
 - b. The minimum size of the primary grounding conduction shall be the same size as the power conductors. For 25 hp and larger, the ground conductors shall be a minimum of 200% of the load conductors, i.e. two full size ground conductors or equivalent. For 40 hp and larger, the ground conductors shall be a minimum of 300% of the load conductors, i.e. three full size ground conductors or equivalent.
 - c. The primary ground conductors must not have intermediate connections to the shield system such as at junction boxes. (Note: if in doubt to what this means, inquire with Engineering Services)
6. VFD Cable:
- a. Cable shall have low capacitance and impedance design.
 - b. VFD cables shall be terminated per the manufacture's installation instructions.
 - c. Cables shall meet or exceed 600V UL 1277 Type TC-ER, 1000V UL 2277 Type WTTC, IEEE 1202.
 - d. VFD cable conductors shall be XHHW-2 or RHW-2 circuit conductors rated at 90 °C wet/dry.
 - e. Cables with armor such as stainless-steel braid, may be installed outside of a raceway, but cables installed in air plenums shall be enclosed in raceway or shall be plenum rated.
 - f. Basis of Design: Less than 40 hp - Belden Classic VFD Cable. Greater than 40 hp- Belden Symmetrical Classic VFD cable. Other brands may be considered.
 - g. VFD cable ground wires, drain wires, shielding and armor shall only be grounded at the VFD and the motor. Any of the above ground system must NOT be bonded to disconnects and will be isolated from disconnects with cable insulation, shrink wrap, or other approved means. (note - do not bond ground system to the shield system except at the ends)
 - h. Cables shall be equipped with a PVC or equivalent jacket. ix. VFD conductors shall be constructed from fine, tinned copper strands.
 - i. Cables with 2 AWG and smaller conductors shall be equipped with a braided armor and copper foil shield. Cables larger than 2 AWG shall have a minimum of copper foil shielding.
 - j. Specify round cable geometry for liquid tight connections.
7. Inspections:

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- a. Each contractor installing VFD to motor wiring shall schedule and conduct a special inspection for the (Engineer, Owner or CxA) to inspect a minimum of one, complete VFD to motor wiring installation.
 - b. The inspector will select the specific installation to be inspected.
 - c. The contractor shall make visible for inspection the terminations at the VFD, at the motor, at any intermediate junction boxes and the terminations of the secondary ground system. The contractor shall open devices as needed to complete the inspection.
 - d. For large projects, inspections shall be completed by the Engineer or the third part CxA.
- E. Startup, training, and warranties
1. Factory Start-up: Specify a factory certified start-up and certification. (The factory certified start-up extends the warranty for ABB brand drives). The VFD manufacturer shall provide a factory certified technical representative to inspect the contractor's installation, to test and start-up the VFD's and to provide a certification letter. The factory representative shall review the project requirements for VFDs (specifications and drawings) and shall document in the certification letter if the project requirements are fully met or shall identify any requirements that are not met. The certification letter shall describe and document the actual start-up, training, and certification effort.
 2. Training: A representative of the VFD manufacturer shall provide on-site training. For large projects, provide factory training in addition to on-site training. The owner has the option to or not to attend training.
 3. Warranty: The VFD and bypass warranty shall be 24 months minimum from the date of startup and shall cover parts, travel, labor, and shipping required for repair. The manufacturer shall provide factory direct warranty and support service.
 4. Accessories: Provide all required cables and copies of software required for adjustment of all user adjustable parameters. Provide one Installation and Operations Manual and wiring schematic per VFD at the time of training.

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 23 05 13

SECTION 23 05 29 - 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 B31.9 - Building Services Piping.
- C. ASTM F708 - Design and Installation of Rigid Pipe Hangers.
- D. MSS SP58 - Pipe Hangers and Supports - Materials, Design and Manufacturer.
- E. MSS SP69 - Pipe Hangers and Supports - Selection and Application.
- F. MSS SP89 - Pipe Hangers and Supports - Fabrication and Installation Practices.

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 Hot Pipe Sizes 2 to 4 Inches (50 to 100 mm): Carbon steel, adjustable, clevis.
 - 4. Hangers for Hot Pipe Sizes 6 Inches (150 mm) and Over: Adjustable steel yoke, cast iron roll, double hanger.
 - 5. Multiple or Trapeze Hangers: Steel channels with welded spacers and hanger rods.
 - 6. 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.
 - 7. Wall Support for Pipe Sizes to 3 Inches (76 mm): Cast iron hook.
 - 8. Wall Support for Pipe Sizes 4 Inches (100 mm) and Over: Welded steel bracket and wrought steel clamp.
 - 9. 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.
 - 10. Vertical Support: Steel riser clamp.
 - 11. Floor Support for Cold Pipe: Cast iron adjustable pipe saddle, lock nut, nipple, floor flange, and concrete pier or steel support.
 - 12. 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.
 - 13. 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.
 - 14. 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 23 05 29

SECTION 23 05 48 - VIBRATION ISOLATION

PART 1 - GENERAL

1.1 SECTION INCLUDES

- A. Provide vibration isolation as noted on plans for motor driven equipment over 3/4 HP, plus connected piping, and ductwork.
- B. Provide minimum static deflection of isolators for equipment as indicated.
 - 1. Under 20 hp (15 kw):
 - a. Under 400 rpm: 1 inch (25 mm).
 - b. 400 - 600 rpm: 1 inch (25 mm).
 - c. 600 - 800 rpm: 0.5 inch (12 mm).
 - d. 800 - 900 rpm: 0.2 inch (5 mm).
 - e. 1100 - 1500 rpm: 0.14 inch (4 mm).
 - f. Over 1500 rpm: 0.1 inch (3 mm).

PART 2 - PRODUCTS

2.1 VIBRATION ISOLATORS

- A. Open Spring Isolators:
 - 1. Spring Isolators:
 - a. For Exterior and Humid Areas: Provide hot dipped galvanized housings and neoprene coated springs.
 - b. Color code springs for load carrying capacity.
 - 2. Springs: Minimum horizontal stiffness equal to 75 percent vertical stiffness, with working deflection between 0.3 and 0.6 of maximum deflection.
 - 3. Spring Mounts: Provide with levelling devices, minimum 0.25-inch-thick neoprene sound pads, and zinc chromate plated hardware.
 - 4. Sound Pads: Size for minimum deflection of 0.05 inch; meet requirements for neoprene pad isolators.
- B. Restrained Spring Isolators:
 - 1. Spring Isolators:
 - a. For Exterior and Humid Areas: Provide hot dipped galvanized housings and neoprene coated springs.

- b. Color code springs for load carrying capacity.
 2. Springs: Minimum horizontal stiffness equal to 75 percent vertical stiffness, with working deflection between 0.3 and 0.6 of maximum deflection.
 3. Spring Mounts: Provide with levelling devices, minimum 0.25-inch-thick neoprene sound pads, and zinc chromate plated hardware.
 4. Sound Pads: Size for minimum deflection of 0.05 inch; meet requirements for neoprene pad isolators.
 5. Restraint: Provide heavy mounting frame and limit stops.
- C. Closed Spring Isolators:
 1. Spring Isolators:
 - a. For Exterior and Humid Areas: Provide hot dipped galvanized housings and neoprene coated springs.
 - b. Color code springs for load carrying capacity.
 2. Type: Closed spring mount with top and bottom housing separated with neoprene rubber stabilizers.
 3. Springs: Minimum horizontal stiffness equal to 75 percent vertical stiffness, with working deflection between 0.3 and 0.6 of maximum deflection.
 4. Housings: Incorporate neoprene isolation pad meeting requirements for neoprene pad isolators, and neoprene side stabilizers with minimum 0.25-inch clearance.
- D. Spring Hanger:
 1. Spring Isolators:
 - a. For Exterior and Humid Areas: Provide hot dipped galvanized housings and neoprene coated springs.
 - b. Color code springs for load carrying capacity.
 2. Springs: Minimum horizontal stiffness equal to 75 percent vertical stiffness, with working deflection between 0.3 and 0.6 of maximum deflection.
 3. Housings: Incorporate neoprene isolation pad meeting requirements for neoprene pad isolators.
 4. Capable of 20-degree hanger rod misalignment.
- E. Neoprene Pad Isolators:
 1. Rubber or neoprene waffle pads:
 - a. 30 durometer.
 - b. Minimum 1/2 inch thick.
 - c. Maximum loading 40 psi.
 - d. Height of ribs shall not exceed 0.7 times width.
 2. Rubber Mount or Hanger: Molded rubber designed for 0.5 inches deflection with threaded insert.

PART 3 - EXECUTION

3.1 INSTALLATION

- A. Install in accordance with manufacturer's instructions.
- B. Install isolation for motor driven equipment.
- C. Adjust equipment level.
- D. Install spring hangers without binding.
- E. On closed spring isolators, adjust so side stabilizers are clear under normal operating conditions.
- F. Prior to making piping connections to equipment with operating weights substantially different from installed weights, block up equipment with temporary shims to final height. When full load is applied, adjust isolators to load to allow shim removal.
- G. Provide pairs of horizontal limit springs on hanger supported horizontally mounted fans.
- H. Support piping connections to isolated equipment as follows:
 - 1. Up to 4 Inch (100 mm) Diameter: First three points of support.
 - 2. 5 to 8 Inch (125 to 200 mm) Diameter: First four points of support.
 - 3. 10-inch (250 mm) Diameter and Over: First six points of support.
 - 4. Select three hangers closest to vibration source for minimum 1.0 inch (25 mm) static deflection or static deflection of isolated equipment. Select remaining isolators for minimum 1.0 inch (25 mm) static deflection or 1/2 static deflection of isolated equipment.
- I. Connect wiring to isolated equipment with flexible hanging loop.

END OF SECTION 23 05 48

SECTION 23 05 53 - 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.

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- 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 23 05 53

SECTION 23 05 93 - TAB

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. Pumps.
2. Air Coils.
3. Air Handling System.
4. Airflow Measuring Stations.
5. Fans.
6. Air filters.

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:

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- 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. 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.

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- o. Air pressure drop, design and actual.
8. 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.
9. 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.
10. 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.

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11. 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.

12. 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.

13. 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.

END OF SECTION 23 05 93

SECTION 23 07 00 - 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.

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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 piping: 1-1/2" thick.
 - 2) Above 1-1/2-inch hot water piping: 2" 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.

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 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.

2.4 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:

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- 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 23 07 00

SECTION 23 08 01 - BAS SYSTEM COMMISSIONING

PART I. GENERAL

I.1 CONTRACTOR RESPONSIBILITIES

- A. Completely install and thoroughly inspect, startup, test, adjust, balance, and document all systems and equipment.
- B. Assist Commissioning Authority in verification and performance testing. This will generally include the following:
 1. Attend Commissioning (Cx) progress and coordination meetings, during functional testing, acceptance and punchlist close out. The number of meetings will vary depending on the complexity of the project.
 2. Prepare and submit required draft forms and systems information.
 3. Help establish trend logs of system operation as specified herein.
 4. Demonstrate system operation.
 5. Manipulate systems and equipment to facilitate testing.
 6. Provide instrumentation necessary for verification and performance testing.
 7. Manipulate control systems to facilitate verification and performance testing.
 8. Train Owner's Representatives as specified in Part III of this section.
- C. Compensation for Retesting: Contractor shall compensate Owner for site time necessitated by incompleteness of systems or equipment at time of functional performance testing. All testing failures, which require on-site time for retesting, will be considered actual damages to the Owner. All parties under contract with the Owner who are affected by the retesting shall be included in the contract modification.

PART II. EXECUTION

II.1 SYSTEMS TO BE COMMISSIONED

1. AHU-1 – Fisheries Building
2. Condenser Water system – bypass valve.

II.2 BAS START-UP TESTING, ADJUSTING, CALIBRATION

1. Tune all control loops to obtain the fastest stable response without hunting, offset or overshoot. Record tuning parameters and response test results for each control loop in the BAS Startup Report. Except from a startup, maximum allowable variance from set point for controlled variables under normal load fluctuations shall be as follows. Within 3 minutes of any upset (for which the system has the capability to respond) in the control loop, tolerances shall be maintained (exceptions noted):
 - a) Duct air temperature: $\pm 1^{\circ}F$.
 - b) Space Temperature: $\pm 2^{\circ}F$
 - c) Chilled Water: $\pm 1^{\circ}F$

- d) Hot water temperature: $\pm 3^{\circ}F$.
- e) Duct pressure: $\pm 0.25''$ w.g.
- f) Water pressure: ± 1 psid
- g) Duct or space Humidity: $\pm 5\%$
- h) Air flow control: $\pm 5\%$ of setpoint velocity.

- B. Submit Start-Up Test Report: Report shall be completed, submitted, and approved prior to Substantial Completion and the start of any Commissioning testing.

II.3 SENSOR CHECKOUT AND CALIBRATION

- A. General Checkout: Verify that all sensor locations are appropriate and are away from causes of erratic operation. Verify that sensors with shielded cable are grounded only at one end.
- B. Calibration: Calibrate all sensors using the following procedures:
 - 1. Sensors Standard Application: Make a reading with a calibrated test instrument within 6 inches of the site sensor at various points across the range. Verify that the sensor reading (via the permanent thermostat, gage or BAS) is within the tolerances specified for the sensor. If not, adjust offset and range, or replace sensor. Where sensors are subject to wide variations in the sensed variable, calibrate sensor within the highest and lowest 20% of the expected range.
- C. Sensor Tolerance: Sensors shall be within the tolerances specified for the device. Refer to Section 230901.

II.4 VALVE STROKE SETUP AND CHECK

- A. For all valve and actuator positions checked, verify the actual position against the Operator Interface readout at 0, 25, 50 75 and 100% position.

II.5 BAS DEMONSTRATION

- A. All BAS Demonstration for the owner shall take place from the BAS graphics prior to the start of commissioning & functional testing.
- B. Demonstrate the operation of the BAS hardware, software, and all related components and systems to the satisfaction of the Commissioning Authority and Owner. If the Work fails to be demonstrated to conform to the Contract specifications, so as to require scheduling of additional site visits by the Commissioning Authority & Owner for re-demonstration, Contractor shall reimburse Owner for costs of subsequent Commissioning Authority site visits.

II.6 BAS WARRANTY PHASE & OPPOSITE SEASON TRENDING AND TESTING:

- A. Opposite Season Testing: Within 12 months of completion of the Acceptance Phase, Commissioning Provider/Owner shall schedule and conduct Opposite Season functional performance testing. Contractor shall remedy any contractual deficiencies identified in the opposite season or warranty testing.

II.7 SOFTWARE OPTIMIZATION ASSISTANCE

- A. Provide a BAS Technician to work at the direction of Commissioning Authority for software optimization assistance for a minimum of 16 hours.
- B. The Contractor shall provide the services of a BAS Technician as specified to be at the disposal of the Commissioning Authority/Owner. The purpose of this requirement is to make changes, enhancements and additions to control unit and/or workstation software that have been identified by the Commissioning Authority/Owner during the construction and commissioning of the project and that are beyond the specified Contract requirements. The cost for this service shall be included with the bid. Requests for assistance shall be for contiguous or non-contiguous 8-hour days.
- C. The BAS Technician provided shall be thoroughly trained in the programming and operation of the controller. If the BAS Technician provided cannot perform every software task requested by the Commissioning Authority/Owner in a timely fashion, contractor shall provide additional qualified personnel at the project site as requested by the Commissioning Authority/Owner, to meet the total specified requirement on-site.

II.8 BAS OPERATOR TRAINING AND O&M MANUALS

- A. Provide up to 4 complete sets of the approved Operations and Maintenance (O&M) Manuals (hard copy and one electronic copy) to be used for training.
- B. Contractor shall submit a Training Plan. On-Site Training: Provide services of controls contractor's qualified technical personnel for one 8-hour day to instruct Owner's personnel in operation and maintenance of BAS. Instruction shall be in classroom setting at the project site for appropriate portions of the training.

END OF SECTION 230801

SECTION 23 09 00 - BUILDING AUTOMATION SYSTEM (BAS) GENERAL

PART 1. GENERAL

1.01 DESCRIPTION OF WORK

- A. Contractor shall furnish and install a direct digital control and building automation system (BAS). The new BAS shall utilize electronic sensing, microprocessor-based digital control, and electronic actuation of dampers, valves and devices to perform control sequences and functions specified. Refer also to control drawings, sequences of operation, and point lists.
- B. The HVAC distributed digital control (DDC) and building automation system (BAS) defined in these specifications shall furnish and install a complete system utilizing one of the following:
 - 1. A LON based Building Automation System (BAS) utilizing LonTalk ANSI 709.1 protocol for all mechanical systems and other facility systems as included in the project documents.
 - 2. Or, a BACnet based BAS utilizing ASHRAE 135 standard BACnet protocol. Towards this end, contractor shall provide all specified objects and services and have them configured/mapped as applicable.
- C. The BAS defined in these specifications shall interface with an existing approved BAS servers located at or operated by EMCS, Giles Horney Building. Reference also controls drawings, sequences of operation, and point lists.

1.02 PROCUREMENT

- A. The BAS and digital control and communications components installed, as work of this contract shall be an integrated distributed processing system of the following manufacturer. No other vendor's products will be considered as substitutions.
- B. Existing Building Controls
 - 1. The existing building controls are Siemens.
- C. Owner Preferred Alternates
 - 1. Alternate No. M-02A: furnish and install a BACnet based building automation system by Johnson Controls Incorporated (JCI).
 - 2. Alternate No. M-02B: furnish and install a BACnet based building automation system by Schneider Electric (SE).
 - 3. Alternate No. M-02C: furnish and install a BACnet based building automation system by Siemens.

1.03 SUBMITTALS

- A. Electronic Submittals: While all requirements for hard copy submittal apply, control submittals and O&M information shall also be provided in electronic format as follows.
 - 1. Drawings and Diagrams: During the initial submittal approval process the drawings can be submitted in PDF format. .
- B. 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. System Architecture and System Layout:
 - 1. One-line diagram indicating schematic locations of all control units, workstations, LAN interface devices, gateways, etc. All optical isolators, routers, repeaters, end-of-line terminators, junctions, ground locations etc. shall be located on the diagram.
 - 2. Provide floor plans and vertical risers drawings locating all control units, workstations, servers, gateways, etc. Include all LAN communication wiring routing, power wiring, power originating sources, and low voltage power wiring. All optical isolators, routers, repeaters, end-of-line terminators, junctions, ground locations etc. shall be located on the floor plans. All remote differential pressure transmitters and sensors (air or water) shall be located on the floor plans. Wiring routing as-built conditions shall be maintained accurately throughout the construction period and the drawing shall be updated to accurately reflect accurate, actual installed conditions.
- C. Schematic flow diagram of each air and water system showing fans, coils, dampers, valves, pumps, heat exchange equipment and control devices. Include verbal description of sequence of operation.
- D. All physical points on the schematic flow diagram shall be indicated with names and, descriptors. Provide a Bill of Materials with each schematic. Indicate device identification to match schematic and actual field labeling, quantity, actual product ordering number, manufacturer, description, size, voltage range, pressure range, temperature range, etc. as applicable.
- E. Indicate all required electrical wiring. Electrical wiring diagrams shall include both ladder logic type diagram for motor starter, control, and safety circuits and detailed digital interface panel point termination diagrams with all wire numbers and terminal block numbers identified. Provide panel termination drawings on separate drawings. Ladder diagrams shall appear on system schematic. Clearly differentiate between portions of wiring which is existing, factory-installed and portions to be field-installed.
- F. Details of control panels, including controls, instruments, and labeling shown in plan or elevation indicating the installed locations.
- G. Sheets shall be consecutively numbered with Table of Contents listing sheet titles and sheet numbers, and legend and list of abbreviations.
- E. Submittal Review Meeting
 - 1. The BAS Contractor will participate in a submittal review meeting at UNC with the Designer, Mechanical Contractor, CxA, UNC and other project members to review

all submittal comments. The BAS engineer assigned to the project will be required to attend the meeting along with other necessary BAS contractor project members.

2. If substantial submittal review comments are made which require resolution subsequent resubmittal meetings may be required.
- H. Control Drawings: Laminated 11 x 17 control drawings including system control schematics, sequences of operation and panel termination drawings, shall be provided in panels for major pieces of equipment. Drawings should be of sufficient size to be easily read. Terminal unit drawings shall be located in the central plant equipment panel or mechanical room panel.
- I. Operation and Maintenance Materials:
1. Submit documents under provisions of Section 017823. Provide 3 copies of the materials shall be delivered directly to the Owner's facilities operation staff along with an electronic (PDF format) version, in addition to the copies required by other Sections.
 2. Submit maintenance instructions and spare parts lists for each type of control device, control unit, and accessory.
 3. Include all submittals (product data, shop drawings, control logic documentation, hardware manuals, software manuals, installation guides or manuals, maintenance instructions and spare parts lists) in maintenance manual; in accordance with requirements of Division 1.
- K. Product Warranty Certificates: submit manufacturers product warranty certificates covering the hardware provided.

1.04 PROJECT RECORD DOCUMENTS

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

1.05 WARRANTY MAINTENANCE

- A. Contractor shall warrant all products and labor for a period of 1 year after Final Project Acceptance (usually 30 days after SCO beneficial occupancy).
- B. The Owner reserves the right to make changes (set point changes, deadbands and tuning adjustments) 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.
- C. At no cost to the Owner, during the warranty period, the Contractor shall provide maintenance services for software, firmware and hardware components.

1.06 LISTING AND LABELING

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

PART 2. EXECUTION

2.01 INSPECTION

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

2.02 DIGITAL CONTROL PANELS AND LOCATION

- A. Contractor shall locate BAS panels as referenced by the designer.

2.03 SURGE PROTECTION

- A. The Contractor shall furnish and install any power supply surge protection, filters, etc. as necessary for proper operation and protection of all controllers, operator interfaces, routers, gateways and other hardware and interface devices. All equipment shall be capable of handling voltage variations 10% above or below measured nominal value, with no affect on hardware, software, communications, and data storage.

2.04 CONTROL POWER SOURCE AND SUPPLY

- A. Section 230900 Contractor shall extend all power source wiring required for operation of all equipment and devices provided under Sections 230900 through 230905 and Sequences of Operation.
- B. General requirements for obtaining power include the following:

1. In the case where additional power is required, obtain power from a source that feeds the equipment being controlled such that both the control component and the equipment are powered from the same panel. Where equipment is powered from a 460V source, obtain power from the electrically most proximate 120v source fed from a common origin.
2. Where control equipment is located inside a new equipment enclosure, coordinate with the equipment manufacturer and feed the control with the same source as the equipment. If the equipment's control transformer is large enough and of the correct voltage to supply the controls, it may be used. If the equipment's control transformer is not large enough or of the correct voltage to supply the controls provide separate transformer

END OF SECTION 230900

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PART 1. GENERAL

1.01 SECTION INCLUDES

- A. Wiring
- B. Control Valves and Actuators
- C. Control Dampers and Actuators
- D. Control Panels
- E. Sensors
- F. Pneumatic Control Components (Gauges, switches, relays, etc.)
- G. Electric Control Components (Switches, EP Valves, Thermostats, Relays, Smoke Detectors, etc.)
- H. Transducers
- I. Current Switches
- J. Nameplates
- K. Testing Equipment

1.02 RELATED DOCUMENTS

- A. Section 230100- Basic Mechanical Requirements
- B. Section 230900 - Building Automation System (BAS) General
- C. Section 230903 - BAS Field Panels
- D. Section 230904 - BAS Communications Devices
- E. Section 230905 - BAS Software and Programming
- F. Section 230993 – Sequences of Operation
- G. Section 230801 - BAS Commissioning

1.03 DESCRIPTION OF WORK

- A. Refer to Section 230900 for general requirements.
- B. Refer to other Division-23 sections for installation of instrument wells, valve bodies, and dampers in mechanical systems; not work of this section.
- C. Provide the following electrical work as work of this section, complying with requirements of Division-26 sections:
 - 1. Control wiring between field-installed controls, indicating devices, and unit control panels.
 - 2. Interlock wiring between electrically interlocked devices, sensors, and between a hand or auto position of motor starters as indicated for all mechanical and controls.

3. Wiring associated with indicating and alarm panels (remote alarm panels) and connections to their associated field devices.
4. All other necessary wiring for fully complete and functional control system as specified.

1.04 WORK BY OTHERS

- A. Control Valves furnished under this section shall be installed under the applicable piping section under the direction of Section 230901 Contractor who will be fully responsible for the proper operation of the valve.
- B. Control Dampers furnished under this section shall be installed under the applicable air distribution or air handling equipment section under the direction of Section 230901 Contractor who will be fully responsible for the proper operation of the damper
- C. Water Pressure Taps, Thermal Wells, Flow Switches, Flow Meters, etc. that will have wet surfaces, shall be installed under the applicable piping Section under the direction of Section 230901 Contractor who will be fully responsible for the proper installation and application.
- D. All Controlled Equipment Power Wiring shall be furnished and installed under Division 16. Where control involves 120V control devices controlling 120V equipment, Division 16 Contractor shall extend power wiring to the equipment. Section 230901 Contractor shall extend it from the equipment to the control device. (i.e. Electrician installs power to motor, Controls Contractor wires relays, etc.)

PART 2. PRODUCTS

2.01 MATERIALS AND EQUIPMENT

- A. General: Provide electronic and electric control products in sizes and capacities indicated, consisting of valves, dampers, controllers, sensors, and other components as required for complete installation. Except as otherwise indicated, provide manufacturer's standard materials and components as published in their product information; designed and constructed as recommended by manufacturer, and as required for application indicated.
- B. DEP Communications: Provide BACnet to Modbus TCP universal gateway to allow transmitting of BAS data to DEP control panel.
- C. **Instrument Pipe and Tube**
 1. **Hydronic and Instruments**
 - a) **Connection to Main Piping:** Provide ½ inch minimum size threadolet, ½" x 2 inch brass nipple, and ½" ball valve for connection to welded steel piping. Provide tee fitting for other types of piping.
 - b) **Remote Instruments:** Adapt from ball valve to specified tubing and extend to remote instruments. Provide a union or otherwise removable fitting at ball valve so that connection to main can be cleaned with straight rod. Where manifolds with test ports are not provided for instrument, provide tees with ¼"

- FPT branch with plug for use as test port. Adapt from tubing size to instrument connection.
- c) **Line Mounted Instruments:** Extend rigid piping from ball valve to instrument. Do not use close or running thread nipples. Adapt from ball valve outlet to instrument connection size. Provide a plugged tee if pipe makes 90 degree bend at outlet of valve to allow cleaning of connection to main with straight rod without removing instrument. Where manifolds with test ports are not provided for instrument, provide tees with ¼" FPT branch with plug for use as test port.
 - d) **Instrument Tubing:** Seamless copper tubing, Type K or L, ASTM B 88; with cast-bronze solder joint fittings, ANSI B1.18; or wrought-copper solder-joint fittings, ANSI B16.22; or brass compression-type fittings. Solder shall be 95/5 tin antimony, or other suitable lead free composition solder. Tubing OD size shall be not less than the larger of ¼" or the instrument connection size.
 - e) **Rigid Piping for Line Mounted Instruments:** Schedule 40 threaded brass, with threaded brass fittings.
2. **Low Pressure Air Instrument Sensing Lines**
- a) **Connections:** Use suitable bulkhead type fitting and static sensing tip for static pressure connections. Adapt tubing to instrument connection.
 - b) **Tubing:** Virgin polyethylene non-metallic tubing type FR, ASTM D 2737, installed in conduit. Use compression or push-on brass fittings.
- D. **Communication Wiring:** All wiring shall be in accordance with National Electrical Codes and Division 16 of this specification. Communication wiring shall be provided in a customized color jacketing material. Material color shall be as submitted and approved by UNC. 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 Controllers, Routers, BPOC(s) and LCS computer.
 - 2. **Control LAN** For any portions of this network required under this section of the specification, contractor shall use Category 5 or better cable as specified in TIA-568B. Media shall be Class 2 plenum rated and installed in accordance with manufacturer's recommendations. Network shall be run with no splices and separate from any wiring over thirty (30) volts.
- E. **Signal Wiring:** Contractor shall run all signal wiring in accordance with National Electric Codes and Division 16 of this Specification.
- 1. Signal wiring to all field devices, including, but not limited to, all sensors, transducers, transmitters, switches, etc. shall be twisted, 100% shielded pair, minimum 18-gauge wire with PVC cover. Signal wiring shall be run with no splices and separate from any wiring above thirty (30) volts.
 - 2. Signal wiring shield shall be grounded at controller end only unless otherwise recommended by the controller manufacturer.
- F. **Low Voltage Analog Output Wiring:** Contractor shall run all low voltage control wiring in accordance with National Electric Codes and Division 16 of this Specification.

1. Low voltage control wiring shall be minimum 18-gauge, twisted pair, 100% shielded, with PVC cover, Class 2 plenum-rated. Low voltage control wiring shall be run with no splices separate from any wiring above thirty (30) volts.
- G. **Control Panels:** Provide control panels with suitable brackets for wall mounting for each controlled system. Locate panel adjacent to systems served. Mount center of control panels 60" above finish floor or roof.
1. **Interior:** Fabricate panels of 16-gage furniture-grade steel, totally enclosed on four sides, with removable perforated backplane, hinged door and keyed lock keyed to the UNC Approved Control Panel Key, with manufacturer's standard shop- painted finish and color.
 2. **Exterior:** 16-gauge 304 Stainless Steel NEMA 4X enclosure. Panel shall have hinged door and keyed lock.
 3. Provide UL-listed cabinets for use with line voltage devices.
 4. To address shock hazard concerns, all terminals with a voltage higher than 24 V must either have shields installed to prevent contact or be 'finger proof' terminals.
 5. Control panel shall be completely factory wired and piped, and all electrical connections made to a terminal strip.
 6. All gauges and control components shall be identified by means of nameplates.
 7. All control tubing and wiring shall be run neatly and orderly in open slot wiring duct with cover.
 8. Provide a 6"x6" metal wiring/tubing trough across the entire width of the panel mounted to the top of the panel with close nipples of sufficient size for additional 50% wiring and tubing capacity. Wiring/tubing troughs shall not be less than 24" in length. Control panel wiring shall be installed and distributed in the trough to minimize routing of wiring and tubing within the control panel.
 9. All controllers and panel mounted control devices shall be located in a single enclosure. Additional panels can be used to house the controllers and devices if all devices will not fit in a single, large control panel.
 10. Complete 11x17 laminated wiring and tubing termination drawings shall be attached to the interior of each panel of sufficient size to be easily readable.

2.02 STANDARD SERVICE CONTROL VALVES

- A. **General:** Provide factory fabricated control valves of type, body material and pressure class indicated. Where type or body material is not indicated, provide selection as determined by manufacturer for installation requirements and pressure class, based on maximum pressure and temperature in piping system. Provide valve size in accordance with scheduled or specified maximum pressure drop across control valve. Control valves shall be equipped with heavy-duty actuators, and with proper close-off rating for each individual application. Minimum close-off rating shall be as scheduled and adequate for each application, and shall generally be considered at dead head rating of the pump.
- B. **Ball Type**
1. **Body:** Brass or bronze; one-, two-, or three-piece design; threaded ends.
 2. **Seat:** Reinforced Teflon
 3. **Ball:** Stainless steel.

4. **Port:** 'V' style.
5. **Stem:** Stainless steel, blow-out proof design, extended to match thickness of insulation.
6. **Cold Service Pressure:** 600 psi WOG
7. **Steam working Pressure:** 150 psi
8. **Acceptable Manufacturers:** Subject to compliance with requirements approved manufacturers are as follows:
 - a) Johnson Controls
 - b) Belimo
 - c) Conbraco
 - d) Worcester
 - e) Nibco
 - f) Jamesbury
 - g) PBM
 - h) Invensys
 - i) Delta
 - j) Approved Equal

C. Pressure Independent Type

1. Valves shall be pressure independent and shall be used for Chilled Water service 2-1/2" and larger unless noted otherwise. The flow through the valve shall not vary more than +/- 5% due to system pressure fluctuations across the valve in the selected operating range. The control valves shall accurately control the flow from 0 to 100% full rated flow. A flow tag, furnished with each valve shall list flows at all the valve positions in 10 degrees rotation increments. A maximum of 5 psi shall be required to operate the valve pressure independently. Electronic type PICV valve is not allowed for use..
 - a) **Rangeability:** The valves shall have a turndown capability of at least 100:1.
 - b) **Body:** Bronze, flanged, 125 psi maximum working pressure.
 - c) **Operating Temperature:** 250°F.
 - d) **Pressure/Temperature ports (Pete's Plugs):** Taps shall be installed at the factory in each valve to measure the pressure drop through the valves to determine the valve flow rate.
 - e) **Acceptable Manufacturers:** Subject to compliance with requirements. Approved manufacturers are as follows:
 - 1) Delta P Valve by Flow Control Industries, Inc.
 - 2) KTM valve by Flow Design.
 - 3) Alternate No. M-04: furnish and install Delta P valve by Flow Control Industries, Inc.

D. Rotary Segmented Ball Type for Steam Pressure Regulating Service:

1. Characteristics: Modified equal-percentage characteristics with 300:1 rangeability.
2. Body: Steel, flanged, 150 psig steam working pressure.
3. Ball: Stainless steel segmented ball
4. Valve Trim and Stem: Stainless steel.
5. Packing: Spring Loaded Teflon.
6. Seat: Reinforced Teflon
7. Acceptable Manufacturers: Subject to compliance with requirements approved manufacturers are as follows:
 - a) Fisher V150
 - b) Valtek ShearStream
 - c) Neles R-Series

2.03 CONTROL DAMPERS

- A. **General:** Provide factory fabricated automatic control dampers of sizes, velocity and pressure classes as required for smooth, stable, and controllable airflow. Provide parallel or opposed blade dampers as recommended by manufacturers sizing techniques. For dampers located near fan outlets, provide dampers rated for fan outlet velocity and close-off pressure, and recommended by damper manufacturer for fan discharge damper service. Control dampers used for smoke dampers shall comply with UL 555S. Control Dampers used for fire dampers shall comply with UL 555.
- B. For general isolation and modulating control service in rectangular ducts at velocities not greater than 1500 fpm (7.62 m/s), differential pressure not greater than 2.5" w.c. (622 Pa):
 1. **Performance:** Test in accordance with AMCA 500.
 2. **Frames:** Galvanized steel, 16-gauge minimum thickness, welded or riveted with corner reinforcement.
 3. **Blades:** Stainless steel in lab exhausts and galvanized steel elsewhere, maximum blade size 8 inches (200 mm) wide by 48 inches (1219 mm) long, attached to minimum 1/2 inch (12.7 mm) shafts with set screws, 16 gauge minimum thickness.
 4. **Blade Seals:** Synthetic elastomer, mechanically attached, field replaceable.
 5. **Jamb Seals:** Stainless steel.
 6. **Shaft Bearings:** Oil impregnated sintered bronze, graphite impregnated nylon sleeve or other molded synthetic sleeve, with thrust washers at bearings.
 7. **Linkage:** Concealed in frame.
 8. **Linkage Bearings:** Oil impregnated sintered bronze or graphite impregnated nylon.
 9. **Leakage:** Less than one percent based on approach velocity of 1500 ft./min. (7.62 m/s) and 1 inches wg. (249Pa).
 10. **Maximum Pressure Differential:** 2.5 inches wg. (622 Pa)
 11. **Temperature Limits:** -40 to 200 °F (-40 to 93 °C).

12. Where opening size is larger than 48 inches (1219 mm) wide, or 72 inches (1829 mm) high, provide dampers in multiple sections, with intermediate frames and jackshafts appropriate for installation.
- C. For general isolation and modulating control service in rectangular ducts at velocities not greater than 4000 fpm (20.3 m/s), differential pressure not greater than 6" w.c. (1493 Pa):
1. **Performance:** Test in accordance with AMCA 500.
 2. **Frames:** Galvanized steel, 16-gauge minimum thickness, welded or riveted with corner reinforcement.
 3. **Blades:** extruded aluminum hollow airfoil shape, maximum blade size 8 inches (200 mm) wide by 48 inches (1219 mm) long, attached to minimum 1/2 inch (12.7 mm) shafts, 14 gauge minimum extrusion thickness.
 4. **Blade Seals:** Synthetic elastomeric, mechanically attached, field replaceable.
 5. **Jamb Seals:** Stainless steel.
 6. **Shaft Bearings:** Oil impregnated sintered bronze sleeve, graphite impregnated nylon sleeve, molded synthetic sleeve, or stainless steel sleeve, with thrust washers at bearings.
 7. **Linkage:** Concealed in frame.
 8. **Linkage Bearings:** Oil impregnated sintered bronze or graphite impregnated nylon.
 9. **Leakage:** Less than 0.1 percent based on approach velocity of 4000 ft./min. (20.3 m/s) and 1 inches wg. (249Pa).
 10. **Maximum Pressure Differential:** 6 inches wg. (622 Pa)
 11. **Temperature Limits:** -40 to 200 °F (-40 to 93 °C).
12. Where opening size is larger than 48 inches (1219 mm) wide, or 72 inches (1829 mm) high, provide dampers in multiple sections, with appropriately intermediate frames, and jackshafts.
- D. For general isolation and modulating control service in rectangular ducts at velocities not greater than 4000 fpm, differential pressure not greater than 12" w.c.:
1. **Performance:** Test in accordance with AMCA 500.
 2. **Frames:** Galvanized steel, 12-gauge minimum thickness, welded or riveted with corner reinforcement.
 3. **Blades:** Extruded aluminum hollow airfoil shape, maximum blade size 8 inches (200 mm) wide by 48 inches (1219 mm) long, attached to minimum 3/4 inch (19 mm) shafts with set screws
 4. **Shaft Bearings:** Oil impregnated sintered bronze or stainless steel, pressed into frame, with thrust washers at bearings.
 5. **Linkage:** 10-gauge minimum thickness galvanized steel clevis type crank arms, 3/16" x 3/4" (4.76 mm x 19 mm) minimum thickness tie rods.
 6. **Linkage Bearings:** Oil impregnated sintered bronze or graphite impregnated nylon.
 7. **Leakage:** Less than 0.2 percent based on approach velocity of 4000 ft./min. (20.3 m/s) and 1 inches wg. (249Pa) differential pressure.
 8. **Maximum Pressure Differential:** 12 inches wg. (2984 Pa)
 9. **Temperature Limits:** -40 to 300 °F (-40 to 149 °C).

10. Where opening size is larger than 48 inches (1219 mm) wide, or 72 inches (1829 mm) high, provide dampers in multiple sections, with appropriately intermediate frames, and jackshafts.
- E. For general isolation and modulating control service in round ducts up to 40 inches in size at velocities not greater than 2500 fpm (12.7 m/s), differential pressure not greater than 4" w.c. (994 Pa):
1. **Performance:** Test in accordance with AMCA 500.
 2. **Frames:** rolled 12 gauge steel strip for sizes 6 inch and smaller, rolled 14 gauge steel channel for larger sizes, galvanized or aluminum finish.
 3. **Blades:** Steel construction, 12 gauge minimum thickness for dampers less than 18 inches (457 mm) in size, 10 gauge minimum thickness for larger dampers.
 4. **Blade Seals:** Full circumference neoprene.
 5. **Shaft:** ½ inch (12.7 mm) diameter zinc or cadmium plated steel.
 6. **Shaft Bearings:** Oil impregnated sintered bronze or stainless steel, pressed into frame, with thrust washers at bearings.
 7. **Leakage:** Less than 0.2 percent based on approach velocity of 4000 ft./min. (20.3 m/s) and 1 inches wg. (249Pa) differential pressure.
 8. **Maximum Pressure Differential:** 4 inches wg. (994 Pa)
 9. **Temperature Limits:** -40 to 300 °F (-40 to 149 °C).
- F. For general isolation and modulating control service in round ducts up to 60 inches in size at velocities not greater than 4000 fpm (20.3 m/s), differential pressure not greater than 6" w.c. (1492 Pa):
1. **Performance:** Test in accordance with AMCA 500.
 2. **Frames:** rolled 10-gauge steel channel for sizes 48 inch and smaller, rolled 3/16 inch (4.76 mm) thick steel channel for larger sizes, galvanized or aluminum finish.
 3. **Blades:** Steel construction, 10-gauge minimum thickness for dampers not greater than 48 inches in size, ¼ inch (6.35 mm) minimum thickness for larger dampers.
 4. **Blade stops:** ½ inch x ¼ inch (12.7 mm x 6.35 mm) full circumference steel bar.
 5. **Blade Seals:** Full circumference neoprene.
 6. **Shaft:** zinc or cadmium plated steel, angle reinforcing as necessary.
 7. **Shaft Bearings:** Oil impregnated sintered bronze or stainless steel, pressed into frame, with thrust washers at bearings.
 8. **Leakage:** Less than 0.4 percent based on approach velocity of 4000 ft./min. (20.3 m/s) and 1 inches wg. (249Pa) differential pressure.
 9. **Maximum Pressure Differential:** 6 inches wg. (1492 Pa)
 10. **Temperature Limits:** -40 to 250 °F (-40 to 121 °C).

2.04 ACTUATORS

- A. **General:** Size actuators and linkages to operate their appropriate dampers or valves with sufficient reserve torque or force to provide smooth modulating action or 2-position action as specified. Select spring-return actuators with manual override to provide positive shut-off of devices as they are applied.
- B. **Actuators**

1. All actuators requiring greater than 150 inch/pounds of torque shall be provided as pneumatic actuators as defined below.
2. Ambient Operating Temperature Limits: -10 to 150°F (-12.2 to 66 °C)
3. **Two Position Electric Actuators:** Line voltage (120 volt, 24 volt) with spring return. Provide end switches as required.
4. **Pneumatic Actuators:** Provide heavy-duty actuators with stroke indication and spring return. Actuator shall consist of steel or aluminum cylinder and pistons. Housing shall be protected both internally and externally with corrosion resistant coating. Provide position feedback positive positioners with adjustable start point and operating range. Positive Positioners shall be provided on all pneumatic valves larger than 1”.
5. **Electronic Actuators:** Provide actuators with spring return for two-position (24v), 0-5 Vdc, 0-10 Vdc, 2-10Vdc, 4-20 mA, or network connection as required. Actuators shall travel full stroke in less than 90 seconds (VAV terminal box actuators may be up to 300 second full stroke time). Actuators shall be designed for a minimum of 60,000 full cycles at full torque and be UL 873 listed. Provide stroke indicator. Actuators shall have positive positioning circuit. When two non-networked actuators are required to operate in parallel, or in sequence, provide an auxiliary actuator driver. Actuators shall have current limiting motor protection. Actuators shall have manual override. Modulating actuators for valves shall have minimum rangeability of 40 to 1.
 - a) **Close-Off Pressure:** Provide the minimum torque required, and spring return for fail positioning (unless otherwise specifically indicated) sized for required close-off pressure. Required close-off pressure for two-way water valve applications shall be the shutoff head of associated pump. Required close-off rating of steam valve applications shall be design inlet steam pressure plus 50 percent for low pressure steam, and 10 percent for high pressure steam. Required close-off rating of air damper applications shall be shutoff pressure of associated fan, plus 10 percent.
 - b) **Acceptable Manufacturers:** Subject to compliance with requirements approved manufacturers are as follows:
 - 1) Siemens
 - 2) Schneider Electric-TAC DuraDrive
 - 3) Belimo
 - 4) Johnson Controls
 - 5) Delta
 - 6) **Substitutions:** As provided under 016000

C. Quarter-Turn Actuators (for ball valves):

1. Electric

- a) **Motor:** Suitable for 24, 120 or 240 Volt single-phase power supply. Insulation shall be NEMA Class F or better. Motor shall be rated for 100 percent duty cycle. Motors shall have inherent overload protection.

- b) **Gear Train:** Motor output shall be directed to a self locking gear drive mechanism. Gears shall be rated for torque input exceeding motor locked rotor torque.
- c) **Wiring:** Power and control wiring shall be wired to a terminal strip in the actuator enclosure
- d) **Failsafe Positioning:** Actuators shall be spring return type for failsafe positioning. For terminal zone reheat valves the actuators can fail in the last position except for DLAM areas and special research areas.
- e) **Enclosure:** Exterior actuator enclosure shall be a NEMA-4 epoxy coated metal enclosure, and shall have a minimum of two threaded conduit entries.
- f) **Limit Switches:** Travel limit switches shall be UL and UNC approved. Switches shall limit actuator in both open and closed positions.
- g) **Mechanical Travel Stops:** The actuator shall include mechanical travel stops of stainless steel construction to limit actuator to specific degrees of rotation.
- h) **Manual Override:** Actuators shall have manual actuator override to allow operation of the valve when power is off. For valves 4 inches and smaller the override may be a removable wrench or lever or geared handwheel type. For larger than 4" valves, the override shall be a fixed geared handwheel type. An automatic power cut-off switch shall be provided to disconnect power from the motor when the handwheel is engaged for manual operation.
- i) **Valve Position Indicator:** A valve position indicator with arrow and open and closed position marks shall be provided to indicate valve position.
- j) **Torque Limit Switches:** Provide torque limit switches to interrupt motor power when torque limit is exceeded in either direction of rotation.
- k) **Position Controller:** For valves used for modulating control, provide an electronic positioner capable of accepting 4-20 mA, 0-10 Vdc, 2-10 Vdc, and 135 Ohm potentiometer.
- l) **Ambient Conditions:** Actuator shall be designed for operation from -140 to 150 °F ambient with 0 to 100 percent relative humidity.

2.05 GENERAL FIELD DEVICES

- A. Provide field devices for input and output of digital (binary) and analog signals into controllers. Provide signal conditioning for all field devices as recommended by field device manufacturers, and as required for proper operation in the system.
- B. Smart sensors or smart actuators shall meet all controller requirements in addition to the relevant sensor or actuator requirements.
- C. It shall be the Contractor's responsibility to assure that all field devices are compatible with controller hardware and software.
- D. Field devices specified herein are generally 'two-wire' type transmitters, with power for the device to be supplied from the respective controller. If the controller provided is not equipped to provide this power, or is not designed to work with 'two-wire' type transmitters, or if field device is to serve as input to more than one controller, or where the length of wire to the controller will unacceptably affect the accuracy, the Contractor

shall provide 'four-wire' type equal transmitter and necessary regulated DC power supply or 120 VAC power supply, as required.

- E. For field devices specified hereinafter that require signal conditioners, signal boosters, signal repeaters, or other devices for proper interface to controllers, Contractor shall furnish and install proper device, including 120V power as required. Such devices shall have accuracy equal to, or better than, the accuracy listed for respective field devices.
- F. **Accuracy:** As stated in this Section, accuracy shall include combined effects of nonlinearity, nonrepeatability and hysteresis.

2.06 TEMPERATURE SENSORS (TS)

- A. **Sensor range:** When matched with A/D converter of controller, sensor range shall provide a resolution of no worse than 0.3°F (0.16 °C) (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 A. Sensor probe shall be 316 or 304 stainless steel.
 - 1. Sensing element shall be platinum RTD, thermistor, or integrated circuit, +/- 0.3°F accuracy at calibration point
- C. **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.
 - 1. Sensing element shall be platinum RTD, or thermistor, +/- 0.3°F accuracy at calibration point.
- D. **Liquid Immersion Temperature Sensor** shall include brass thermowell, sensor and connection head for wiring connections. Temperature range shall be as required for resolution of 0.15°F.
 - 1. Sensing element (chilled water/glycol systems) shall be thermistor or platinum RTD ±0.3 °C measured at 0 °C.
- E. **Pipe Surface-Mount Temperature Sensor:** Shall include metal junction box and clamps and shall be suitable for sensing pipe surface temperature and installation under insulation. Provide thermally conductive paste at pipe contact point. Temperature range shall be as require for resolution indicated in paragraph A.
 - 1. Sensing element shall be platinum RTD, thermistor, or integrated circuit, +/- 0.4°F accuracy at calibration point.
- F. **Outside Air Sensor:** Shall consist of a sensor, sun shield, utility box, and watertight gasket to prevent water seepage. Temperature range shall be as require for resolution indicated in Paragraph A
- G. Sensing element shall be platinum RTD, thermistor, or integrated circuit, sensor range shall provide a resolution of no worse than ±0.1 °C measured at 10 °C.

2.07 HUMIDITY TRANSMITTERS

- A. Units shall be suitable for duct, wall (room) or outdoor mounting. Unit shall be two-wire transmitter utilizing bulk polymer resistance change or thin film capacitance change humidity sensor. Unit shall produce linear continuous output of 4-20 mA for percent relative humidity (% RH). A combination temperature and humidity sensor may be used for zone level monitoring. Sensors shall have the following minimum performance and application criteria:
1. Input Range: 0 to 100% RH.
 2. Accuracy(% RH): +/- 2% (when used for outside air, enthalpy calculation, dewpoint calculation or humidifier control) or +/- 3% (monitoring only) between 20-90% RH at 77°F, including hysteresis, linearity, and repeatability.
 3. Sensor Operating Range: As required by application
 4. Long Term Stability: Less than 1% drift per year.
- B. **Acceptable Manufacturers**: Units shall be Vaisala HM Series, Hy-Cal HT Series or approved equal

2.08 DIFFERENTIAL PRESSURE TRANSMITTERS (DP)

- A. General – For all hydronic Differential Pressure Transmitters, provide a 5 valve bypass assembly for connection between the DP transmitter and the piping system being monitored. The purpose of the connect is to allow air to be efficiently bled from the branch piping and also to allow for easy calibration of the DP transmitter via parallel connection of a test instrument at the “bleed” lines.
- B. **Water General Purpose**:
1. **General**: Two wire transmitter, 4-20 mA or 0-5 volt for runs less than 100’ output with zero and span adjustments.
 2. **Ambient Limits**: -40 to 175 °F (-40 to 121 °C), 0 to 100% RH.
 3. **Process limits**: -40 to 250 °F
 4. **Accuracy**: 0.5% overall accuracy,
 5. **Maximum Pressure Rating**: 450 psig (3103 KPa) maximum static pressure rating, 200 psid maximum overpressure rating for 6 through 60 psid range, 450 psid for 100 through 300 psid range.
 6. Kele & Associates Model 360 C, Approved Equal.
- C. **VAV Velocity Pressure**: Generally for use in variable volume air velocity pressure measurement where the range is applicable.
1. **General**: Loop powered two-wire differential capacitance cell type transmitter.
 2. **Output**: Two-wire, 4-20 mA output with zero adjustment.
 3. **Overall Accuracy**: Plus or minus 0.25%
 4. **Minimum Range**: 0 in. w.c.
 5. **Maximum Range**: 1 inch w.c.
 6. **Housing**: Polymer housing suitable for surface mounting.

7. **Acceptable Manufacturers:** Setra or Approved Equal. Substitutions shall be allowed per Division 1.
8. **Range:** Select for minimum range that will accept the maximum velocity pressure expected.

2.09 AIRFLOW MEASURING STATIONS (AFMS)

- A. Fan Inlet Probe: Shall consist of vortex shedding multi-sensor probes which are installed in the inlet of the fan. Individual sensor transmitters on the probe provide direct proportional and linear signals to airflow velocity.
 1. Sensor Accuracy: $\pm 2.0\%$
 2. Interchangeability: $\pm 0.5\%$
 3. Velocity Range: 750 to 9000 fpm
 4. Electronics Accuracy: $\pm 0.05\%$
 5. Temperature Limits: -20°F to 140°F
 6. Enclosure for Electronics: NEMA 1
 7. Material: Aluminum (stainless steel if located in a corrosive environment)
 8. Operating Range: Select minimum range to accommodate the expected flow range of the equipment
 9. Acceptable Manufacturer: Tek-Air Systems Inc. 'Vortek' Model 7000, Ebtron Gold or Approved Equal.
- B. Air Flow Traverse Probes – Minimum duct air velocity greater than 400 fpm: Furnish where indicated on the drawings, vortex shedding multi-sensor insertion type, air flow traverse probes. The probes, and placement of the probes, shall provide measurement accuracy within $\pm 2\%$ of actual velocity. Probes shall be aluminum or (where located in a corrosive environment) 304 stainless steel or CPVC. Probes over 18" long shall be provided with an end mounting rod for support. The probe assemblies shall not have a pressure drop greater than 10% of the velocity pressure at the maximum design flow. The probes shall not amplify sound levels in the duct. The vortex-shedding transmitter shall provide a direct proportional and linear signal of airflow volume. Contractor to provide with a straight section of duct meeting upstream and downstream requirements using air flow straighteners as needed and will verify transmitter signal range
 1. Sensor Accuracy: $\pm 2.0\%$
 2. Interchangeability: $\pm 0.5\%$
 3. Velocity Range: 350-7000 fpm
 4. Temperature Limits: -20°F to 200°F for SS, -20°F to 140°F for Aluminum
 5. Material: Aluminum or 304 stainless steel or CPVC (as indicated above).
 6. Enclosure for Electronics: NEMA 1
 7. Operating Range: Select minimum range to accommodate the expected flow range of the equipment
 8. Manufacturer: Tek-Air Systems Inc. 'Vortek' Series VT5000 for large ducts (>4 sq. ft.) or for smaller ducts VT2000.
- C. Air Flow Traverse Probes – Minimum duct air velocity less than 400 fpm (especially for Outside Air measurement): Provide either of the following;

1. Ebtron Gold Series GTC116-P+. The Air Flow Measurement Station (AFMS) shall use the principle of thermal dispersion with one self-heated and one-zero power bead-in-glass thermistor at each sensing node. Only the thermistor shall be located within the sensing node, all other electronic components shall be outside the airstream
 - a) Sensor Accuracy: +/- 3% of reading when installed in accordance with the manufacturer's recommended sensor density and placement guidelines.
 - b) Velocity Range: 0-3500 fpm
 - c) Locate and install AFMS per manufacturer's recommendations.
2. Tek-Air IAQ-TEK Series IAQ series. The number of Tamer Probes required shall be based upon the size and aspect ratio of the duct or other housing at the Probe location. Contractor to provide straight section meeting upstream and downstream requirements using air flow straighteners as needed and will verify transducer range
 - a) Sensor Accuracy: 200-1000 fpm is $\pm 5.0\%$, 75-200 fpm is $\pm 10\%$
 - b) Velocity Range: 75-1000 fpm
 - c) Temperature Limits: -20°F to 200°F
 - d) Probe Material: PVC/ABS plastic.
 - e) Enclosure for Electronics: NEMA 4X
 - f) Operating Range: Select minimum range to accommodate the expected flow range of the equipment.
 - g) Manufacturer: Tek-Air Systems Inc. 'IAQ-Tek' Series IAQ2000.

2.10 VALVE BYPASS FOR DIFFERENTIAL PRESSURE SENSORS

- A. Provide a five valve bypass kit for protection of DP sensors. Kit shall include high and low pressure isolation valves, high and low pressure vent valves, calibration taps, and a bypass valve.

2.11 DIFFERENTIAL PRESSURE SWITCHES (DPS)

- 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.

2.12 PRESSURE SWITCHES (PS)

- A. Diaphragm or bourdon tube with adjustable setpoint and differential and snap-acting Form C contacts rated for the application. Pressure switches shall be capable of withstanding 150% of rated pressure.
- B. **Acceptable Manufacturers:** Square D, ITT Neo-Dyn, ASCO, Penn, Honeywell, and Johnson Controls. Substitutions shall be allowed per Division 1.

2.13 CURRENT SWITCHES (CS)

- A. **Clamp-On or Solid-Core Design Current Operated Switch** (for Constant Speed Motor Status Indication)
 - 1. **Range:** 1.5 to 150 amps.
 - 2. **Trip Point:** Adjustable.
 - 3. **Switch:** Solid state, normally open, 1 to 135 Vac or Vdc, 0.3 Amps. Zero off state leakage.
 - 4. **Lower Frequency Limit:** 6 Hz.
 - 5. **Trip Indication:** LED
 - 6. **Approvals:** UL, CSA
 - 7. **Max. Cable Size:** 350 MCM
 - 8. **Acceptable Manufacturers:** Veris Industries H-708/908; Inc., RE Technologies SCS1150A-LED, 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. Substitutions shall be allowed per Division 1.
- C. **Clamp-On Design Current Operated Switch for Variable Speed Motor Status Indication**
 - 1. **Range:** 1.5 to 135 Amps.
 - 2. **Trip Point:** Self-calibrating based on VA memory associated with frequency to detect loss of belt with subsequent increase of control output to 60 Hz.
 - 3. **Switch:** Solid state, normally open, 1 to 135 Vac or Vdc, 0.3 Amps. Zero off state leakage.
 - 4. **Frequency Range:** 5-75 Hz
 - 5. **Trip Indication:** LED
 - 6. **Approvals:** UL, CSA
 - 7. **Max. Cable Size:** 350 MCM
 - 8. **Acceptable Manufacturers:** Veris Industries, Inc. H-904, 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. Substitutions shall be allowed per Division 1.
- E. **Variable Speed Status:** Where current switches are used to sense the status for variable speed devices, the CT shall include on-board VA/Hz memory to allow distinction between a belt break and subsequent ramp up to 60 Hz, versus operation at low speed. The belt break scenario shall be indicated as a loss of status and the operation at low speed shall indicate normal status.

2.14 CURRENT TRANSFORMERS (CT)

- 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.

2.15 OUTDOOR AIR STATIC PRESSURE SENSING TIP

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

2.16 ELECTRIC CONTROL COMPONENTS

- A. **Limit Switches (LS):** Limit switches shall be UL listed, SPDT or DPDT type, with adjustable trim arm. Limit switches shall be as manufactured by Square D, Allen Bradley. Substitutions shall be allowed per Division 1.
- B. **Electric Solenoid-Operated Pneumatic Valves (EP):** EP valves shall be rated for a minimum of 1.5 times their maximum operating static and differential pressure. Valves shall be ported 2-way, 3-way, or 4-way and shall be normally closed or open as required by the application. EPs shall be sized for minimum pressure drop, and shall be UL and CSA listed. Furnish and install gauges on all inputs of EPs. Furnish an adjustable air pressure regulator on input side of solenoid valves serving actuators operating at greater than 30 psig.
 - 1. **Coil Enclosure:** Indoors shall be NEMA-1, Outdoors and NEMA-3, 4, 7, 9.
 - 2. **Fluid Temperature Rating:** Valves for compressed air and cold water service shall have 150 °F (66 °C) minimum rating. Valves for hot water or steam service shall have fluid temperature rating higher than the maximum expected fluid temperature.

3. **Acceptable Manufacturers:** EP valves shall be as manufactured by ASCO or Parker. Substitutions shall be allowed per Division 1.
 4. **Coil Rating:** EP valves shall have appropriate voltage coil rated for the application (i.e., 24 VAC, 120 VAC, 24 VDC, etc.).
- C. **Low Temperature Detector ('Freezestat') (FZ):** Low temperature detector shall consist of a 'cold spot' element which responds only to the lowest temperature along any one foot of entire element, minimum bulb size of 1/8" 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.
- D. **Surface-Mounted Thermostat:** Surface-mounted thermostat shall consist of SPDT contacts, operating temperature range of 50 to 150°F (10 to 65°C), and a minimum 10°F fixed setpoint differential.
- E. **Low Voltage Wall Thermostat:** Wall-mounted thermostat shall consist of SPDT sealed contacts, operating temperature range of 50 to 90°F (10 to 32°C), switch rating of 24 Vac (30 Vac max.), and both manual and automatic fan operation in both the heat and cool modes.
- F. **Control Relays:** All control relays shall be UL listed, with contacts rated for the application, and mounted in minimum NEMA-1 enclosure for indoor locations, NEMA-4 for outdoor locations.
1. Control relays for use on electrical systems of 120 volts or less shall have, as a minimum, the following:
 - a) AC coil pull-in voltage range of +10%, -15% or nominal voltage.
 - b) Coil sealed volt-amperes (VA) not greater than four (4) VA.
 - c) Silver cadmium Form C (SPDT) contacts in a dustproof enclosure, with 8 or 11 pin type plug.
 - d) Pilot light indication of power-to-coil and coil retainer clips.
 - e) Coil rated for 50 and 60 Hz service.
 - f) **Acceptable Manufacturers:** Relays shall be Potter Brumfield, Model KRPA or approved Equal.
 2. Relays used for across-the-line control (start/stop) of 120V motors, 1/4 HP, and 1/3 HP, shall be rated to break minimum 10 Amps inductive load. Relays shall be IDEC. Substitutions shall be allowed per Division 1.
 3. Relays used for stop/start control shall have low voltage coils (30 VAC or less), and shall be provided with transient and surge suppression devices at the controller interface.
 4. 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.
- G. **General Purpose Power Contactors:** NEMA ICS 2, AC general-purpose magnetic contactor. ANSI/NEMA ICS 6, NEMA type 1 enclosure. Manufacturer shall be Square 'D', Cutler-Hammer or Westinghouse. Substitutions shall be allowed per Division 1.

- H. **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.
 - 1. Transformers shall be manufactured by Westinghouse, Square 'D', or Jefferson. Substitutions shall be allowed per Division 1.
- I. **Time Delay Relays (TDR):** TDRs shall be capable of on or off delayed functions, with adjustable timing periods, and cycle timing light. Contacts shall be rated for the application with a minimum of two (2) sets of Form C contacts, enclosed in a dustproof enclosure.
 - 1. TDRs shall have silver cadmium contacts with a minimum life span rating of one million operations. TDRs shall have solid state, plug-in type coils with transient suppression devices.
 - 2. TDRs shall be UL and CSA listed, Crouzet type. Substitutions shall be allowed per Division 1.
- J. **Electric Selector Switch (SS):** Switch shall be maintained contact, NEMA ICS 2, oil-tight selector switch with contact arrangement, as required. Contacts shall be rated for minimum 120 Vac operation. Switch shall be 800T type, as manufactured by Allen-Bradley. Substitutions shall be allowed per Division 1.

2.17 NAMEPLATES

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

2.18 TESTING EQUIPMENT

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

PART 3. EXECUTION

3.01 INSPECTION

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

3.02 INSTALLATION OF CONTROL SYSTEMS

- A. **General:** Install systems and materials in accordance with manufacturer's instructions, roughing-in drawings and details shown on drawings. Install electrical components and use electrical products complying with requirements of National Electric Code and all local codes.
- B. **Control Wiring:** The term "control wiring" is defined to include providing of wire, conduit and miscellaneous materials as required for mounting and connection of electric control devices.
 - 1. **Wiring System:** Install complete wiring system for electric control systems. Conceal wiring except in mechanical rooms and areas where other conduit and piping are exposed. Installation of wiring shall generally follow building lines. Install in accordance with National Electrical Code and Division 16 of this Specification. Fasten flexible conductors bridging cabinets and doors, neatly along hinge side, and protect against abrasion. Tie and support conductors neatly.
 - 2. **Control Wiring Conductors:** Install control wiring conductors, without splices between terminal points, color-coded. Install in neat workmanlike manner, securely fastened. Install in accordance with National Electrical Code and Division 16 of this Specification.
 - 3. Communication wiring, signal wiring and low voltage control wiring shall be installed separate from any wiring over thirty (30) volts. Signal wiring shield shall be grounded at controller end only, unless otherwise recommended by the controller manufacturer.
 - 4. All control network wiring shield shall be terminated as recommended by controller manufacturer. All control network wiring shall be labeled with a network number, NodeID at each termination and shall correspond with the network architecture and floor plan submittals.
 - 5. Install all control wiring external to panels in electric metallic tubing or raceway. Installation of wiring shall generally follow building lines. Provide compression type connectors. Provide rigid conduit at all exterior locations and where subjected to moisture. All conduits penetrating partitions, walls or floors shall be sealed with a submitted and approved non-hardening putty material to prevent migration of air through the conduit system
 - 6. Communication cabling shall be provided in an UNC approved color dedicated to the BAS.
 - 7. Number-code or color-code conductors appropriately for future identification and servicing of control system. Code shall be as indicated on approved installation drawings.

- C. **Control Valves:** Install so that actuators, wiring, and tubing connections are accessible for maintenance. Where possible, install with valve stem axis vertical, with operator side up. Where vertical stem position is not possible, or would result in poor access, valves may be installed with stem horizontal. Do not install valves with stem below horizontal, or down.
- D. Room Temperature Sensors: Mount 48" above finished floor.
- E. Critical Room Temperature Sensors: Mount 48" above finished floor.
- F. **Averaging Temperature Sensors:** Cover no more than two square feet per linear foot of sensor length except where indicated. Generally where flow is sufficiently homogeneous/adequately mixed at sensing location, consult AE for requirements.
- G. **Airflow Measuring Stations:** Install per manufacturer's recommendations in an unobstructed straight length of duct (except those installations specifically designed for installation in fan inlet). For installations in fan inlets, provide on both inlets of double inlet fans and provide inlet cone adapter as recommended by AFM station manufacturer.
- H. **Fluid Flow Sensors:** Install per manufacturer's recommendations in an unobstructed straight length of pipe.
- I. **Relative Humidity Sensors:** Provide element guard as recommended by manufacturer for high velocity installations. For high limit sensors, position remote enough to allow full moisture absorption into the air stream before reaching the sensor.
- J. **Pipe Surface Mount Temperature Sensors:** Pipe Surface Mount temperature sensor shall be installed with thermally conductive paste at pipe contact point. Where sensor is to be installed on an insulated pipe Contractor shall neatly cut insulation install sensor, repair or replace insulation and vapor barrier and adequately seal vapor barrier.
- K. **Pipe Immersion Temperature Sensors:** Install a "P/T" port directly next to EACH immersion sensors installed for the project. The Pressure/Temperature test port shall have ¼" or ½" MPT brass body, dual durometer EPDM core, threaded brass cap with o-ring seal and neoprene retainer strap and shall accept standard 1/8" gauge adapter or thermometer stem. Rated to 500 PSI / 3450 kPa, and 250°F / 120°C. Pressure/Temperature Test Port shall be PTV ENTERPRISES Model PT or approved equal.
- L. **Flow Switches:** Where possible, install in a straight run of pipe at least 15 diameters in length to minimize false indications.
- M. **Current Switches for Motor Status Monitoring:** Adjust so that setpoint is below minimum operating current and above motor no load current.
- N. **Supply Duct Pressure Transmitters:**
 - 1. **General:** Install pressure tips with at least 4 'round equivalent' duct diameters of straight duct with no takeoffs upstream. Install static pressure tips securely fastened with tip facing upstream in accordance with manufacturer's installation instructions. Locate the transmitter at an accessible location to facilitate calibration. Provide a capped "T" in line with the pneumatic sensing line for parallel connection of calibration/ test instrumentation. Alternatively, provide a test port in the duct directly next to the DP transmitter sensing location.

2. **VAV System ‘Down-Duct’ Transmitters:** Locate pressure taps approximately 3/4 of the hydraulic distance to the most remote terminal in the air system where shown on the drawings. Provide a capped “T” in line with the pneumatic sensing line for parallel connection of calibration/ test instrumentation. Alternatively, provide a test port in the duct directly next to the DP transmitter sensing location.
- O. **Cutting and Patching Insulation:** Repair insulation to maintain integrity of insulation and vapor barrier jacket. Use hydraulic insulating cement to fill voids and finish with material matching or compatible with adjacent jacket material.

UNC MASTER SPECIFICATION									
Water Control Valve Specification Sheet (Globe Body)									
Project Name	Revisions					SHEET		xx of xx	
	NO.	BY	DATE	DESCRIPTION	SPEC. NO.		REVISION		
	1				230901		*		
	2				CONTRACT		DATE		
	3				X		mm/dd/yy		
	4				PROJECT NUMBER				
	5				XXXX.XX				
	6				BY	CHECKED	APPROVED		
7				XYZ	XYZ	XYZ			
GENERAL	Tag Number		*						
	Service Description		*						
	P&ID Sheet Number		*						
	Line No. or Vessel No.		*						
	Line Size / Mat'l / Sch.		*						
	Electrical Class	Power Supply	*			*			
PROCESS DATA	Fluid	Fluid State	WATER			LIQUID			
	Operating Condition		Units	Minimum	Normal	Maximum	Othe		
	Flow Rate		GPM	*	*	*	*		
	Inlet Pressure		PSIG	*	*	*	*		
	Outlet Pressure		PSIG	*	*	*	*		
	Temperature		DEG	*	*	*	*		
	Level		FEET	*	*	*	*		
	Mol. Wt.								
	Sp. Wt	Sp. Grav							
BODY	Viscosity	Sp Heat							
	Style	Size	GLOBE				xx"		
	End Connection	Rating	xx" RF FLANGED				ANSI CLASS 150		
	Port Size	Travel	*				*		
	Valve Cv	Valve C1/Km	*				**		
	Body Matl.	Bonnet	ASTM A216 WCC				ASTM A216 WCC		
	Characteristic	Trim Number	EQUAL PERCENTAGE				**		
	Cage Matl.	Retainer Matl.	*				*		
	Seat Matl.	Seat Ring Matl.	316 STAINLESS STEEL				316 STAINLESS STEEL		
	Plug Matl.	Stem Matl.	316 STAINLESS STEEL				316 STAINLESS STEEL		
	Flow Action		DOWN						

	Gaskets	PTFE	
	Stem Guide	**	
	Packing	PTFE	
	Required Seat Tightness	ANSI CLASS IV	
	Max. Allowable Sound Level (dBA)	<75 dBA	
ACTUATOR	Type	ELECTRONIC	
	Size	*	*
	Push-Down To	Fail Position	CLOSE*
	Close At	Open At	6 PSIG*
	Handwheel	NONE*	
POSITIONER	Type	Electronic	
	Communications Protocol		
	Input Signal	Output Signal	4-20 mA
	Air Supply		
TRANSDUCER	Type	*	
	Input Signal	*	
	Output Signal	*	
OPTIONS	Air Set w/ Gauges	YES*	
	Solenoids	*	
	Position Switches	*	
SELECTION BASED ON	Manufacturer	Fisher, Valtek, Dezurik-Copes, Leslie	
	Valve Model Number	*	
	Actuator Model No.	*	
	Positioner Model No.	*	
	Filter Regulator	YES	
NOTES			

END OF SECTION 230901

SECTION 23 09 03 - BAS FIELD PANELS

PART 1 GENERAL

1.1 DESCRIPTION OF WORK:

- A. Furnish and install DDC Control units and/or Smart Devices required to support specified building automation system functions.

PART 2 PRODUCTS

2.1 STAND-ALONE FUNCTIONALITY

- A. General: These requirements clarify the requirement for stand-alone functionality relative to packaging I/O devices with a controller.
- B. Functional Boundary: Provide controllers so that all points associated with and common to one unit or other complete system/equipment shall reside within a single control unit. When referring to the controller as pertains to the standalone functionality, reference is specifically made to the processor. One processor shall execute all the related I/O control logic via one operating system that uses a common programming and configuration tool.
- C. The following configurations are considered acceptable with reference to a controller's standalone functionality:
 - 1. Points packaged as integral to the controller such that the point configuration is listed as an essential piece of information for ordering the controller (having a unique ordering number).
 - 2. Controllers with processors and modular back planes that allow plug in point modules as an integral part of the controller.
 - 3. I/O point expander boards, plugged directly into the main controller board to expand the point capacity of the controller.
 - 4. I/O point expansion devices connected to the main controller board via wiring and as such may be remote from the controller and that communicate via a sub LAN protocol. These arrangements to be considered standalone shall have a sub LAN that is dedicated to that controller and include no other controller devices. All wiring to interconnect the I/O expander board shall be:
 - a) Contained in the control panel enclosure;
 - b) Or run in conduit. Wiring shall only be accessible at the terminations.
- D. Alternate Configuration:
 - 1. Multiple controllers may be provided to control a single unit or other complete system if the provided Building Automation System manufacturer does not have a single controller (with or without expansion modules) that can be provided to meet the single unit/ system point count.
 - 2. In this instance, multiple controllers may be provided as long as each controller is still "stand-alone". All points required to execute any subroutine or PID Loop type control shall be contained in a single controller.

3. Each Open Lab shall be treated as a single system and shall be on a dedicated network segment such that only network traffic necessary for the control of the terminal units in a specific open lab will be present on that network segment. (i.e. provide at least 1 LON router or BACnet Routing device for each open LAB system).

2.2 CONTROLLERS

A. General Requirements for all Controllers:

1. Controller shall have hardware I/O to support the application. Controller's hardware I/O shall meet the following requirements:
 - a) Digital Outputs (DO): Outputs shall be rated for a minimum 24 VAC or VDC, 1 amp maximum current. Each shall be configurable as normally open or normally closed. Each output shall have an LED to indicate the operating mode of the output and a manual hand off or auto switch to allow for override. Each DO shall be discrete outputs from the controller board (multiplexing to a separate manufacturer's board is unacceptable). Provide suppression to limit transients to acceptable levels.
 - b) Analog Inputs (AI): AI shall be 0-5 Vdc, 0-10Vdc, 0-20Vdc, and 0-20 mA. Provide signal conditioning, and zero and span calibration for each input. Each input shall be a discrete input to the controller board (multiplexing to a separate manufacturers board is unacceptable unless specifically indicated otherwise). A/D converters shall have a minimum resolution of 8-10 bits depending on application.
 - c) Digital Inputs (DI): Monitor dry contact closures. Accept pulsed inputs of at least one per second. Source voltage for sensing shall be supplied by the controller and shall be isolated from the main board.
 - d) Universal Inputs (UI-AI or DI): To serve as either AI or DI as specified above.
 - e) Electronic Analog Outputs (AO) as required by application: voltage mode, 0-5VDC and 0-10VDC; current mode (4-20 mA). Provide zero and span calibration and circuit protection. Where floating control is allowed, transducer/actuator shall be programmable for normally open, normally closed, or hold last position and shall allow adjustable timing. In addition, use of floating control without any feedback of actual output device position requires the capability to periodically re-zero the output device. Pulse Width Modulated (PWM) analog via a DO and transducer is acceptable only with Owner approval (Generally these will not be allowed on loops with a short time constant such as discharge temperature loops, economizer loops, pressure control loops and the like. They are generally acceptable for standard room temperature control loops.). Where these are allowed, transducer/actuator shall be programmable for normally open, normally closed, or hold last position and shall allow adjustable timing. Each AO shall be discrete outputs from the controller board (multiplexing to a separate manufacturers board is unacceptable). D/A converters shall have a minimum resolution of 8 bits.

- f) Analog Output Pneumatic (AOP), 0-20 psi: Pneumatic outputs via an I/P transducer, PWM/P transducer, or digital to pneumatic transducer are acceptable.
 - 2. Shall be mounted on equipment, in packaged equipment enclosures, or wall mounted in a locking NEMA 1 enclosure, as specified elsewhere.
- B. Terminal Box Controllers:
- 1. Terminal box controllers (Direct Digital Air Volume System) controlling damper positions to maintain a quantity of supply or exhaust air serving a space shall have an automatically initiated function that resets the volume regulator damper to the fully closed position on a scheduled basis. The controllers shall initially be set up to perform this function once every 24 hours. The purpose of this required function is to reset and synchronize the actual damper position with the calculated damper position and to assure the damper will completely close when commanded. The software shall select scheduled boxes randomly and shall not allow more than 5% of the total quantity of controllers in a building to perform this function at the same time. When possible the controllers shall perform this function when the supply or exhaust air system is not operating or is unoccupied.

2.3 CONTROL PANELS:

- A. Provide control panels with suitable brackets for wall mounting for each controlled system. Locate panel adjacent to systems served. Mount center of control panels 60" above finish floor or roof.
- B. Interior: Fabricate panels of 16-gage furniture-grade steel, totally enclosed on four sides, with removable perforated backplane, hinged door and keyed lock keyed to the UNC Approved Control Panel Key, with manufacturer's standard shop-painted finish and color.
- C. Exterior: 16-gauge 304 Stainless Steel NEMA 4X enclosure. Panel shall have hinged door and keyed lock.
- D. Provide UL-listed cabinets for use with line voltage devices.
- E. To address personnel shock hazard concerns: All terminals with a voltage higher than 30 volts must either have shields installed over exposed terminals or be 'finger proof' terminals to prevent inadvertent contact.
- F. Control panel shall be completely factory wired and piped, and all electrical connections made to a terminal strip.
- G. All gauges and control components shall be identified by means of nameplates.
- H. All control tubing and wiring shall be run neatly and orderly in open slot wiring duct with cover.
- I. If needed for cable and tubing management provide a 6"x6" metal wiring/tubing trough across the entire width of the panel mounted to the top of the panel with close nipples of sufficient size for additional 50% wiring and tubing capacity. Wiring/tubing troughs shall not be less than 24" in length. Control panel wiring shall be installed and distributed in the trough to minimize routing of wiring and tubing within the control panel.

- J. All controllers and panel mounted control devices shall be located in a single enclosure. Additional panels can be used to house the controllers and devices if all devices will not fit in a single, large control panel.
- K. Complete 11x17 laminated wiring and tubing termination drawings shall be attached to the interior of each panel of sufficient size to be easily readable.

PART 3 EXECUTION

3.1 INSTALLATION OF CONTROL SYSTEMS:

- A. General: Install systems and materials in accordance with manufacturer's instructions, specifications roughing-in drawings and details shown on drawings. Contractor shall install all controllers in accordance with manufacturer's installation procedures and practices.

3.2 RE-ZERO FUNCTION FOR FLOATING CONTROL WITHOUT FEEDBACK

- A. Where floating control is used without actuator feedback, contractor shall program an automatically initiated function that resets the actuator to the fully closed position on a scheduled basis. The controllers shall initially be set up to perform this function once every 24 hours. This function may be either programmed in the individual controllers, or resident elsewhere on the network as a supervisory control program, or some combination of the two. In any case, not more than 5% of the total quantity of controllers in a building shall perform this function at the same time. When possible the controllers shall perform this function when the duct or pipe controlled by the actuator is not operating or is serving unoccupied zones.

3.3 HARDWARE APPLICATION REQUIREMENTS

- A. Standalone Capability: Each controller shall be capable of performing the required sequence of operation for the associated equipment. All physical point data and calculated values required to accomplish the sequence of operation shall originate within the associated controller with only the exceptions enumerated below.

END OF SECTION 230903

SECTION 23 09 04 - BAS COMMUNICATION DEVICES

PART 1. PRODUCTS

1.01 EMCS GATEWAY (BUILDING POINT OF CONNECTION - BPOC)

- A. The EMCS Gateway shall be the gateway/router between the building controllers and EMCS server.
- B. The gateway shall perform information translation between the Primary LAN and the Local Supervisory LAN, which is 100 Mbps Ethernet TCP/IP and shall utilize BACnet over IP or LON over IP.
- C. The BAS contractor will provide a controls gateway (BPOC), the gateway will be either;
 - 1) Johnson Controls NAE gateway (not LCS) communicating with the existing Metasys server located at Giles Horney Building. The NAE(s) will be provided with 3 years of free upgrades following the installation date
 - 2) Schneider Electric Struxureware Automation Server (AS) communicating with an existing Struxureware server located at Giles Horney Building. The AS(s) will be provided with 3 years of free upgrades following the installation date.
 - 3) Tridium Niagara 4 gateway communicating with an existing Niagara 4 server located at Giles Horney Building. The Niagara Compatibility Statement (NICS) for all JACEs shall allow open access and be set as follows: Accept Station In = *; Accept Station Out = *; Accept Tool In = *; Accept Tool Out = *, the Owner shall be free to direct the modification of the software license, regardless of supplier, by Tridium Inc. The Niagara 4 will be provided with 3 years of free Niagara Framework upgrades following the installation date.
- D. The gateway shall contain its own microprocessor, RAM, battery, real-time clock, communication ports, and power supply. Each gateway/router shall be mounted in a lockable enclosure.
- E. Upon loss of power to the Gateway, the battery shall provide for minimum 100 hour backup of all programs and data in RAM. The battery shall be sealed and self-charging.

1.02 VFD NETWORK REQUIREMENTS

- A. Variable frequency drives shall include either a ANSI 709.1 network connection consisting of a ANSI 709.3 TP/FT-10 connector or a ASHRAE 135 standard BACnet protocol connection depending on the protocol being used by the BAS network.
- B. The drive shall have the capability of allowing the BAS to monitor feedback such as process variable feedback, output speed / frequency, current (in amps), % torque, power (kW), kilowatt hours (resettable), operating hours (resettable), and drive temperature.

PART 2. EXECUTION

2.01 INSTALLATION OF CONTROL SYSTEMS:

- A. General: Install and configure EMCS gateway(s) to provide interface between the UNC EMCS VLAN and an existing approved vendor's server located in Giles Horney building (or ITS data room), and the building control network. 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.
- B. Provide and install all necessary cat 5e or cat 6 wiring and temporary switches necessary for BAS IP connectivity to support startup and full commissioning of the BAS. A network jack will be provided on each floor and within 100 ft. of any HVAC control device. The jacks will be used to provide connection to a wireless router for startup and commissioning purposes. The jacks need to be located near a 120v source to power the wireless router. After project acceptance UNC will provide the permanent Gateway IP network drop used for a single point of connection to the BAS.
- C. Provide all interface devices and software to provide an integrated system and coordinate with all other Divisions of the Specifications and suppliers to assure all systems are interoperable and data specified provided.
- D. Coordinate closely with the Owner, or designated representative, to establish IP addresses and communications to assure proper operation of the building control system with the UNC EMCS VLAN.
- E. Gateways shall be capable of synchronizing time with a UNC time server. The Gateway shall be capable of pushing correct time to any controller with a real time clock.
- F. Use Local Data Points for network communication. The use of External Data Points for integration is not permitted.
- G. BPOC shall be configured to provide alarm information for the following events:
 - 1. Any control network fault
 - 2. Any communication error on the control network

END OF SECTION 230904

SECTION 23 09 05 - BAS SOFTWARE AND PROGRAMMING

1.01 DESCRIPTION OF WORK:

- A. Fully configure systems and furnish and install all software and programming for a complete and fully functioning system as specified.

PART 2. PRODUCTS

2.01 SYSTEM SOFTWARE-GENERAL

- A. **Functionality and Completeness:** The Contractor shall furnish and install all software and programming necessary to provide a complete and functioning system as specified.
- B. **Configuration:** The software shall support the system as a distributed processing network configuration.

2.02 APPLICATION PROGRAMMING DESCRIPTION

- A. The application software shall be either user configurable or user programmable.
- B. This specification generally requires a programming convention that is logical, easy to learn, use, and diagnose. General approaches to application programming shall be provided by one, or a combination, of the following conventions:
 - 1. **Graphical Block Programming:** Manipulation of graphic icon 'blocks', each of which represents a subroutine, in a functional/logical manner forming a control logic diagram. Blocks shall allow entry of adjustable settings and parameters via pop-up windows. Provide a utility that shall allow the graphic logic diagrams to be directly compiled into application programs. Logic diagrams shall be viewable either off-line, or on-line with real-time block output values.
 - 2. **Functional Application Configuration:** For air terminal units only, pre-programmed application specific programs that allow/require limited customization via 'fill-in-the-blanks' edit fields. Typical values would be setpoints gains, associated point names, alarm limits, etc.
- C. Provide a means for testing and/or debugging the control programs both off-line and on-line.

2.03 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. All alarms and events shall be routable to the UNC EMCS.

2.04 TRENDING

- A. The software shall display historical data in both a tabular and graphical format. The requirements of this trending shall include the following:
 - 1. Provide ten-minute, 3 day minimum historical trends easily accessible from the BAS graphics for all physical (AI, AO) analog and related setpoints. Provide the

capability, but do not activate historical trends for ALL physical digital (DI, DO) points, virtual points and calculated variables. All binary trends can be recorded in change-of-value (COV) format.

- B. Control Loop Performance Trends: Controllers incorporating PID control loops shall also provide high resolution sampling in less than five second increments for verification of control loop performance.

2.05 TOTALIZATION

- A. The software shall support totalizing analog, digital, and pulsed inputs and be capable of accumulating, storing, and converting these totals to engineering units used in the documents. These values shall generally be accessible to the Operator Interfaces to support management-reporting functions.

2.06 OVERRIDES

- A. BAS shall provide an audit log report of all overrides currently active and historical overrides along with the user who initiated the override.

2.07 POINT STRUCTURING AND NAMING

- A. General: The intent of this section is to require a consistent means of naming points across the UNC EMCS VLAN. Contractor shall configure the systems from the perspective of the UNC EMCS VLAN, 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 is tailored towards the UNC EMCS VLAN and as such, the interface shall always use this naming convention, any deviations from this naming convention shall be approved by the Owner. Each controller shall have English language descriptors for all system points, variables, parameters etc. located and accessible from the controller memory. All point naming shall match between all system files and record documents.
- B. Point Summary Table
 1. The term 'Point' is a generic description for the class of object represented by analog and binary inputs, outputs, and values.
 2. With each schematic, Contractor shall provide a Point Summary Table listing:
 - a) Building Designator
 - b) Building Name
 - c) System Description
 - d) Point ID
 - e) Point Type
 - f) Full point name (see Point Naming Convention paragraph)
 - g) English language point description

- h) The BAS Contractor shall coordinate with the Owner's representative and compile and submit a proposed Point Summary Table for review prior to any object programming or project startup.

PART 3. EXECUTION

3.01 SITE-SPECIFIC APPLICATION PROGRAMMING

- A. Provide all database creation and site-specific application control programming as required by these Specifications, national and local standards and for a fully functioning system. Contractor shall provide all initial site-specific application programming and thoroughly document programming. Generally meet the intent of the written sequences of operation. It is the Contractor's responsibility to request clarification on sequence issues that require such clarification.
- B. All site-specific programming shall be fully documented and submitted for review and approval, both prior to downloading into the panel, at the completion of functional performance testing, and at the end of the warranty period.
- C. All programming, user interfaces and data files must be maintained in a logical system of directories with self-explanatory file names. All files developed for the project will be the property of the Owner and shall remain on the workstation(s)/server(s) at the completion of the project.

END OF SECTION 230905

SECTION 23 09 06 – BAS OPERATOR INTERFACE

PART 1. GENERAL

1.01 DESCRIPTION OF WORK

- A. The scope of this section is to provide BAS graphics, alarming, scheduling and trending.

PART 2. PRODUCTS

2.01 Operator Interface Graphic Software (General):

- A. Graphic software shall facilitate user-friendly interface to all aspects of the System Software specified above.
- B. Dynamic Data Displays: Dynamic physical point values shall automatically updated at a minimum frequency of 12 updates per minute without operator intervention. Point value fields shall be displayed with a color code depicting normal, abnormal, offline or loss of communications, override and alarm conditions.
- C. 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 reported as an alarm, and shall be displayed in a coded color on the BAS graphic screens for that applicable system. The alarm message shall include the operator's user name. A list of points that are currently in an override state shall be available through menu selection.

2.02 Graphic Software (Design Requirements):

- A. Floor Plan Layout Graphics:
 - 1. Provide floor plan graphics for all areas/ floors served by BAS controlled equipment
 - 2. Provide links from large floor plans to smaller, more detailed graphics (Zoom in feature).
 - 3. Locate all controlled or monitored equipment on the floor plan graphics with a link to the equipment.
 - 4. Show locations of all terminal unit Zone Sensors on the floor plans,
 - 5. 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.
 - 6. Ensure room numbers reported on the floor plan graphics match the room number signage locate 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.
 - 7. 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.

B. 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.)
5. Provide and install an electronic version of the as built control schematics on the gateway server. Provide a link to the electronic control schematics on each major equipment page.

C. 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. Provide a table of all VAVs by a AHU listing zone temperature, air flow, damper position, HW valve position, terminal discharge air temperature, heating and cooling demand.
4. Provide a table of exhaust terminals by EF system listing air flow, damper position and command
5. 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.).

2.03 Operator Interface Alarm and Event Reporting

- A. Alarm management shall be provided to monitor, buffer, and direct alarms and messages to the LCS operator interface. At no time shall the ability to report alarms be affected by either operator activity at the LCS, or by communications with other panels on the network.
- B. Alarm Descriptor: Each alarm or point change shall include that point's English language description, and the time and date of occurrence. In addition to the alarm's descriptor and the time and date, the user shall be able to print, display and store an alarm message to more fully describe the alarm condition or direct operator response.
- C. Alarm Prioritization: The software shall allow users to define the handling and routing of each alarm by their assignment to discrete priority levels. 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 UNC on establishing alarm priority definitions.

- D. Alarm Acknowledgment: For alarm priority levels directed to the LCS, 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 a selected file on the LCS hard disk.
- E. 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; alarm priority; and notification class.
- F. Typically, alarms will be specified in the sequence of operations or the control system logic diagrams. However, alarm points shall be as dictated by the owner. The following guide is presented for use in further determining what points to initially set up for any given system/ equipment/ unit, etc. This contractor shall coordinate all alarm requirements with the owner. For systems not listed here, the requirements should be extrapolated from similar systems that are listed. The minimum alarm requirements for the systems listed below are as follows:
 - 1. STANDARD AHU ALARMS
 - a) Fan Failure --- should reference command
 - b) Pump Failure --- should reference command
 - c) Freeze stat --- alarm enabled at all times
 - d) Fire Alarm --- alarm enabled at all times
 - e) Hi Fan Static --- alarm enabled at all times
 - f) Filter Alarm --- alarm enable at all times
 - g) Mixed air temp below 40 on units without preheat, no alarm on units with preheat and minimum OA requirements - alarm enabled at all times
 - h) Preheat temp below 40 on units with preheat --- alarm enabled at all times
 - i) Discharge temps 2 degrees above and below the min and max reset set points if using resets 1 degree differential, set up warning to indicate temp 1 degree off of set point for more than 5 minutes --- alarm disabled when system is shut down and have a 5 minute delay after system restarts.
 - j) Duct Static pressures should alarm when more than a .25 inch or 10% off of set point --- alarm disabled when system is shut down and have a 5 minute delay after system restarts.
 - k) Discharge humidity above 90% --- alarm enabled at all times
 - l) Chill water supply above 50 with 3 degree differential

2.04 OPERATOR INTERFACE TRENDING

**University of North Carolina Chapel Hill
Coastal Process Environmental Health Lab
SCO # 23-26296-01A**

- A. The LCS shall be able to display historical data in both a tabular and graphical format. The requirements of this trending shall include the following:
- B. Provide trends for all physical points, setpoints, other virtual points (as indicated) and calculated variables. A minimum of 80% of the systems AI/AO trends can be active without impacting remote data access performance.
- C. 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.
- D. The sample rate (up to 5 second interval) and data selection shall be selectable by the operator.
- E. The trended value range shall be selectable by the operator.
- F. Where trended values on one table/graph are COV, software shall automatically fill the trend samples between COV entries.
- G. Trending Requirements: All I/O points on primary equipment shall be trended throughout the Cx process on 10 min. intervals for analog values and change-of-value for binary values.
- H. A total of 1 week of data (minimum) shall be stored locally at the controller/ gateway. Older data shall be archived to the central server by the BAS.
- I. All trends shall be accessed from the user graphic displayed I/O point, not only through a trend menu.

2.05 Operator Interface Equipment Scheduling

- A. Provide a graphic utility for user-friendly operator interface to adjust equipment-operating schedules.
- B. Scheduling feature shall include multiple seven-day master schedules, plus holiday schedule, each with start time and stop time. Master schedules shall be individually editable for each day and holiday.

2.06 Gateway/BPOC

- A. Furnish and install all Routers and Gateways/ Building Point of Connection (BPOC) gateways as required for the BAS to function locally. One VLAN connection will be provided to the LCS for connectivity of the OI.

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2.07 Submittals

- A. Electronic Submittals: While all requirements for hard copy submittal apply, these control submittals shall also be provided in electronic format as follows:
 - 1. Graphic Files: Graphic drawings shall be provided on electronic media as an Acrobat PDF. Each unique graphic shall be represented one time. This submittal must be approved by the Owner 60 days prior to the start of commissioning activities.

END OF SECTION 230906

Section 23 09 93 - SEQUENCE OF OPERATION – Table of Contents

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SECTION 23 09 93 - SEQUENCE OF OPERATION

PART I. GENERAL

1.01 SECTION INCLUDES

- A. Air Handling Units
- B. Chilled Water System
- C. Terminal Units
- D. Exhaust Fans

1.02 RELATED DOCUMENTS:

- A. Drawings and general provisions of Contract, including the General Conditions and Supplementary Conditions and other Division-1 Specification Sections, apply to this Section.
- B. Section 230100 - Basic Mechanical Requirements
- C. Section 230900 - Building Automation System (BAS) General
- D. Section 230901 - BAS Basic Materials, Interface Devices, and Sensors
- E. Section 230903 - BAS Field Panels
- F. Section 230904 - BAS Communications Devices
- G. Section 230905 - BAS Software and Programming
- H. Section 230801 – BAS Commissioning

1.03 SYSTEM DESCRIPTION

- A. The systems to be controlled under work of this section basically comprise the Fisheries Building AHU-1 and condenser water loop bypass valve.
- B. This Section defines the manner and method by which controls function.

1.04 SUBMITTALS

- A. Refer to Section 230900 and Division 1 for requirements for control shop drawings, product data, Users Manual, etc.
- B. Programming Manual: Provide DDC system programming manual as well as documentation of site-specific programming prior to the start of Acceptance Phase.

1.05 PROJECT RECORD DOCUMENTS

- A. Within two weeks of the completion of commissioning, provide record documents to represent the final control configuration with actual setpoints and tuning parameters as existed at acceptance.
- B. Record documents shall be modified control drawings with the actual installed information. Drawings shall be delivered in both reproducible hard copy and electronic

format in AutoCAD 2002 drawing files. Provide all supporting files, blocks, fonts, etc. required by the drawings.

- C. Provide final points list as described above
- D. Provide final detailed wiring diagrams with all wire numbers and termination points indicated
- E. Accurately record final sequences and control logic made after submission of shop drawings.

PART II. PRODUCTS

Not Used

PART III. EXECUTION

3.01 GENERAL

- A. Sequences specified herein indicate the functional intent of the systems operation and may not fully detail every aspect of the programming that may be required to obtain the indicated operation. Contractor shall provide all programming necessary to obtain the sequences/system operation indicated.
- B. When an air handling unit is not in operation, control devices shall remain in their “off” positions. “Off” positions may differ from the “normal” (meaning failed) position. Except as specified otherwise, “off” and “normal” positions of control devices shall be as follows:

Device	“Off” Position	“Normal” Position
Heating coil valves	closed	open
Cooling coil valves	closed	closed
Steam coil valves	closed	closed
Outside air damper	closed	closed
Return air damper	open	open
Exhaust/relief air damper	closed	closed

Variable Frequency Drives: For a VFD dependent on an external input for its output setting (e.g. the VFD gets “Frequency” as an input), loss of that external input shall result in the VFD holding its last value. If the VFD is running its own PID loop and the external input to the VFD is a setpoint (e.g. duct static pressure setpoint), the VFD shall hold the last setpoint. If the VFD loses its process variable (e.g. duct static pressure), the VFD shall go to its minimum speed setting.

- C. Except as specified otherwise, throttling ranges, proportional bands, and cycle differentials shall be centered on the associated setpoint. All modulating feedback control loops shall include the capability of having proportional, integral, and derivative action. Unless the loop is specified “proportional only” or “P+I”, Contractor shall apply appropriate elements of integral and derivative gain to each control loop which shall

result in stable operation, minimum settling time, and shall maintain the primary variable within the specified maximum allowable variance.

- D. Provide a real time clock and schedule controller with sufficient scheduling capability to schedule all required controllers and sequences. Schedule functionality may reside in BPOC or a controller. If BPOC is used, document scheduling functionality on BPOC submittal, if a controller is used, document scheduling functionality including SNVT names and types on controller points list submittal. Set up initial schedules in coordination with UNC.
- E. Scheduling Terminology: When air handlers are scheduled throughout the day, the following defines the terminology used:
1. Occupied Period: period of time when the building is in use and occupied. Unless indicated otherwise, this period is defined as X:00 AM – X:00 PM weekdays and X:00 AM to X:00 Saturdays. Exclude all national holidays. Generally systems will be fully operational throughout this period and ventilation air shall be continuously introduced. Space temperature setpoints will generally be in the “normal” range of 69°-77°F.
 2. Unoccupied period: period of time when the building or zone is not in use and unoccupied. Ventilation air shall not be introduced.
 3. Preoccupancy Period: Time prior to the Occupied period when the systems are returning the space temperatures from setback to “normal” or occupied setpoints (warm-up and cool-down). Ventilation air shall not be introduced unless outside air conditions permit free-cooling. Time period shall be determined by an optimum start strategy unless otherwise specified.
 4. Setback Period: Setback will typically start with the end of the occupied period and end with the start of the preoccupancy period, however it shall be provided with its own schedule. Generally systems will be off except to maintain a “setback” temperature, economization may be enabled to maintain “setback” cooling setpoint when applicable.

Note: Controls contractor shall match existing AHU schedule

- F. Where any sequence or occupancy schedule calls for more than one motorized unit to start simultaneously, the BAS start commands shall be staggered by 5 second (adj.) intervals to minimize inrush current.
- G. Wherever a value is indicated as adjustable (adj.), it shall be modifiable, with the proper password level, from the LCS via an LNS plug-in or via a function block menu. For these points, it is unacceptable to have to modify programming statements to change the setpoint.
- H. When a power failure is detected in any phase, the BAS start commands shall be retracted immediately from all electrically powered units served by the failed power source. If the associated controller is powered by normal or emergency power, it may monitor its own power source as an indication of power status. If the controller is powered by uninterruptible power supply (UPS), or if it is not capable of monitoring its own power for use in sequences, Contractor shall provide at least one voltage monitor (three phase when applicable) per building. When the BAS detects that normal or emergency power has been restored, all equipment for which the BAS start command had been retracted

shall be automatically restarted in an orderly manner on staggered 5 second intervals to minimize inrush current.

- I. Where reset action is specified in a sequence of operation, but a reset schedule is not indicated on the drawings, one of the following methods shall be employed:
 1. Contractor shall determine a fixed reset schedule which shall result in stable operation and shall maintain the primary variable within the specified maximum allowable variance.
 2. A floating reset algorithm shall be used which increments the secondary variable setpoint (setpoint of control loop being reset) on a periodic basis to maintain primary variable setpoint. The recalculation time and reset increment shall be chosen to maintain the primary variable within the specified maximum allowable variance.
 3. Primary variable shall control the devices directly using a PID feedback control loop without resetting the secondary variable. However, the control devices shall still modulate as necessary to maintain upper and lower limits on the secondary variable. Proportional band, integral gain, and derivative term shall be selected to maintain the primary variable within the specified maximum allowable tolerance while minimizing overshoot and settling time. Contractor shall gain prior approval for implementing this method of reset.
- J. Where a supply air temperature or duct pressure setpoint is specified to be reset by the space temperature of the zones calling for the most cooling/heating, the following method shall be employed:
 1. A floating reset algorithm shall be used which increments the secondary variable (e.g., supply air temperature or duct pressure) setpoint on a periodic basis to maintain primary variable (e.g. space temperature) setpoint. The reset increment shall be determined by the quantity of “need heat” or “need cool” requests from individual SCU’s. A SCU’s “need heat” virtual point shall activate whenever the zone’s space temperature falls below the currently applicable (occupied or unoccupied) heating setpoint throttling range. A SCU’s “need cool” virtual point shall activate whenever the zone’s space temperature rises above the currently applicable (occupied, unoccupied, or economy) cooling setpoint throttling range. The recalculation time and reset increment shall be chosen to maintain the primary variable within the specified maximum allowable variance while minimizing overshoot and settling time. Reset range maximum and minimum values shall limit the setpoint range.
- K. Where a supply air temperature, duct pressure, or differential water pressure setpoint is specified to be reset by valve or damper position of the zone or zones calling for the most cooling/heating, the following method shall be employed:
 1. A floating reset algorithm shall be used which increments the secondary variable (e.g., supply air temperature, pipe or duct pressure) setpoint on a periodic basis to maintain primary variable (e.g. cooling valve, heating valve, damper position) setpoint of 85% open. The reset increment shall be calculated based on the average position of the quantity of the worst (most open valve/damper) zone(s) as specified. The recalculation time, reset increment and control device position influence shall be chosen to maintain the primary variable within the specified maximum allowable variance while minimizing overshoot and settling time. The BAS analog output value shall be acceptable as indicating the position of the control device.

2. Alternatively to continuously calculating the average of the quantity of worst valve/damper positions, a method similar to the one described above may be employed whereby the “need heat” or “need cool” virtual point shall increment by one unit each time a zone’s valve/damper position rises to greater than 95%. The quantity of “need heat” or “need cool” points shall then be the basis for reset.
- L. Where “prove operation” of a device (generally controlled by a digital output) is indicated in the sequence, it shall require that the BAS shall, after an adjustable time delay after the device is commanded to operate (feedback delay) , confirm that the device is operational via the status input. If the status point does not confirm operation after the time delay or anytime thereafter for an adjustable time delay (debounce delay) while the device is commanded to run, an alarm shall be enunciated audibly. Upon failure, run command shall be removed and the device shall be locked out until the alarm is manually acknowledged unless specified otherwise.
- M. BAS shall provide for adjustable maximum rates of change for increasing and decreasing output from the following analog output points:
1. Speed control of variable speed drives
 2. Control Reset Loop
 3. Valve Travel Limit
- N. Wherever a value is indicated to be dependent on another value (i.e.: setpoint plus 5°F) BAS shall use that equation to determine the value. Simply providing a virtual point that the operator must set is unacceptable. In this case three virtual points shall be provided. One to store the parameter (5°F), one to store the setpoint, and one to store the value which is the result of the equation.

3.02 AIR HANDLING UNITS - GENERAL

- A. Logic Strategies: The BAS shall fully control the air handlers. Generally the BAS shall energize the AH (start the fans and activate control loops) as dictated for each air handler. The following indicates when and how the BAS shall energize the AHs and control various common aspects of them. The following “logic strategies” shall be included by reference with each air handler with any specific clarifications required:
1. Scheduled Occupancy: BAS shall determine the occupancy periods (occupied, unoccupied, preoccupancy, and setback) as defined above. The following details the common control aspects related to the scheduled occupancy
 - a) Occupied Period: BAS shall energize the AH during all occupied periods. Note that the beginning of the occupancy period shall be set sufficiently before the actual start of occupancy to obtain the required building component of ventilation per ASHREA 62. Specific times shall be as directed by the A/E. Minimum OA flow setpoint shall be as scheduled on the drawings. “Normal” setpoints shall apply.
 - b) Unoccupied Period: Minimum OA flow shall be 0 CFM and the minimum OA damper position shall be 0%. If during the unoccupied period there is a request for occupancy override, the occupancy mode shall become active for an adjustable period. The unoccupied period and the preoccupancy period will typically overlap.

- c) Setback Period: the BAS shall deenergize the unit except as required to maintain a setback temperature as indicated in the individual sequences with a 5°F cycle differential. Generally, where setback temperatures apply in multiple zones, the worst zone shall control the system. Setback setpoints generally apply except during preoccupancy. If during the unoccupied period there is a request for occupancy override, the occupancy mode shall become active for an adjustable period.
- d) Preoccupancy: BAS shall energize the AH continuously during the preoccupancy period. Minimum OA flow shall be 0 CFM or the minimum OA damper position shall be 0%. “Normal” setpoints shall apply. Preoccupancy duration shall be one of the following as specified by reference:

- 1) Fixed: The duration of the preoccupancy period shall be reset based on outside air temperature as follows:

Outside Air Temperature	Preoccupancy Start Time
> 70°F	1 hour early start
60°F to 70°F	On time start
50°F to 60°F	30 minutes early start
40°F to 50°F	1 hour early start
30°F to 40°F	1½ hour early start
< 30°F	2 hour early start

- 2. Airside Economizer: BAS shall modulate the mixing dampers to provide “free cooling” when conditions merit. The free cooling shall generally be staged before any mechanical cooling. While conditions merit, dampers shall be modulated in a DA PID loop to maintain mixed air temperature at a setpoint as specified for the individual unit. Economizer logic shall remain enabled during setback cooling where applicable. :
 - a) Dry Bulb Switch: Economizer mode shall be active while:
 - 1) The unit is energized
 - 2) AND, when outside air temperature falls below the switching setpoint of 63°F (adj.) (with 2°F (adj.) cycle differential - Enable at 63°F, Disable at 65°F).
 - 3) AND, either of the following are true:
 - 1. Outside air temperature is less than 55°F (adj.)OR, Return (exhaust) air humidity is not greater than 55% (with 2% (adj.) cycle differential).
 - 2. Economizer mode shall be inactive when outside air temperature rises above switching setpoint, dampers shall return to their scheduled minimum positions as specified above.
- 3. Sequenced Heating and Cooling: BAS shall control the heating and cooling coils and air side economizer as detailed for the particular AH. Program logic shall directly prohibit the heating and cooling valves as well as the heating valve and economizer damper to be open (or above minimum) simultaneously. This does not apply to cooling and reheat valves that are used simultaneously for dehumidification.

4. Freeze Safety: Upon operation of a freezestat, unit shall be deenergized with the exception of the heating loops. Typically supply and return fans where applicable shall be deenergized via a hardwired interlock, , and an indication of the operation shall be sensed by the BAS. BAS shall enunciate appropriate alarm and remove and lock out the start command, which shall initiate "fan failure" alarms. OA dampers shall close, RA dampers shall open, all hydronic valves shall open and heating loops shall remain active.
 5. Smoke Safety (Non-Smoke Control AHs): Upon indication of smoke by a smoke detector, BAS shall deenergize the AH. Smoke detector shall notify the fire alarm system, shut down the fans, and close the smoke dampers via hard-wired interlock.
 6. Smoke Safety (Smoke Control AHs): Upon indication of smoke by a smoke detector, BAS shall override the AH control as needed for smoke control sequence of operation.
 7. High or Low Pressure Safety: Upon activation of a high or low pressure safety switch, AH shall be deenergized, fans shall be deenergized via a hard wired interlock, and an indication of the operation shall be sensed by the BAS. BAS shall enunciate appropriate alarm and remove and lock out the start command, which shall initiate "fan failure" alarms.
- B. The detailed "logic strategies" above shall be required by reference to them in each of the individual sequences specified below.

3.03 100% OA VAV AH WITH PREHEAT & CHW COIL [DWG M4.1]

- A. General: The air handler shall be fully controlled by the BAS. For details on the referenced logic strategies refer to item 3.02 Air Handling Units General on page 230993 - 6. Air handler control logic strategies shall include
1. scheduled occupancy
 2. sequenced heating and cooling coil valve control
 3. high & low pressure safety
 4. freeze Safety.
 5. smoke/fire Safety
- B. Supply Fan: BAS shall control the starting and stopping of the supply fan as follows:
1. Start/Stop: BAS shall command the operation of the supply fan and it shall run continuously whenever the AH is "energized" as specified for the applicable logic strategies specified in item Air Handlers General on page 230993 - 6 above. Typically, the unit will run continuously in both the occupied and unoccupied modes. Provide a software switch that will allow the user to choose between running the unit continuously in the unoccupied mode and cycling on only when needed to maintain minimum space temperatures.
 2. Proof: BAS shall prove fan operation and use the status indication to accumulate runtime. Upon failure of the associated exhaust fan, BAS shall deenergize the supply fan, lockout the run command, and enunciate an alarm as specified above.
 3. VSD Control: Whenever the fan is energized, BAS shall control the speed of the VSD to maintain the supply duct static pressure setpoint. On start and stop, the VSD shall ramp to speed and slow down within adjustable acceleration and deceleration limits.

4. Supply Duct Pressure Setpoint: Setpoint shall be:
 - a) Reset between the limits of .5" to 2" as to maintain pressure requests of the VAV boxes at approximately [4] with all values adjustable.
 - b) BAS shall utilize a Sample and Bump output strategy or other similar loop output or logic to reset the static setpoint. Reset values shall be adjusted for optimized building and energy performance.
5. VSD LON Interface: BAS shall monitor the VSD via a LON interface. All available information shall be accessible via the interface for display on the VFD graphic. BAS shall also accumulate energy consumption of the fan motor (KWH) on a daily, monthly & yearly basis. BAS shall display KWH values for the following:
 - a) KWH day to date (total for the day)
 - b) KWH previous day
 - c) KWH week to date
 - d) KWH previous week
 - e) KWH year to date
 - f) KWH previous year
- C. OA Dampers: The dampers shall open whenever the Supply Fan is energized and close when it is deenergized. A damper position end switch shall prove the damper open before the fan is allowed to run. Upon failure of the OA damper, BAS shall deenergize the supply fan, lockout the run command, and enunciate an alarm.
- D. Discharge Temperature Control: The discharge temperature setpoint shall be set to the lower of the following:
 1. A Sample and Bump output, or similar loop output or logic shall reset the discharge temperature setpoint from 65°F to 58°F (both adjustable) to maintain the cooling requests at approximately [4] (adj.)
 2. A linear reset loop output reset from 65°F to 55°F (both adjustable) as the return air humidity rises from 52% to 58% (both adjustable).Reset values shall be adjusted for optimized building and energy performance.
- E. Preheating Section:
 1. HW Heating Valve: The heating valve will be enabled under all conditions, N.O. valve shall modulate per the higher of:
 - a) a PID loop to maintain a leaving coil temperature at 52°F, and
 - b) a linear % reset loop output from 0% to 100% as leaving coil temperature falls from 47°F to 42°F,.
 2. HW Circulating Pump:
 - a) BAS shall enable the pump whenever the OA Temperature is less than 45°F. BAS shall disabled the pump whenever the OA Temperature is greater than 50°F.
 - b) Proof: BAS shall prove pump operation and use the status indication to accumulate runtime. BAS shall enunciate an alarm upon pump failure.

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- F. Cooling Section:
 - 1. Cooling Coil Valve: N.C. cooling coil valve shall modulate via a DA PID loop to maintain discharge temperature at setpoint.
- G. Occupancy Override: When the Occupancy Override button on any of the room sensors is depressed momentarily, the unit shall be indexed to the Occupied period for 60 min. (adj.)

END OF SECTION 230993

SECTION 23 21 13 - 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.

1.5 ENVIRONMENTAL REQUIREMENTS

- A. Do not install underground piping when bedding is wet or frozen.

1.6 SUBMITTAL

- A. Restrained joint calculations; submit complete calculations for all underground ductile iron pipe joints indicating the requirements for restrained and push-type joints. Unless submitted, all joints shall be restrained type. Submission of output data from an approved vendor computer selection/calculation program will be required to justify the use of push-type joints in certain locations. This program shall utilize the depth of cover of a minimum of 3 feet, the specified test pressure for the system, a 1.5 safety factor and ANSI/AWWA C150/A21.50 Type 4 laying condition.

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.

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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.

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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.
- E. After completion, fill, clean, and treat systems. Refer to Section 23 25 00.

3.2 INSTALLATION

- A. Install in accordance with manufacturer's instructions.
- B. All chilled, hot, and condenser 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.

- T. For buried condenser water piping provide buried utility warning and identification tape. Polyethylene plastic tape manufactured specifically for warning and identifying buried utility lines shall be supplied and installed. Tape shall be buried above the pipe during the trench backfilling operation and shall be buried approximately 12” below grade. Tape shall be (0.004-inch-thick polyethylene) (polyethylene with a metallic core). Tape shall be 6” wide and printed with a caution and identification of the piping system over the entire tape length. Tape shall be yellow with bold black letters. Tape color and lettering shall be unaffected by moisture and other substances contained in the backfill materials.

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 23 21 13

SECTION 23 21 23 - PUMPS

PART 1 - GENERAL

1.1 WORK INCLUDED

- A. Furnish and install centrifugal type pumps with the following characteristics:
 - 1. In-Line
 - 2. Bronze fitted.
 - 3. Non-overloading.
 - 4. Single stage.
 - 5. 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 CENTRIFUGAL VERTICAL IN-LINE PUMPS

- A. Provide Vertical In-Line pumps, single stage, single or double suction type, with pump characteristics which provide rising heads to shut off. Refer to pump schedule for pump flows, heads, motor speed, enclosure, efficiency, and power requirements.
- B. Pump Casing - Cast iron for working pressure below 175 psig at 150°F (125 psig ANSI flange rating) or 1-1/2 times the actual discharge pressure (pump head plus static head) whichever is greater. Suction and Discharge connections shall be flanged and the same size and shall be drilled and tapped for seal flush and gauge connections. Pressure classification of flange

connection shall correspond to casing work pressure. High points of pump casing provided with air vent cocks. Where pumps are insulated, extend vent cocks outside insulation.

- C. All pumps one horsepower and large shall have impellers cut to provide capacities called for.
- D. The contractor shall have the impellers trimmed to match actual flow conditions on all pumps 10 H.P. and greater after the system is balanced to minimize throttling losses per NC State Building Code Volume X current edition.
- E. Fully bronzed fitted with enclosed impellers dynamically balanced. Bronze wearing ring or impeller runners provided on the suction side of the impellers.
- F. Shafts stainless steel.
- G. Coupling - Rigid spacer type of high tensile aluminum alloy. Couplings shall be split to allow removal from pump and motor shafts, leaving space between the shafts sufficient to replace all mechanical seal components without disturbing the pump or motor.
- H. Motor sized not to overload at any point within the operating range of impeller and piping system.
- I. Provide and install combination starter with circuit breaker to match motor.

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.

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- B. 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.
- C. Provide air cock and drain connection on horizontal pump casings. Provide drains for bases and seals.
- D. Provide drains for bases and seals.
- E. 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.
- F. 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 23 21 23

SECTION 23 31 00 - 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. Stainless Steel: ASTM A480, Type 304, sheet form, with No. 1 finish.
- C. 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.
- D. 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.
- E. 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.
- F. Fasteners: Rivets, bolts, or sheet metal screws; stainless steel for stainless steel ductwork.
- G. 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.
- H. 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 broken, 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 or oval ducts upstream of terminal units 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. Double wall insulated round ducts downstream of terminal boxes: Machine made from round spiral lockseam duct with light reinforcing corrugations, galvanized steel outer wall, 1” thick fiberglass insulation, perforated galvanized steel inner wall; fittings manufactured with solid inner wall.
- D. 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.
- E. 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 terminal units to supply ducts with maximum length of flexible duct as detailed on plans. Do not use flexible duct to change direction unless shown on drawings.
- I. 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.
- J. Connect flexible ducts to metal ducts with adhesive and draw bands. Use sheet metal screws for positive pressure over 2".
- K. Set plenum doors 6 to 12 inches above floor. Arrange door swings so that fan static pressure holds door in closed position.

- L. During construction, provide temporary closures of metal or taped polyethylene on open ductwork to prevent construction dust or weather from entering ductwork system.
- M. Manufactured casings shall be assembled and installed as noted in paragraph 3.1 A above.

3.2 CLEANING

- A. Clean duct system and force air at high velocity through duct to remove accumulated dust. To obtain sufficient air, clean duct in sections of size approved by the Designer. Protect equipment which may be harmed by excessive dirt with temporary filters, or bypass during cleaning.
- B. Clean new plenums and accessible ducts in Mechanical/Equipment Rooms with high power vacuum machines. Clean existing plenums and accessible ducts in Mechanical/Equipment Rooms where indicated with high power vacuum machines. Protect equipment which may be harmed by excessive dirt with filters, or bypass during cleaning. Provide adequate access into ductwork for cleaning purposes.

3.3 DUCTWORK PRESSURE CLASS 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
Space and Fume Hood Exhaust	6
All Other Ducts	2

END OF SECTION 23 31 00

SECTION 23 33 00 - DUCTWORK ACCESSORIES

PART 1 - GENERAL

1.1 SECTION INCLUDES

- A. Louvers
- B. Air turning devices/extractors.
- C. Backdraft dampers.
- D. Duct test holes.
- E. Flexible duct connections.
- F. Volume control dampers.

1.2 REFERENCES

- A. AMCA 500 - Test Methods for Louvers, Dampers and Shutters.
- B. NFPA 90A - Installation of Air conditioning and Ventilating Systems.
- C. NFPA 92A - Smoke Control Systems.
- D. SMACNA - HVAC Duct Construction Standards - Metal and Flexible.
- E. UL 33 - Heat Responsive Links for Fire-Protection Service.
- F. UL 555 - Fire Dampers and Ceiling Dampers.
- G. 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 LOUVERS

- A. Manufacturers:

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1. Ruskin.
2. Price.
3. Greenheck.

A. WIND DRIVEN RAIN STATIONARY BLADE LOUVER

Model: EME3625DFL as manufactured by Ruskin Company.

1. AMCA 540 Level D and AMCA 550 Listing with the Air Movement and Control Association Certified Ratings Program.

Fabrication:

1. Design: High performance wind-driven rain (WDR) stationary vertical blade louver type with drain spouts in jambs and mullions. Extended sill. Louver design shall limit single span between visible mullions to 60 inches (1524 mm).
2. Frame:
 - a. Frame Depth: 3 inches (76 mm).
 - b. Material: Extruded aluminum, Alloy 6063-T6.
 - c. Wall Thickness: 0.062 inch (1.6 mm), nominal.
3. Blades:
 - a. Style: Vertical sinusoidal.
 - b. Material: Extruded aluminum.
 - c. Exterior Wall Thickness: 0.040 inch (1.0 mm), nominal.
 - d. Centers: 3/4 inch (19 mm), nominal.
4. Fabrication:
 - a. Mullion Style – Design incorporates visible mullions or frames at the perimeter of the louver and also at certain intervals within the louver perimeter to support the louver blades. Louver blade sightlines are interrupted at the mullion locations. No rear-mounted blade supports are utilized.
5. Minimum Assembly Size: 12 inches wide by 12 inches high (305 mm x 305 mm).
6. Maximum Factory Assembly Size: Single sections shall not exceed 48 inches wide by 96 inches high (1220 mm x 2438 mm) Louvers larger than the maximum single size shall be require field assembly of smaller sections.
7. Recycled Content: 18% post-consumer. 55% pre-consumer, post-industrial, total 73% by weight.

Performance Data:

1. Performance Ratings: AMCA licensed.
 - a. Based on testing 48 inch by 48 inch (1219 mm by 1219 mm) size unit in accordance with AMCA 500.
2. Free Area: 45 percent, nominal.
3. Free Area Size: 7.29 sf (.68 sm).
4. Maximum Recommended Air Flow through Free Area: 2024 feet per minute (7.2 m/s).
5. Air Flow: 14755 cubic feet per minute (418 cu. m/min).
6. Maximum Pressure Drop: .42 inches w.g. (.05 kPa).

Wind Driven Water Penetration Performance:

1. Based on testing 39 inches x 39 inches (1 m x 1 m) core area, 41 inches x 44 inches (1.04 m x 1.12 m) nominal size unit in accordance with AMCA 500-L.
2. Wind Velocity: 29 mph (47 kph).
 - a. Rainfall Rate: 3 inches/hour (76 mm/hour).
 - b. Free Area Velocity: 2010 feet per minute (10.0 m/sec).
 - c. Water Resistance Effectiveness: 100% (AMCA Class A).

- 3. Wind Velocity: 50 mph (80 kph).
 - a. Rainfall Rate: 8 inches/hour (203 mm/hour).
 - b. Free Area Velocity: 2024 feet per minute (10.1 m/sec).
 - c. Water Resistance Effectiveness: 100% (AMCA Class A).
- A. Design Windload: 20 psf

2.2 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.

2.3 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.

2.4 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.

2.5 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.

2.6 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.

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- 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 23 33 00

SECTION 23 42 13 – ULTRAVIOLET GERMICIDAL IRRADIATION (UVGI) SYSTEMS

PART 1 - GENERAL

1.1 SECTION INCLUDES:

- A. UV Lighting for:
- B.
 - 1. AHU Cooling Coils

1.2 REFERENCES

- A. International Ultraviolet Association (IUVA) Compliance
- B. IUVA G01A – General Guideline for Air and Surface Disinfection Systems
- C. IUVA G02A – Guideline for Design and Installation of UVGI Air Disinfection Systems in New Building Construction

1.3 QUALITY ASSURANCE

- A. UVGI system components shall be constructed to withstand typical HVAC environments and to be ETL listed under UL Standard 1598.
- B. UVGI system shall comply with UL 1995 for use in HVAC equipment and carry the UL Label.

1.4 SUBMITTAL

- A. **Manufacturer's Data:** Submit manufacturer's specifications showing dimensions, capacities, ratings, performance characteristics, gages and finishes of materials and installation instructions for each manufactured component.

PART 2 - PRODUCTS

2.1 UVGI LAMPS AND LAMP ARRAY

UVGI System

23 42 13 - 1

- A. Lamps: Lamps and ballasts shall have the following characteristics:
 - 1. Emit UVC radiation, at least 85% of which is emitted at 253.7 nm wavelength.
 - 2. Withstand typical HVAC environments and be ETL listed under UL Standard 1598.
 - 3. Be certified as non-generators of ozone.
 - 4. Have rated lamp life of at least 9,000 hours.
- B. Lamp Array: Quantity and arrangement of UVGI lamps shall be determined by the manufacturer to satisfy the following performance requirements:
 - 1. Produce constant and uniform irradiation dose for the application, resulting in at least a 90% disinfection effect for vegetative bacteria, mycobacteria, bacterial spores, and fungal spores, computed in accordance with 2016 ASHRAE Handbook – HVAC Systems and Equipment.
- C. System: Provide UVC lamps, reflectors, controls, wiring, and supporting framework to form a complete UVGI system.
- D. Disconnect: Provide manual, lockable disconnecting switch, located on the outside of the AHU, to de-energize the UVGI system by authorized personnel.
- E. Performance Monitor: Provide UV radiometer, permanently installed, to measure UV radiation output of lamps and provide an audible and visual alarm when the radiation level falls to a preset level. Provide a dry contact for connection to BAS system.

PART 3 - EXECUTION

3.1 INSTALLATION

- A. The UVGI system shall be installed in strict accordance with manufacturer's requirements.

3.2 SAFETY REQUIREMENTS

- A. Install safety interlock switches, with manual reset, on each air-handling unit access door or panel, interlocked to de-energize the UVGI system if any access door or panel is opened.
- B. Provide signage on AHU access door with black letters on a yellow background indicating the following:

CAUTION!

Ultraviolet Energy in Air Handling Unit
Do not Switch off Safety Interlock or Activate Lamps While Unit is Occupied.

- C. Test UVGI system radiation levels upon completion of installation using a UV radiometer directly facing the lamp(s) at eye level at several locations within the application area. If test levels exceed 600000 mJ/cm², the system must be de-energized and adjusted to reduce radiation levels to below this value.

3.3 OWNER INSTRUCTION AND TRAINING

- A. Provide Owner instruction and training for UVGI system.

3.4

- A. Remove scale and dirt on inside and outside before assembly.
- B. Make piping connections to equipment with flanges or unions.
- C. Keep open ends of pipe free from scale and dirt. Protect open ends with temporary plugs or caps.
- D. After completion, fill, clean, and treat systems. Refer to Section 23 25 00.

3.5 INSTALLATION

- A. Install in accordance with manufacturer's instructions.
- B. All chilled, hot, and condenser 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:
- J.
 - 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.
- K. Pipe Hangers and Supports:
- L.
 - 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.
- M. Provide clearance in hangers and from structure and other equipment for installation of insulation and access to valves and fittings.
- N. Provide access where valves and fittings are not exposed.
- O. Slope piping and arrange system to drain at low points. Use eccentric reducers to maintain proper grade.
- P. Where pipe support members are welded to structural building framing, scrape, brush clean, and apply one coat of zinc rich primer to welds.
- Q. Install valves with stems upright or horizontal, not inverted.
- R. Pipe Joints: Unless otherwise specified, join pipes as follows:
- S.
 - 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:
4.
 - 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.
- T. Do not make direct welded connections to valves, expansion joints, strainers, apparatus, or any other units which are intended to be removable.
- U. 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.
- V. For screwed joints, use Teflon tape or approved pipe joint compound; apply only on male threads.
- W. For buried condenser water piping provide buried utility warning and identification tape. Polyethylene plastic tape manufactured specifically for warning and identifying buried utility lines shall be supplied and installed. Tape shall be buried above the pipe during the trench backfilling operation and shall be buried approximately 12" below grade. Tape shall be (0.004-inch-thick polyethylene) (polyethylene with a metallic core). Tape shall be 6" wide and printed with a caution and identification of the piping system over the entire tape length. Tape shall be yellow with bold black letters. Tape color and lettering shall be unaffected by moisture and other substances contained in the backfill materials.

3.6 SCHEDULES

A. Pipe Hanger Spacing:

3.7

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

3.8

END OF SECTION 23 21 13

SECTION 23 73 00 – CUSTOM AIR HANDLING UNITS

PART 1 - GENERAL

1.1 DESCRIPTION

- 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.
 - 1. Manufacturer’s project number.
 - 2. Plant name and location.
 - 3. Equipment number.
 - 4. Date of manufacture.

1.3 QUALITY ASSURANCE

- A. The unit shall be specifically designed, manufactured and tested for specialized duty. Field assembled or modified standard commercial grade equipment shall not be accepted.
- B. The product, including cabinet design, materials and major components, shall have a proven record of satisfactory use in installations of the specific application of this project for a minimum of 5 years.
- C. Where a standard quality is specified for a major component, one of the acceptable manufacturers and models specified herein shall be provided.
- D. NFPA Compliance. Units and components shall be designed, fabricated and installed in compliance with NFPA 90A.
- E. UL Compliance. Electrical components used shall be listed and labeled by UL.
- F. NEMA Compliance. All motors shall comply with applicable NEMA Standards.
- G. AMCA Compliance. Fans shall be certified to bear the AMCA seal for air and acoustic performance per Standards 210 and 310. Dampers shall be tested and rated according to Standard 500D.
- H. ETL Compliance. Complete unit shall be listed and labeled by ETL per standards ANSI/UL 1995 and CAN/CSA C22.2 #236-05.

1.4 PRECONSTRUCTION SUBMITTALS

- A. Product Data: For each air-handling unit.
 - 1. Include construction details, material descriptions, dimensions of individual components and profiles, and finishes.
 - 2. Include rated capacities, operating characteristics, electrical characteristics, and furnished specialties and accessories.
 - 3. Include unit dimensions and weight.
 - 4. Include cabinet material, metal thickness, finishes, insulation, and accessories.
 - 5. Fans:
 - a. Include certified fan-performance curves with system operating conditions indicated.
 - b. Include certified fan-sound power ratings.
 - c. Include fan construction and accessories.
 - d. Include motor ratings, electrical characteristics, and motor accessories.
 - 6. Include certified coil-performance ratings with system operating conditions indicated.
 - 7. Include filters with performance characteristics.
 - 8. Include dampers, including housings, linkages, and operators.
- B. Shop Drawings: For each type and configuration of indoor, semi-custom air handling unit.

1. Include plans, elevations, sections, and attachment details.
2. Include details of equipment assemblies. Indicate dimensions, weights, loads, required clearances, method of field assembly, components, and location and size of each field connection.
3. Detail fabrication and assembly of indoor, semi-custom air-handling units, as well as procedures and diagrams.
4. Include diagrams for power, signal, and control wiring.

1.5 CLOSEOUT SUBMITTALS

- A. Operation and Maintenance Data: For air-handling units to include in emergency, operation, and maintenance manuals.

1.6 MAINTENANCE MATERIAL SUBMITTALS

- A. Furnish extra materials that match products installed and that are packaged with protective covering for storage and identified with labels describing contents.
 1. Filters: One set for each air-handling unit.
 2. Gaskets: One set for each access door.

1.7 PRODUCT HANDLING

- A. Deliver equipment to the job site with all exposed openings temporarily closed off with plywood, sheet metal or shrink-wrap. All equipment intended for indoor use shall be shrink-wrapped prior to shipment.

1.8 WARRANTY

- A. All equipment, materials, and workmanship shall be warranted for twelve (12) months from project acceptance.
 1. Manufacturer Warranty - Parts and labor for all equipment, materials and workmanship for a period of two (2) years from project acceptance.
- 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. Provide custom air handler as manufactured by Annexair.

- B. Innovent
- C. Haakon
- D. Pre-approved Equivalent.

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.

2.3 UNIT CONSTRUCTION – COMPOSITE MATERIAL

1. The unit housing shall be fabricated from BIOSOURCED Engineered Composite, which is 100% metal free and sandwiched with a 100% recycled High-Performance GREEN foam insulation. The sandwich panel shall be bonded together with an organic, BIOSOURCED fire-resistant resin, that has no environmental impact or health hazard to humans. The panels shall be used for the base floor, walls and roof.
2. All panels shall be tested in accordance with AHRI 1350 to have a deflection rating of no more than L/1400 (Casing Deflection Rating Class CD1); 0.5% leakage rate at 10” (Casing Air Leakage rating Class 2, for one piece construction); and a Thermal Bridging rating of no lower than 0.86 (Thermal Bridging rating Class CB1).
3. Unit construction shall be certified for wind and seismic conditions, per the requirements of 2018 International Building code and ASCE 7-16. The test results shall be certified to seismic site class D and wind speed conditions of 195 mph (Miami-Dade County, FL).
4. Unit housing shall have no exterior condensation at interior AHU temperatures down to 42.5F while unit exterior conditions are maintained at 95 F dry bulb / 85 F wet bulb.
5. Fire resistance of the panel shall be in compliance with UL 94; and a flame spread / smoke development in compliance with UL 723 ASTM E84 Class 1 rating.
6. The housing assembly shall be screwless, monocoque construction, complete with smooth rounded interior corners and edges. These smooth corner or edges shall have a minimum 1” radius to facilitate easy wash down cleaning, reducing the possibility of dirt accumulation and improve Indoor Air Quality .

7. Unit housing shall have NO thermal bridging material from interior to exterior, avoiding any condensation that can lead to premature corrosion; as seen with conventional metal units.
8. The walls and roof panels shall be all double wall with 1/8" BIOSOURCED Engineered Composite, reinforced glass-fiber on both sides of panel, and insulated with a High-Performance GREEN foam insulation that is made from 100% recycled content, produced in an eco-friendly manner without using CFCs or HCFCs. The U-value of the sandwich panel shall be .
9. The base floor structure shall be constructed in the same process as the walls and roof. Base structure shall be fully welded G-90, painted exterior, and have integral lifting lugs which can be removed once the unit is installed.
10. Each floor compartment shall be additionally sealed, for Hygienic purposes, with a self levelling 1/8" fire retardant epoxy to guarantee no leakage between compartments. The outdoor air compartment shall have a 3/4" FPT ABS floor drain, flush mounted to unit base exterior. All bottom duct openings shall be covered with 1" fiberglass walkable molded gratings, with a 1" upturn collar around the perimeter of the opening.
11. All access doors shall be thermally broken and constructed from the same material and thickness as the housing panels. The access door frame shall have no thermal bridging and shall be made from UV-resistant Acrylonitrile Styrene Acrylate (ASA), that provides superior resistance to outdoor weathering. Access doors shall be flush mounted to the housing with rounded corners and full depth 45 degree chamfer frame. The frame shall have a dual staged EPDM gasket, providing a superior air tightness when the door is compressed to the frame. Each access door shall contain one dual-function lockable compression latch and handle; operable from inside and outside. The access door and frame shall have a piano hinge design with a stainless steel pin rod, allowing the door to open 180 degrees.

2.4 UNIT CONSTRUCTION – STAINLESS STEEL

1. General. Construct unit with materials and features as specified herein. Provide structural base and tube frame to house inset wall, ceiling and floor panels. Unit construction shall meet Cabinet Performance specified in this section. Structural tube frame and panel construction shall be provided with no individual panel exceeding 36" width. All panels on the unit shall be fully removable without the use of cutting tools. All internal components shall be removable without compromising the structural integrity of the unit.
2. Cabinet Performance. Unit construction shall meet the following minimum performance criteria.

3. Base Deflection. Design structural base to limit deflection to 1/4" in length and width when rigging the unit according to manufacturer recommendations. Provide engineering calculations demonstrating compliance with this requirement.

4. Cabinet Deflection. Construct cabinet to limit deflection of the walls and roof to L/250 at 8" w.c. static pressure, or 1.5 times the maximum static pressure within the unit at design conditions, whichever is lower. Deflection ratings for panels only shall not be accepted.

5. Floor Deflection: Maximum floor deflection shall be L/500 (L=span in inches) when subjected to an 800 lb/sq ft. point load. Provide test data demonstrating compliance with this requirement.

6. Casing Air Leakage. Maximum casing leakage shall meet SMACNA duct leakage class (DLC) rating of 5.0. Provide calculations demonstrating compliance with this requirement.

7. Thermal Performance. All interior walls, floor, and ceiling shall be double wall and insulated with polyurethane injected foam insulation having a minimum R- value of 6.3 - 7.1/inch. Fiberglass or non-injected foam insulation is not acceptable and will be rejected.

8. Base. Base shall be constructed of welded 10 ga. structural steel G channel perimeter and C channel cross members with integral lifting lugs. Units without a welded structural steel base that utilize lifting provisions near the top of the cabinet shall be unacceptable. Bolted bases shall not be acceptable. Coat base exterior with 2 part epoxy primer and urethane modified enamel topcoat. Welded lifting lugs shall be provided. Weep holes shall be provided in base channels. Base height shall be a minimum of 8" to facilitate proper trapping of drains.

9. Frame. Frame shall be constructed of structural tube members designed to support flush-mounted double-wall panels. Vertical frame members shall be easily removable without the use of specialty tools or torches for replacement of large internal components. Welded frame shall not be accepted unless all internal components can be easily removed without cutting any welds. A closed-cell polyvinyl foam gasket with a thickness of 3/16" or greater shall be applied between all frame members and panels, providing a thermal break between the panels and the structural frame. Units without a structural tube frame shall be unacceptable.

a. Frame Material: Extruded 6063 Aluminum Tube

10. Floor. Floor shall be 2" thick double-wall, foam injected panel construction for optimal support strength. Floor shall be a fastener free design, bonded to the unit base with a structural adhesive. All seams shall be finished with an adhesive sealant providing a watertight floor system. Use of tack welding, caulk or screws penetrating the entire floor panel anywhere in the floor shall not be accepted. The floor shall have a smooth and flat walk-on surface. A minimum 1" lip shall be provided around all floor penetrations. Walk-on grating shall be provided over all accessible floor mounted duct connections. Paneled floor shall be constructed of a minimum of 18 ga 304 stainless steel walk on surface and 22 gauge galvanized steel underside surface.

11. Wall and Ceiling Panels. Unit shall have non-load bearing, fully removable, heavy gauge 2" double-wall panels which fully encapsulate the injected foam insulation. No individual panel shall exceed 36" width. Panel edges utilizing PVC edge wrappers to cover the insulation shall not be accepted. Panels shall be manufactured with an integral thermal break.

a. Exterior Materials: Exterior skin shall be 304 stainless steel.

b. Interior Materials: Interior skin shall be 304 stainless steel.

1. Perforated liner shall be provided in the fan sections for additional sound attenuation. The perforated liner shall be incorporated into the standard panel design providing a completely flush inner surface. The insulation behind the perforated metal shall be non-porous, fiber-free and include an EPA-registered antimicrobial agent for protection against mold, fungal and bacterial growth.

12. Thermal Break Construction. The casing (panels and frame) shall meet AHRI 1350 CB-1 requirements.

13. Insulation. Insulation shall be a product of a manufacturer specializing in insulating materials. All walls, floor, and ceiling shall be double wall and insulated with polyurethane injected foam insulation. Provide a data sheet from the insulation manufacturer confirming an R-value of 6.3 - 7.1 per inch. No insulation shall be exposed to the airstream. Non-injected foam board insulation or air handler manufacturer produced insulating material shall not be accepted. Fiberglass, mineral wool, and non-injected foam board insulation shall not be accepted.

14. Access Doors. Provide double wall doors with the same insulation and inner/outer wall material as the wall panels. Doors shall have an integral aluminum frame and shall be mounted into the structural frame of the unit. Door openings cut into casing panels shall not be accepted. Doors shall be full height (up to 72") with industrial continuous stainless steel hinges. Bi-directional compression latches with integral roller cam and hex-screw locking assembly shall be provided. An EPDM type door gasket shall be provided in accordance with ASTM D 2000. Supply and exhaust airstreams shall not be covered by a single door. Access panels in lieu of access doors shall not be accepted. All doors that open with pressure shall be provided with a pressure relief safety latch. Access doors shall be provided for sections requiring routine maintenance.

15. Door Options Included:

- a. Access doors shall be provided with 12"x12" double pane wire-glass windows in all sections.
- b. Access doors shall be provided with aluminum door tie backs.
- c. All access doors shall be thermal break design.
- d. A mechanical interlink shall be provided such that all door handles can be opened by only using one handle.

2.4 BLOWER/MOTOR

A. Supply Blower;

1. Wheel. The fan shall be non-overloading centrifugal type. Wheel shall be statically and dynamically balanced to balance grade G6.3 per ANSI S2.19.
 - a. The supply fan wheel shall be manufactured with a minimum of seven, stitch welded steel backward curved blades.
 - b. Fan wheel shall be finished with a protective coating to inhibit corrosion.
 - c. The wheel and fan inlet shall be carefully matched and shall have precise running tolerances for maximum performance and operating efficiency.
2. Construction. Plenum fans shall be of the unhooded direct drive centrifugal type.
3. Motor: Reference section 230300 for motor requirements.
4. Performance. Conform to ANSI/AMCA standards 210 and 300. Fans shall be tested in accordance with AMCA Publications 211 and 311 in an AMCA accredited laboratory and certified for air and sound performance. Fans shall be licensed to bear the AMCA ratings seal for air performance (AMCA 210) and sound performance (AMCA 300).
 - a. Fan brake horsepower shall not exceed the scheduled brake horsepower at the total static pressure and airflow scheduled.
 - b. Provide the number of fans scheduled.
 - c. Fan motors shall be selected to run at no more than 90 Hz at design conditions.
5. Mounting. Blower and motor shall be mounted on a unitary isolation base.
 - a. Structural steel fan/motor base shall be designed by the manufacturer to properly support the fan/motor assembly to mitigate vibration.

2.5 DAMPERS

A. Dampers shall meet or exceed the following construction and ratings.

1. Outside air damper:
 - a. 316 stainless steel frame and blade dampers, airfoil blade
 - 1) Construction
 - a) Frame material: 16 ga. 316 stainless steel, 5" x 1" hat channel
 - b) Blade Material: 2 skins of 14 ga. 316 stainless steel
 - c) Blade Type: Airfoil
 - d) Linkage: 316 stainless steel concealed in the jamb (out of airstream). Plastic and/or gear driven linkages shall not be allowed.
 - e) Axle material: 316 stainless steel
 - f) Axle Bearings: 316 stainless steel
 - g) Blade seals: TPE
 - h) Jamb seals: 316 stainless steel

- 2) Ratings. AMCA Class 1A rated at 1" w.c. and Class 1 at 4-10" w.c. with AMCA certified performance for pressure drop and leakage per AMCA 500-1D, Test Figures 5.2, 5.3, and 5.5. Dampers shall be IECC compliant.
 - a) Velocity Limit: Suitable for use to 6000 fpm
 - b) Leakage: 3 cfm/sq ft (AMCA class 1A)
 - c) Temperature Rang: -40°F to 250 °F
 - d) Pressure Limit: Suitable for use to 8" w.c.
- B. The following dampers shall be provided at a minimum:
1. Outside air shut-off damper, 2 position actuator required.

2.6 FILTERS

- A. General Requirements. Provide filters as specified in this section. Filter racks shall be blanked off to the unit casing to inhibit air bypass. Filters shall be located within the air handling unit cabinet and shall not be in a hood or duct sleeve outside of the air handler cabinet.
- B. Supply Air Pleated Filter: Provide a flat or V-bank filter section as shown on the unit drawing and as follows:
1. Depth and rating: 2" MERV-8
 2. Location: Mount filters immediately downstream of the outside air inlet.
 3. Rack: Mount in shared rack with cartridge filters
 4. Face Velocity: Provide filters sized for 500 fpm maximum face velocity, but no higher than the scheduled value.
 5. Filters shall be rated per UL standard 900.
- C. Supply Air High Efficiency Cartridge Filter: Provide a flat bank or V-bank cartridge filter section as shown on the unit drawing and as follows:
1. Depth and Rating. Provide 4" MERV-14 cartridge filters
 2. Location: Mount in a shared rack with the pre-filter, immediately downstream of the OA inlet.
 3. Rack: Provide a stainless steel front access rack. Front access racks shall include filter clips and be gasketed.
 4. Face velocity: Provide filters sized for 500 fpm maximum face velocity, but no higher than the scheduled value.
 5. Filters shall be rated per UL standard 900.
- D. Filter Pressure Monitoring: Magnahelic pressure gauges shall be provided across all filter racks.

2.7 HOT WATER COIL

- A. Provide preheat coils as scheduled.
1. Construction. Provide coils with the following material types and thicknesses:
 - a. Fins: 0.006" thick aluminum
 - b. Tubes: 0.02" thick seamless copper
 - c. Tube Diameter: 5/8"
 - d. Casing: Stainless Steel.
 2. Performance: Provide coils meeting the following performance parameters:

- a. System parameters (provide as scheduled):
 - 1) Fluid: water
 - 2) Entering fluid temperature
 - 3) Water temperature drop
 - b. Face Velocity: Not to exceed the scheduled value.
 - c. Air Pressure Drop: Not to exceed the scheduled value.
 - d. Water pressure drop: Maximum 10' w.c., but not to exceed the scheduled value
 - e. GPM: Not to exceed the scheduled value
 - f. Heat Transfer Surface:
 - 1) Rows: Provide the number of rows scheduled.
 - 2) Fin Density: maximum 10 fins/inch, but not to exceed the number of fins/inch scheduled
3. Piping Connection. Supply and return connections up to 2" diameter shall be copper sweat type. Connections larger than 2" shall be steel grooved connections.
 4. Coil Coatings (s).
 - a. Preheat: Baked Heresite P413.

2.8 CHILLED WATER COIL

- A. Provide ARI rated coils.
 1. Construction. Provide coils with the following material types and thicknesses:
 - a. Fins: 0.006" thick aluminum
 - b. Tubes: 0.02" thick seamless copper
 - c. Tube Diameter: 5/8"
 - d. Casing: Stainless Steel.
 2. Performance: Provide coils meeting the following performance parameters:
 - a. System parameters (provide as scheduled):
 - 1) Fluid: water
 - 2) Entering fluid temperature
 - 3) Water temperature rise
 - b. Face Velocity: Minimum 250 fpm, maximum 450 fpm, but not to exceed the scheduled value.
 - c. Air Pressure Drop: Not to exceed the scheduled value.
 - d. Water pressure drop: Maximum 20' w.c., but not to exceed the scheduled value
 - e. GPM: Not to exceed the scheduled value
 - f. Heat Transfer Surface:
 - 1) Rows: Provide the number of rows scheduled.
 - 2) Fin Density: maximum 10 fins/inch, but not to exceed the number of fins/inch scheduled
 3. Cooling Coil Drain Pan. All cooling coils shall be provided with 304 stainless steel IAQ drain pans that begin at the entering air side of the coil face and extend a minimum of 12" past the leaving air side of the coil face. Entire underside of the drain pan, including the piping run to the casing exterior, shall be coated with no less than 2" of spray foam insulation to ensure no sweating occurs below. Coil shall be installed on "walk-on" supports spaced a maximum of 6" apart to allow full access to the coil face without damage to the drain pan. Pans without the feature shall not be accepted. The drain pan shall be sloped in a minimum of 2 directions to ensure proper drainage. The drain shall be located on the bottom of the drain pan and the connection countersunk below the surface of the drain pan to eliminate the potential for standing water at the connection. No side

connections in the pan shall be allowed. An integral intermediate drain pan shall be provided for tall coils in applications where condensate is expected. The intermediate pan shall be factory piped with PVC piping to the main drain pan.

4. Piping Connections. Supply and return connections up to 2" diameter shall be copper sweat type. Connections larger than 2" shall be steel grooved connections.
5. Coil Coatings (s).
 - a. Preheat: Baked Heresite P413.

2.9 ELECTRICAL

A. General Requirements.

1. Units shall be provided fully factory wired per the requirements of this section.
2. Units shall be ETL listed to the Standard for Safety for Heating and Cooling Equipment, ANSI/UL Standard 1995 and CAN/CSA C22.2 No. 236-05. Factory wiring practices, safety provisions, components, and labeling shall be per the requirements of the ETL listing.
3. All major electrical components shall be UL listed.

B. Wiring Requirements.

1. Power wiring shall be enclosed in conduit.
2. Ladder wiring diagrams shall be provided. Lines on the diagram shall be numbered, and the associated wires shall be numbered at both terminations for help in troubleshooting.
3. Wires shall be color coded per voltage (line voltage/120V/24V) in the Electrical Panel, and per function from the terminal blocks in the Electrical/Control panel to end devices. Color coding shall be called out on the ladder diagram.
4. Provide units with an SCCR rating of 5kA.
5. Provide dedicated wires to end devices (transducers, analog sensors, etc.) to limit potential electrical interference.
6. Wiring and conduit penetrations through panels or block-offs shall be provided with a grommet per metal surface to protect against electrical short circuiting an abrasion, and sealed with sealant to prevent leakage.

C. Major components

1. Variable Frequency Drives shall be provided by installing contractor. Refer to section 230513.

D. Accessories:

1. Lights: Provide IP67 rated LED light stirps in all access sections. Wire lights to a single switch. Mount light switch near the electrical panel and wire switch to a terminal stirp in the electrical panel. A transformer shall be provided to provide power to the lighting circuit.
- 2.

PART 3 - EXECUTION

3.1 INSTALLATION

- A. Install unit per manufacturer's recommendations and instructions as described in the Installation, Operation and Maintenance (IOM) manual.
- B. Install each unit on a 10" channel base or as indicated on the drawings, grouted to set level.
- C. Mount each unit by spring isolators (minimum 1-1/2" deflection) to prevent transmission of vibration.
- D. Coordinate the selection of the isolators with manufacturer of the air handling units to assure compatibility of mounting details.
- E. Units with internal frame to utilize internal vibration isolation.
- F. Isolators for units mounted on inertia bases to be supplied by vibration isolation manufacturer.
- G. 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.
- H. 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, supply fan and the cooling coil. Each differential pressure gauge shall utilize copper tubing for sensing points. Mount pressure gauges on the exterior of the air handling unit. Gauges shall not be mounted into the air-handling unit housing or onto doors. Mount gauges on the exterior of the air-handling unit at a fixed location. Provide on-off-vent valves at each differential pressure gauge to provide static and differential pressure in each section of the air handling unit.
- I. 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. Provide flexible connections at duct connections to unit.
- J. 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. Route condensate drain piping to nearest floor drain.
 - 4. Install service valves and companion flanges or unions on supply and return lines to coils.
 - 5. Arrange piping such that valves can be shut off, a small section of pipe removed, and the coil pulled.

3.2 EXAMINATION

- A. After completing the installation, inspect the air handler for damage, dirt or debris. Remove all dirt, construction debris and repair any damage to the finish including chips, scratches or dents.

3.3 FIELD AQUALITY CONTROL

- A. After the equipment is installed, the manufacturer's representative shall inspect the installation and recommend any corrective actions. Do not start up the equipment until the following are completed:
1. All controls are installed and fully operational.
 2. Power is connected to the unit.
 3. Shipping materials have been removed.
 4. Filtration media is installed and clean.
 5. Piping and duct connections are installed and operational.
 6. Leak checks are completed on all water connections.
 7. All wiring, refrigerant piping, gasketing and hardware are properly installed on any multiple section units.

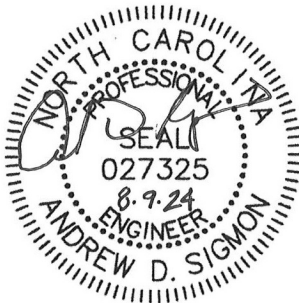
3.4 START-UP AND OWNER ORIENTATION

- A. Equipment start-up and owner maintenance orientation shall be the responsibility of the unit manufacturer to activate equipment warranty and assure that the Owner and his facility personnel are comfortable and familiar with equipment maintenance.
1. Manufacturer shall include a minimum of four hours on-site for owner maintenance training and orientation.
- B. 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.
- C. Equipment startup shall be in compliance with requirements listed in Mechanical General Specification.

END OF SECTION 23 73 00

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

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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

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- 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 insulation resistance tester.
 - 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.

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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. Provide phase rotation testing before and after service and feeder replacements to assure uniform rotation of motors in the buildings. Contractor shall document testing for each service and feeder included in the scope of work. Provide results to Engineer prior to final inspection.
- E. All test results for items A. and B. above shall be included in Operation and Maintenance manuals for Owner future trending.
- F. 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

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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, Republic, or Encore, Engineer approved equivalent, 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

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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

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- r) RoHS compliant
- s) CE approved
- t) C(UL) 600V Type RW90 TC

PART 3 EXECUTION

3.1 INSTALLATION

- 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.

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- 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.

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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. The main service ground clamp shall be attached to the metallic cold water main at an accessible point and before its size is reduced immediately after it enters the building. Clamp shall be accessible after construction is complete. Grounding conductor shall be without splice into the service enclosure where it shall be connected to main service neutral.
- B. In addition to the clamp on the water main, a supplemental electrode shall be provided. This supplemental electrode shall consist of the following: three (3) 10-foot minimum copper clad ground rods, 3/4" in diameter, driven to a depth so top of rod is below finished grade. Grounding conductor shall be continuous and sized as shown on plans. The grounding conductor conduit shall be fastened to service enclosure with double locknuts and bonding bushing.
- C. In addition to the metallic cold water pipe and supplemental electrode, the metal frame of the building shall be bonded to the grounding electrode system using a conductor sized the same as the main grounding conductor on the drawings.
- D. Bond the above ground portion of the gas piping system upstream from equipment shutoff valve to the building electrical service ground. The bonding jumper shall be sized per NEC Table 250.66.
- E. Upon completion of installation of the grounding electrode and bonding system, the ground resistance shall be tested with a ground resistance tester. Resistance to ground shall be less than 25 ohms. If test indicates a greater resistance, appropriate measures shall be taken, including driving additional ground rods, to reduce the resistance to less than 25 ohms. Contractor shall send a letter

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to the engineer and owner certifying that the ground resistance test has been performed and stating the resistance measured.

- F. 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.
- G. 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.
- H. Attach rigid metal conduits with double locknuts - one inside and one outside - and fiber bushing, or in a threaded hub.
- I. 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.
- J. 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.
- K. 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 05 26

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.

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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, Raco, 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.

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- 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.

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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" (± 4 " in concrete block construction) from finished floor to top of can.
 6. Fire alarm pull stations 46" from finished floor to center.

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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

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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. All underground utility locates requests shall call 811 and the EDS Main Phone Number: 919-962-8394. Contractor must allow at least three (3) days for all locates requests to be processed.
- C. 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 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.
- 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.



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- 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

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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

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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. In outdoor locations, labels shall be applied using two-part epoxy that is weatherproof and sunlight resistant. Nameplates shall identify

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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.

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- 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 firestopping 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 MANUFACTURER

- A. Square D I-Line distribution panel is specified as basis of design for Coker Building Switchboard replacement. Equivalent by Eaton or ABB may also be quoted.

2.2 MATERIALS

- A. Branch circuit panelboards shall be bolt-on type, Square D NQOD or NF types, or equivalent. Distribution panelboards shall be Square D I-Line types HCN, HCM, HCW, as indicated on plans, or equivalent.
- B. Types, sizes, capacities and characteristics shall be as shown on riser diagram or in schedules. Service equipment shall be labeled "UL Approved for Service Entrance Use".
- C. All breakers shall be fully rated. Series rating are not acceptable.
- D. Feed through panels shall not be used.

2.3 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 in door design with 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.

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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 in the plans and specifications. 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 600A 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.
 10. All breakers in distribution panels shall include LOTO (lock out tag out) capability.
- 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

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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. 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.
- K. 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.

2.4 METERING:

- A. Panel shall be equipped with a high performance utility meter with communications, such as the Square D Power Logic PM 5563 I-Line smart cell, or equivalent system by Eaton, or ABB (meters shall be same manufacturer as switchboard manufacturer). The intent is to provide provision for connecting to the building energy management system via Modbus protocol, or protocol as provided with the building management system. The meter shall provide for continuous readouts as well as maximum capture of amps, volts, watts, kvars, kva, power factor, frequency, demand amps, demand watts, and wathours. Values shall be in true RMS. Meter shall flag tripping events and capture readings that trigger the event.

2.5 SURGE PROTECTION DEVICE (SPD)

- A. Surge protection device, Type 2, shall be provided in distribution and branch circuit panelboards where indicated on drawings.
- B. SPD units shall meet the following performance criteria:
 1. Feeder/Branch mounted.
 2. Surge current capacity rating of at least 160 KA per mode/80 KA per phase.
 3. Shall meet U.L. 1449,4th edition (or later) standards and be U.L. listed.
 4. SPD shall be UL labeled with 100kA short circuit current rating (SCCR).
 5. Unit shall have overcurrent protection with no less than the KAIC rating as the panelboards.
 6. Unit shall have diagnostic testing capability as well as status monitoring indication for each phase.
 7. SPD shall provide surge current paths for all modes of protection.
 8. Unit shall be serviceable with replaceable modules.
 9. Unit shall have 1283 EMI/RFI filtering with minimum attenuation of -50dB at 100 KHz.
 10. Unit shall include visual LED diagnostics with minimum of a test function, audible alarm with on/off switch, phase indicators and service indicator.
 11. Unit shall have a surge event counter with back up power source.
 12. Provide integral three (3) pole breaker sized per manufacturer's recommendations as part of the panelboard.

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- C. All ratings specified in "B" above shall be verified by an independent testing lab. Results of these tests shall be provided with submittals

PART 3 EXECUTION

3.1 INSTALLATION

- A. Mount equipment plumb and level.
- B. Openings in boxes, cabinets, or gutters shall be cut or sawed. Burning of openings is prohibited.
- C. 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.
- D. Only one solid wire is allowable under a screw. Use lug for connecting stranded wire or more than one solid conductor.
- E. Label all equipment in conformance with Section 26 05 53.
- F. 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.
- G. 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.
- H. 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

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 industrial specification grade or heavy duty grade, 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. Switches considered equivalent are as follows:

- 1. Single Pole:
 - Hubbell 1221
 - Bryant 4901
 - P & S 20AC1
 - Leviton 1221
 - Eagle 2221

B. Duplex receptacles considered equivalent are as follows:

- 1. Heavy Duty Specification Grade:
 - Hubbell 5362
 - Bryant 5362
 - P & S 5362
 - Leviton 5362
 - Eagle 5362

C. 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.).

D. 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.

E. Ground fault interrupter type duplex receptacles shall be heavy duty specification grade. Where used outdoors, they shall be the weather-resistant type, as well as ground fault unless otherwise indicated. They shall have metallic extra duty rated weather proof while-in-use protective covers (Hubbell WP26E/WP26EH series or equivalent).

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

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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.

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- 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

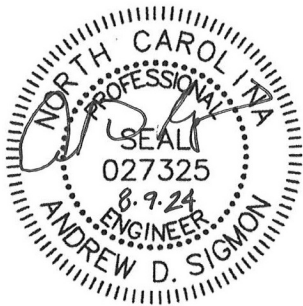
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DIVISION 28 – TABLE OF CONTENTS

<u>SECTION</u>	<u>TITLE</u>
28 31 00	FIRE DETECTION AND ALARM



MCKIM & CREED

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SECTION 28 31 00 - FIRE DETECTION AND ALARM

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of Contract, including General and Supplementary Conditions, apply to work of this section.

1.2 SCOPE

- A. This section of the specifications includes providing upgrades associated with the AHU-1 modifications in the Fisheries Building of the microprocessor controlled fire alarm equipment required to form a complete coordinated system ready for operation. It shall include, but not be limited to, alarm initiating devices, auxiliary control devices, and accessories as shown on the drawings and specified herein.
- B. All devices shall be compatible and UL Listed for use with these systems.

1.3 QUALITY ASSURANCE

- A. Manufacturer's Qualifications: Firms regularly engaged in manufacture of fire alarm systems of types, sizes, and electrical characteristics required, and whose products are Listed and Labeled by UL, Inc. All products, including initiating devices, shall be as produced or supplied by the same manufacturer as the main fire alarm control panel. Products of firms that do not maintain factory authorized service organization and spare parts stock are not acceptable for use on this project.

Manufacturer's shall agree to make factory training/certification, product programs and/or operating systems, and continued product updates and/or Tech notes available to the University. Any licensing and/or proprietary agreements between the manufacture/distributor and the University shall be completed and in place prior to the manufacture and/or product being acceptable for installation.

- B. Installer's Qualifications: An experienced company who is an authorized representative of the FACP manufacturer for both installation and maintenance of all equipment is required for installation of the FACP and connection of all circuits for any project. The Installer shall have a minimum of five (5) years documented experience installing fire detection and alarm systems similar in size and scope to this project. The Installer technicians shall be individually certified NICET Level 2 and by the manufacturer of the equipment and trained and certified on the specific model being installed. The Installer shall have at least one technician on staff certified NICET Level 3. Certifications shall be current to latest release and shall have occurred in the most recent 24 months. All connections to the FACP, system programming, and/or programming changes shall be accomplished only by the Installer technicians compliant with qualifications, and shall be present for the 100% test, Engineer's inspection, and Owner inspections.
- C. Codes and Standards: The codes and standards listed below are utilized as design criteria for "minimal" system coverage. The University may require additions to these codes and standards

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based on historical consensus criteria for design and installation of fire alarm systems specific to facility applications within University type settings.

1. NFPA Compliance: Comply with current applicable requirements of NFPA-72 2013, National Fire Alarm Code.
2. NEC Compliance: Comply with current applicable requirements of NFPA-70 2014, National Electrical Code (NEC) standards pertaining to fire alarm systems.
3. State Building Code Compliance: Comply with applicable requirements of the North Carolina State Building Code 2012.
4. Testing Laboratory Compliance: Comply with provisions of UL safety standards pertaining to fire alarm systems. Provide products and components, which are Listed and Labeled.
5. FM Compliance: Provide fire alarm systems and accessories, which are FM approved.
6. Comply with Authority(ies) Having Jurisdiction (AHJ):
 - a) NC State code requirement issues: NC Department of Insurance/State Construction Office
 - b) City of Chapel Hill code requirement issues: Chapel Hill Fire Marshall
 - c) University code requirement issues: UNC Health & Safety Fire Marshall
 - d) University policy and system application requirements: UNC Facilities Services Superintendent of Life Safety & Access Controls

1.4 SUBMITTALS - GENERAL

- A. Submittals shall demonstrate compliance with technical requirements by reference to each subsection of this specification. Where a submitted item does not comply fully with each and every requirement of the specifications, the submittal shall clearly indicate such deviations and may be subject to rejection. Identification requirements for non-complying features of items are very specific.
1. Installer Certifications: Copies of manufacturer signed certifications and NICET certifications as required in section 1.3.B above.
 2. Product Data: Submit Manufacturer's technical product data, including specifications and installation instructions, for all system components (i.e, boards, devices and/or modules, duct mounted smoke detectors, flow switches, tamper switches, supervisory switches, and/or other similar items which require mechanical installation.) that will support the entire fire alarm system. Submit technical product data on any required fire alarm system servicing and/or support equipment.
 3. Maintenance Data: Submit maintenance data and parts lists for each type of fire alarm equipment being furnished, including furnished specialties and accessories. Include this data and product data in maintenance manual.

4. Shop Drawings: Submit one electronic set of shop drawings showing all equipment, all device/module locations, and connecting wiring of entire fire alarm system depicted on scaled architectural floor plans with Installer's border sheet. Include wiring and riser diagrams and battery calculations. See (Attachment A) for typical wiring and riser diagrams requirements for these applications. Provide distance and proposed route for each Notification Appliance Circuits (NAC's). Provide electronically in PDF format as well. An electronic copy of such plans shall also be provided by the Contractor in a format compatible with the most recent release of AutoCAD if requested.
5. Standby Battery Sizing Calculations: Submittal shall list voltage drop allowed for main fire alarm panel and Notification Appliance Circuits panels (NAC's). Calculations shall be submitted prior to installation of equipment. Battery calculation shall be based on "worst case" scenario of current draw, voltage available after 24-hours standby and five (5) minutes of full alarm, shall be indicated on a battery chart. The UL minimum voltage allowed by panel shall be used to calculate NAC current draw and voltage drop. Submittals shall provide milliamp current draw data for each device submitted and UL Listed minimum voltage required to operate.
6. Owner Training and Certification: Provide the owner a current factory approved certification/ training schedule for the specific system installed.

PART 2 - PRODUCTS

2.1 MANUFACTURER'S/MODELS

A. The existing system is a Notifier AFP200.

3. System Response to an Alarm Condition: When a fire alarm condition is detected and reported by one of the system initiating devices or appliances, the following functions shall immediately occur:
 - a) The system alarm LED shall flash.
 - b) A local piezo-electric signal in the control panel shall sound.
 - c) The 80-character LCD display shall indicate all information associated with the fire alarm condition including: the type of alarm point, the initiating device address and the description of its physical location within the protected premises.
 - d) History logging of all information associated with the event, including time and date of occurrence.
 - e) Activate all system outputs, including program assigned via control-by-event equations, shall be executed by the particular point in alarm. Exact programming shall be provided by the Contractor to meet the Owner's requirements.
 - f) Activate all fire alarm notification appliances in the building, sounding and flashing in synchronization continuously until manually silenced, or until the initiating device and control unit has been reset to normal condition.
 - g) Activate digital alarm communicator(s).
 - h) Deactivate door hold control relay such that all smoke doors are allowed to close.
 - i) Deactivate control relays allowing HVAC units to stop.

- k) Activate elevator recall sequence if smoke is detected in any elevator lobby or in the elevator equipment room.
 - l) Release all doors, which may be secured by “fail secure” methods.
 - m) Transmission of all data to any remote annunciation panels.
4. System Response to Trouble Conditions:
- a) The system trouble LED(s) shall flash.
 - b) A local piezo-electric signal in the control panel shall sound.
 - c) The 80-character LCD display shall indicate all information associated with the trouble condition including: the type of device point, the device address and the description of its physical location within the protected premises.
 - d) History logging of all information associated with the event, including time and date of occurrence.
 - e) Activate digital alarm communicator(s).
 - f) System AC power trouble signal shall not be sent unless maintained for 8 hours (or more).
 - g) Provide adjustable time delay for all trouble signals prior to transmission.
 - h) Transmission of all data to any remote annunciation panels.
5. System Response to Supervisory Conditions (typically associated with sprinkler system monitored type devices only):
- a) The system supervisory LED(s) shall flash.
 - b) A local piezo-electric signal in the control panel shall sound.
 - c) The 80-character LCD display shall indicate all information associated with the supervisory condition including: the type of device point, the device address and the description of its physical location within the protected premises.
 - d) History logging of all information associated with the event, including time and date of occurrence.
 - e) Activate digital alarm communicator(s).
 - f) Transmission of all data to any remote annunciation panels.

B. General Requirements:

1. A copy of the final building floor plans with all device locations and assigned system addresses shall be permanently mounted at the location of the main FACP. All AV circuit EOL's, riser cabinets, and Isolation Modules shall also be included on these drawings. A separate sheet shall be provided for each floor. Sheets shall be laminated. Provide legend for symbols.
2. All external modules required to be mounted at the main FACP location shall be housed in a UL listed cabinet suitable for surface or semi flush mounting. Cabinet and front shall be corrosion protected, given a rust resistant prime coat, and manufacturer's standard finish. The door shall provide a key lock. For convenience, the door may be hinged on

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either the right or left side (field selectable). Where multiple enclosures are required in the same area, the cabinets shall all be the same size and color. Cabinet doors shall be electrically bonded to enclosure it serves.

3. The system modifications shall be new and furnished with a warranty (parts & labor) of at least one (1) year from the date of final inspection and acceptance by the Owner. Equipment, initiating devices, and alarm appliances shall be arranged as described in the Drawings; annunciator zones shall be configured as described in the Drawings.
 4. All system components shall be attached to walls and ceiling/floor assemblies and shall be held firmly in place (*e.g.*, detectors shall not be supported solely by suspended ceilings). Fasteners and supports shall be adequate to support the required load. Adhesives are not permitted to mount fire alarm system components to building surfaces or structure.
 5. Loops shall be confined to one floor of coverage and shall not include any devices/modules located or serving other floor areas of coverage. Loop 1 shall be assigned to the lowest elevation level of the building. Loop numbers shall increment with elevation levels of the building floors. Device numbering starts the loop with address 001 and increments sequentially accordingly as electrically connected in the circuit to the return of the loop.
 6. For AHU shutdown, silencing the alarm (without resetting) shall not reverse the shutdown. A supervised programmable "Hot Key" for all AHU Shutdown Defeat modules shall be provided in the FACP. The switch shall indicate "Normal" or "Off Normal" position.
 7. The coverage of each fire alarm loop as described in the Drawings shall be indicated on the FACP and any remote annunciator. This may be accomplished by engraved labels, framed directories, and/or graphic displays. Label tape or handwritten labels are not acceptable. Update existing as applicable.
- L. Input Power Requirements:
1. Existing to Remain.
- M. Wiring:
1. Non-Power-Limited Circuits: Copper conductors with 600V rated, THHN/THWN, color coded insulation.
 - a) Low Voltage Circuits: STRANDED, #18 AWG, minimum.
 - b) Line Voltage Circuits: SOLID, #12 AWG, minimum.
 2. Power Limited Circuits: NFPA70, Types FPL, FPLR, or FPLP, as recommended by the manufacturer. Data Loop wire shall be shielded pair #18 AWG, 30 pf/ft capacitance or less, unless specifically prohibited by the manufacturer and stated on the wiring submittal.
 - a) Acceptable cables include Atlas 228-18-1-1STP, Belden YQ28541, BSCC S1802s19 (same as EEC 7806LC), West Penn D975, D991 (AWG 16), D995 (AWG 16), D995 (AWG 14), or equal wire having capacitance of 30pf/ft. maximum between conductors. The cable jacket color shall be red, with red (+) and black (-) conductor insulation.

EXCEPTION #1: Unshielded cable, otherwise equal to the above, is permitted to be used where the manufacturer's installation instructions unequivocally require,

or state a preference for, the use of unshielded cable of all systems, AWG #16 minimum.

EXCEPTION #2: In underground conduit, use Type TC or PLTC cable (PE insulated) to avoid problems from moisture.

3. Style 6 Circuits Required: Systems with one or more addressable sub-panels that (1) have an integral addressable loop controller, or (2) monitor multiple conventional initiation zones, shall comply with the NFPA 72 requirements for Style 6 circuits.
4. All wiring shall be color coded in accordance with the following scheme, which shall be maintained throughout the system, without color change in any wire run:

<u>Addressable Devices</u>	<u>Approved Manufacture Data</u>
Signal Line Circuit cable	Red jacket with Red(+)/Black(-)
Alarm Indicating Appliance Circuits	Blue (+)/Black (-)
<u>Conventional Type Devices or Circuits connected directly to the FACP or to Monitored or Controlled Addressable Devices</u>	
Initiating Circuits, General*	Red (+)/White (-)
Initiating Circuits, Smoke Detectors Only*	Violet (+)/Gray (-)
AHU Shutdown Circuits	Yellow (+)/Brown (-)
Door Control Circuits	Orange
Elevator Capture Circuits	Brown

5. All wiring and cable shall be in EMT (minimum), 3/4" minimum diameter, unless indicated otherwise on the Drawings or elsewhere in the Specifications. All fire alarm system raceway, couplings, and connectors shall meet the performance and installation requirements of Section 260533 RACEWAY AND BOXES FOR ELECTRICAL SYSTEMS. Couplings shall be steel compression type and connectors shall be steel compression type with insulated throats.
 6. All wiring shall be checked for grounds, opens, and shorts, prior to termination at panels and installation of detector heads. The minimum resistance to ground or between any two (2) conductors shall be ten megohms (10 MΩ), as verified with a megger. Provide advance notice to the Engineer of these tests so they can witness at their discretion.
- 2.2 DIGITAL ALARM COMMUNICATOR TRANSMITTERS (DACTs)
- A. Remote Transmissions: Existing to Remain.
- 2.3 AUXILIARY POWER SUPPLY PANELS (APS)
- A. Auxiliary Power Supply(ies) - General: Typical applications for usage of APS panels include but are not limited to: notification appliance circuits (NAC), door holders, control relays, and sounder base power extenders.
 - B. APS – Auxiliary Power Supplies: Existing to Remain.
- 2.4 ANNUNCIATION DEVICES

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- A. Alarm Notification Appliances – Existing to Remain.
- B. Device Remote Annunciation: Remote annunciator indicator lights (RAILs) shall be provided in locations where indicated on the Drawings. In addition, RAILs shall have the following features:
 - 1. RAILs shall be provided with a key type switch for testing of the annunciated device. Testing device activation shall be accomplished through direct hardwiring to the device NOT through software activation, be program activated, or by any external logic controlling.
 - 2. Voltage: RAILs shall operate on 24 VDC nominal.
 - 3. Mounting: Device shall be mounted in/to the wall at the same height requirements per NFPA72 as audible/visual devices. Do not mount in ceiling tiles without specific approval from the Owner and Engineer. Devices shall be located in the nearest corridor or public area and identified by an engraved affixed label.
- H. Alphanumeric Display Annunciators (FACP and Remote Annunciator): Existing to Remain.
- I. Serially Connected LED Annunciator (FACP): Existing to Remain.

2.5 INITIATING DEVICES

- A. Non-Addressable Type Devices – General: In some cases, the use of non-addressable devices with an addressable monitor type module is acceptable. These areas shall be identified on the drawings with the acceptable device type for the specific locations. Affected areas may include where:
 - 1. Temperature Ratings: Non-addressable devices shall be utilized in unconditioned spaces where temperature and/or humidity ranges can exceed the manufactures recommended ratings of the electronic component circuitry for proper operation of addressable type devices. Acceptable substitutions with these non-addressable type devices may include:
 - a) Thermal Detection Devices
 - b) Manual Stations
 - c) Tamper Switches
 - d) Duct Smoke Detectors
 - 2. Harsh Environments: Areas that is environmentally detrimental to addressable type devices. Acceptable substitutions with these conventional type devices may include:

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- a) Explosion proof devices
 - b) Flame detection devices
3. Mounting: When using non-addressable type devices monitored with an addressable monitor type modules. Mount addressable monitor type modules in nearest conditioned space and indicate its address on the outside of the enclosure by means of a label.
- B. Addressable Type Devices – General: Unless otherwise indicated on the Drawings all initiating devices shall be individually addressable. Addressable devices shall comply with the following general requirements:
- 1. Address Setting: Addressable devices shall provide an address setting means inherent within the device. Devices, which are addressed by the FACP are also acceptable.
 - 2. Device Identification: Addressable devices shall store an internal specific identifying “type” code that the FACP shall use to identify the type of device.
 - 3. Temperature Ratings: Addressable devices shall not be utilized in unconditioned spaces where temperature and/or humidity ranges can exceed the manufactures recommended ratings of the electronic component circuitry for proper operation.
 - 4. Operational Indications: Addressable devices shall provide powered LEDs. LEDs shall flash under normal conditions, indicating that the device is operational and in regular communication with the FACP. LEDs shall be placed into steady illumination by the FACP to indicate that an alarm or off normal condition has been detected. The flashing mode operation of the detector LEDs shall be optional through the system field program. An output connection shall also be provided in the device base to connect an external/remote LED indication of an alarm or off normal condition in specific required locations.
 - 5. Device Mounting: Unless otherwise specified all devices shall provide the following mounting criteria:
 - a) All detectors shall be ceiling-mount.
 - b) All other addressable devices, remote LED indicators, remote test switches, and isolation modules shall be wall-mount type unless specifically approved by the Owner and Engineer.
- C. Addressable Manual Stations (Pull Stations): Existing to Remain.
- D. Addressable Smoke Detectors: Unless otherwise indicated on the Drawings all smoke detectors shall comply with the following additional requirements:

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1. All smoke detector sensitivity shall be set through the FACP and shall be capable of adjustment in the field through the field programming of the system. Sensitivity shall be capable of being automatically adjusted by the FACP program on a time-of-day basis. Devices shall be capable of reporting obscuration levels and maintenance alerts when any smoke/duct detector approaches 80% of its alarm threshold due to gradual contamination.
2. Provide smoke detection in telecommunication closets, electrical closets, and rooms that contain significant electronic equipment such as computer server rooms and audio and/or video projection rooms.
3. Shall be the plug-in type, each having a separate base, to facilitate replacement and maintenance. When installed in a room, detectors shall be oriented so their alarm light is visible from the nearest door to the corridor.
 - a) In areas where smoke detector placements are not easily visible a Remote Alarm Indicator Light (RAIL) shall be provided, or in areas that will allow, a RED circle shall be painted on the floor directly below the detector with the device system address; these areas shall be specifically approved by the Owner and Engineer.
4. Spot type smoke detectors mounted within 12 feet of a walking surface shall have their built-in locking device activated.
5. Unless suitably protected against dust, paint, etc., detectors shall not be installed until the final construction clean-up has been completed. Contaminated detectors (at time of Owner testing) shall be replaced with new detectors by the Contractor at no additional cost to the Owner.
6. Identification of individual detectors is required. These device numbers, which shall also be shown on the shop drawings, shall be permanently affixed to the detector base. Device labels may not be affixed to the device. Identification labels shall be printed labels with black lettering on a clear background. Handwritten labels or labels made from embossed tape are not acceptable.
7. Smoke detector guards, where indicated on the drawings shall be listed for use with the specific model of smoke detector being protected. All smoke detector guards shall have a separate base which shall be very securely anchored to wall or ceiling. The cover shall be readily removable by the Owner for periodic detector cleaning and servicing but, to prevent unauthorized entry, shall be secured to the base by a lock or tamper resistant screws approved by the Engineer. Metal guards shall be 16 gauge or heavier steel.
8. Devices used for elevator capture are identified on the drawings. Primary and/or alternate recall points are indicated on the drawings. Elevator capture or control signals shall come from the FACP as relayed by control modules. Use of detector auxiliary contacts for elevator capture is not acceptable or permitted.

E. ALARM VERIFICATION FOR SMOKE DETECTORS

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1. The fire alarm system shall be equipped with logic method of verifying the presence of smoke.
 2. Alarms from other than spot type smoke detectors shall not be delayed by alarm verification. Alarm verification is *not* to be applied to linear beam, duct smoke detectors, elevator lobby and machine room detectors, nor to any software configured "cross zoned" detection devices. When programming the system, activate the automatic drift compensation feature for all spot-type smoke detectors. Whether or not to activate the alarm verification feature for such detectors is to be determined by the Engineer and Owner.
 3. Systems with alarm verification shall be permanently labeled to indicate that fact.
 4. While a verification cycle is in progress, an alarm, which occurs on another zone, shall not cause the verification cycle under way to be restarted or extended. It may have the same effect on the system as a verified alarm.
 5. The equipment shall be listed for alarm verification purposes. It shall either be installed at the factory, or field programmable and tested by the Manufacturer's authorized representative.
- F. Addressable Thermal Detectors (Heat): Unless otherwise indicated on the drawings, all addressable heat detectors shall comply with the design criteria of the conditioned protected space.
- G. Addressable Duct Smoke Detectors: Unless otherwise indicated on the drawings all duct smoke detectors shall be the photoelectric type.
1. General: Each duct detector installation shall have a hinged or latched duct access panel, 12x12 inches minimum, for sampling tube inspection and cleaning. Indicate airflow direction on the duct, adjacent to the detector, using stencil or permanent decal.
 - a) Air duct/plenum detectors shall have device remote annunciation. Furnish each duct detector unit with a remote alarm indicator light (RAIL) and test station. Mount remote indicator light/test station on wall at 8'-0" AFF in the nearest corridor or public area.
 - b) These detectors shall be installed in a manner that provides suitable access for required periodic cleaning and calibration.
 - c) Detectors shall be installed by Mechanical Contractor. Fire Alarm Contractor in coordination with Mechanical Contractor shall wire to fire alarm system. Fire alarm AHU shutdown relay circuits shall be wired from the fire alarm control panel to a termination point, adjacent to the AHU controller by the Fire Alarm Contractor in coordination with Mechanical Contractor. Mechanical Contractor shall make all control wiring connections for shutdown of respective AHUs via addressable control relays at termination point activated by the fire alarm control panel. Addressable control relays

shall be installed within three (3) feet of the controller for the equipment being controlled. All air handling systems shall be shutdown directly by the FACP during alarm shutdowns. Building automation systems shall not be used for alarm shutdowns of air handling systems.

d) A supervised "AHU Shutdown Defeat" switch shall be provided in/adjacent to the FACP or as a key-operated function in the Remote Annunciator (where provided). If the RA option is utilized, provide an informative engraved at the FACP about this function; otherwise provide an informative engraved label at the switch provided in/adjacent to the FACP. The switch shall cause a system "trouble" indication when the switch is placed in the off-normal ("Shutdown Defeated") position.

e) Unless the AHJ requires otherwise, all duct detectors shall be programmed for fire alarm as Owner preference (not supervisory annunciation).

2. Air Sampling Tubes: Probe length shall extend the full width of the duct. Those over 36 inches long shall be provided with far-end support for stability. Seal around the tube where it penetrates the duct wall and plug the end with a rubber stopper. Lengths shall be determined by Mechanical Contractor in coordination with the University.

2.6 MONITOR AND CONTROL DEVICES

A. Addressable Dry Contact Monitor Modules: Addressable monitor modules shall be provided to connect one (1) non-addressable device or to supervise a non-addressable IDC zone (either Style D or Style B) of conventional type alarm initiating devices (any Normally Open (N.O.) dry contact device) to one (1) of the Fire Alarm Control Panel Signaling Line Circuit Loops. Monitor modules shall be installed as required by the system configuration. All required monitor modules may not be shown on the Drawings.

1. Indication of Operation: Unless otherwise indicated on the drawings, an LED shall be provided that shall flash under normal conditions, indicating that the Monitor Module is operational and in regular communication with the FACP. The LED shall be visible from the device faceplate.
2. Mounting Requirements: Shall be mounted at the same height requirement as Notification Appliance devices in a clearly visible location.

B. Addressable Control Modules: Addressable control modules shall be provided to supervise and control the operation of one (1) conventional Notification Appliance Circuit (NAC) of compatible, 24 VDC powered, polarized Audio/Visual (A/V) Notification Appliances. For fan shutdown and other auxiliary control functions, the control module may be set to operate as a dry contract relay. The control module shall provide address-setting means using decimal switches and shall also store an internal identifying code that the control panel shall use to identify the type of device. An LED shall be provided that shall flash under normal conditions, indicating that the control module is operational and is in regular communication with the control panel. The LED shall be visible from the device faceplate. Control modules shall be rated for the load they control.

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1. Mounting Requirements: Shall be mounted at the same height requirement as Notification Appliance devices in a clearly visible location. Addressable control relays shall be installed within three (3) feet of the controller for the equipment being controlled.
2. Configuration: The control module NAC circuit may be wired for Style Y Class B with up to 1 Amp of inductive A/V signal, or 2 Amps of resistive A/V signal operation, or as a dry contact (Form C) relay. The control module shall be suitable for pilot duty applications and rated for a minimum of 0.6 amps at 30 VDC. The relay coil shall be magnetically latched to reduce wiring connection requirements, and to insure that 100% of all auxiliary relay or NAC's may be energized at the same time on the same pair of wires.
3. Power Source: Audio/visual power shall be provided by a separate supervised power loop from the main fire alarm control panel or from a supervised, UL listed remote power supply. A/V power sources and connections are not shown on the Drawings.
4. Supervision required: The connection between individual addressable modules and their contact type initiating device(s) shall be supervised.

C. Isolator Modules: Existing to Remain.

2.7 MISCELLANEOUS SYSTEM ITEMS

- A. Door Hold Open Magnets: Existing to Remain.
- B. Rolling Fire or Smoke Doors: Existing to Remain.
- C. Remote Power Supplies: Where remote power supplies are required, they shall meet the same requirements as those for the main fire alarm control panel, including the requirements for batteries and supervision.
- D. Keys and Locks: All panels, terminal cabinets, and pull stations shall be keyed alike. Coordinate key/lock with the Owner's requirements.
- E. Building Automatic Door Locking Systems Interface Requirements: Existing to Remain.
- F. Remote terminal cabinets: Existing to Remain.
- G. Spare Parts Requirements:
 1. Spare Parts: Provide the following spare parts with the system, each individually packaged and labeled. For multi-building projects, calculate separately for each building:

Fuses	2 of each size used in system
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Isolation Modules	2% of installed quantity
Manual Stations	2% of installed quantity
Indoor Horns/Strobes	4% of installed quantity
Spot Smoke Detectors, Bases	6% of installed quantity
Heat Detectors	6% of installed quantity
Monitor/Relay Modules	2% of installed quantity

2. Increase decimal quantities of spare parts to the next higher whole number. For example if a system has 20 spot-type smoke detectors provide two (2) spare detectors with bases.

PART 3 EXECUTION

3.1 INSTALLATION

- A. All equipment and components shall be installed in strict compliance with manufacturers' recommendations. Consult the manufacturer's installation manuals for all wiring diagrams, schematics, physical equipment sizes, etc., before beginning system installation. Refer to the Riser/Connection diagram for all specific system installation/termination/wiring data.
- B. All system components shall be attached to walls and ceiling/floor assemblies and shall be held firmly in place (e.g., detectors shall not be supported solely by suspended ceilings). Fasteners and supports shall be adequate to support the required load. Adhesives are not permitted to mount fire alarm system components to building surfaces or structure.
- C. All addressable loop controller circuits shall be "Class A" and shall have a minimum of 20% spare addresses for future use. Loops shall be confined to one floor of coverage and shall not include any devices/modules located or serving other floor areas of coverage. Loop 1 shall be assigned to the lowest elevation level of the building. Loop numbers shall increment with elevation levels of the building floors. Device numbering starts the loop with address 001 and increments sequentially accordingly as electrically connected in the circuit to the return of the loop. The supply and return conduit shall have at least one (1) foot vertically and four (4) feet horizontally of separation between them at all times.
- D. The system design includes AHU shutdown; therefore, silencing the alarm (without resetting) shall not reverse them. A supervised programmable "Hot Key" for all AHU Shutdown Defeat modules will be provided in the FACP. The switch will indicate "Normal" or "Off Normal" position. In addition, a supervised Hand-Off-Auto switch(es) will be provided at the FACP for any building smoke control equipment (pressurization, smoke purge or exhaust fans).
- E. The coverage of each fire alarm loop as described in the drawings shall be indicated on the FACP and any remote annunciator. This may be accomplished by engraved labels, framed directories, and/or graphic displays. Label tape or handwritten labels are not acceptable.

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- F. The system shall be equipped with the following protective devices to prevent damage or nuisance alarms by nearby lightning strikes, stray currents, or voltage transients. The devices are to be provided by the fire alarm equipment supplier:
1. On AC Input(s): A feed-through (not a shunt-type) branch circuit transient arrester such as: EFI HWM-120, Leviton OEM-120EFI, Northern Technologies TCS-HW, Transtector ACP100BWN3, or other equivalent Listed device shall be installed. Install at panelboard and trim excess lead lengths. Wind a small coil in branch circuit conductor, within panelboard, downstream of the suppressor connection. Coil is to be about 1" diameter, 7 to 10 turns, and tie-wrapped.
- G. Wiring:
1. No T-taps are allowed in system wiring.
 2. No splices are allowed in the system wiring. All wiring runs shall be continuous between devices. Use terminals on devices or terminal cabinets on each floor. "Wire nuts" and crimp splices shall not be permitted. Floating terminal strips shall not be permitted.
 3. Permanent wire markers shall be used to identify all connections at the FACP and other control equipment, at power supplies, and in terminal cabinets. In addition, for wiring inside terminal cabinets, affix typed professional legend to inside of terminal cabinet doors indicating wiring diagrams, line/load direction, etc.
 4. All conduits that penetrate outside walls from air conditioned space shall have internal sealing (duct-seal), to prevent condensation from infiltrating humid air.
 5. The exterior of all junction boxes containing fire alarm conductors shall be painted RED; box interiors shall not be painted. Box covers for junction boxes containing fire alarm conductors shall be painted RED on both sides. All painting of junction boxes and junction box covers shall be accomplished prior to installation of the boxes to avoid possible problems with overspray.
 6. Box covers shall be labeled to indicate the circuit(s) or function of the conductors contained therein. Labels shall be neatly applied black lettering on a clear background. Handwritten labels or labels made from embossed tape are not acceptable.
 7. Detection or alarm circuits shall not be included in raceways containing AC power or AC control wiring. Within the FACP, any 120 VAC control wiring or other circuits with an externally supplied AC/DC voltage above the nominal 24 VDC system power shall be properly separated from other circuits and the enclosure shall have an appropriate warning label to alert service personnel to the potential hazard.
 8. All wiring shall be checked for grounds, opens, and shorts, prior to termination at panels and installation of detector heads. The minimum resistance to ground or between any two conductors shall be ten megohms, as verified with a megger. Provide advance notice to the University of these tests.
 9. The system shall be electrically supervised for open or ground fault conditions in SLC, alarm circuits, and control circuits. Removal of any detection device, alarm appliance, plug in relay, system module, or standby battery connection shall also result in a trouble signal. Fire

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alarm signal shall override trouble signals, but any pre alarm trouble signal shall reappear when the panel is reset.

- H. Any circuit breaker supplying 120 VAC to any fire alarm equipment shall have a locking tab installed at the breaker. Electrical contractor shall provide breaker locks for breakers serving fire/smoke dampers.
- I. All junction and pull boxes shall be painted red prior to pulling wire unless installed in finished areas.
- J. Addressable interface modules (used to monitor all contact type initiating devices) shall be located in a conditioned space, unless they are tested, listed, and marked for continuous duty across the range of temperatures and humidity expected at their installed location. With AHJ approval they may be permitted to serve as many as three (3) sprinkler system valve supervisory switches, or six (6) heat detectors, in a single space.
- K. No isolation modules, relay modules, interface modules, terminal cabinets, etc. shall be located above drop ceilings.
- L. Unless suitably protected against dust, paint, etc., spot type smoke detectors shall not be installed until the final construction clean-up has been completed. In the event of contamination during construction, the detectors shall be replaced at the contractor's expense. Covers supplied with smoke detector heads do not provide protection against heavy construction dust, spray painting, etc., and shall not be used for that purpose. These covers are suitable only during final, minor cleanup or touchup operations.
- M. Mechanical Contractors shall include two (2) relocations per duct detector specified on drawings to assure working placement in ducts. Coordinate with Mechanical Contractor and University.
- N. All intelligent fire alarm systems shall be zoned. Systems shall be zoned first by floor, then by wing (N,S,E,W), if applicable. System shall also be zoned at any fire partitions or identifiable building features. System devices shall be zoned by type (i.e. smoke detectors, pull stations, heat detectors, duct detectors, sprinkler system monitoring components, etc. shall be on separate zones). Combining separate types of devices on the same zone is prohibited. Any LED type annunciators shall have separate zone lights for alarm (red) and trouble (amber). All supervisory LEDs shall be amber in color.

3.2 Contractor/Installer Testing and Certification

- A. The Contractor shall print-out a complete "System Status and Programming Report" after completing the above. This print out shall include the program settings for each alarm initiating device and for smoke detectors, its current sensitivity.
- B. The Contractor shall 100% test all site-specific software functions for the system and then provide a detailed report showing the system's operational matrix. This documentation shall be a part of the "System Status and Programming Report" described herein. The Contractor shall provide written notification to engineer of the 100% test one (1) week prior to testing commencement to allow the option of witnessing any or all of the testing.
- C. After completion of the installation and all programming, the Contractor shall test every alarm initiating device for proper response and indication, and all alarm notification appliance for effectiveness. Also, in coordination with the other building system contractors, all other system

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functions shall be verified, including (where applicable) elevator recall, control of HVAC systems, release of smoke doors, etc. This final testing of the system shall be under the direct supervision of the Engineer and University.

- D. Database and Drawing Inspection: The Contractor shall 100% test all site-specific software functions for the system and provide a written test report or detailed check list. This documentation shall include a system operation matrix showing the actual FACP response for each initiating device input. Drawings shall be verified for accurate device locations and system addresses.
1. The complete final configuration database (site-specific programming) for the system shall be permanently stored on a computer disk or CD and archived by the manufacturer or authorized distributor. A disk or CD copy of that database shall also be provided to the Owner when the system is commissioned.
 2. The Manufacturer or authorized distributor shall maintain software version (VER) records on the system installed. The system software shall be upgraded free of charge if a new VER is released for any reason during the warranty period. For any new VER to correct problems, free upgrade shall apply during the entire life of the system.
- E. Installer Field Testing: Upon completion of the installation, the University shall 100% test each and every alarm initiating device for proper response and annunciation, every alarm signaling appliance for effectiveness, and all other functions such as elevator capture, control of smoke doors/dampers, proper operation of HVAC systems, and pressurization fans. All supervised circuits shall also be tested to verify proper supervision. (Control circuits are among those required to be supervised.) The documentation shall be part of the programming reports. The Contractor shall keep history of all deficiencies determined. All deficiencies shall be corrected and retested. Once this has been accomplished, the Contractor shall submit to the Engineer all documentation of all problems and corrections and request the Engineer to inspect and test the components of the system related to the fire/smoke damper installations.
- F. Testing of smoke sensing devices shall be accomplished using manufacturer and NFPA approved methods for all devices.
- G. Upon successful completion of the Pre-final Inspection and correction of all deficiencies, the Contractor shall issue a test report to: the Engineer and the Owner (UNC Health and Safety Officer) detailing and certifying the test, including those requirements as specified in this document.

See Attachment B for Addressable System Checklist

- H. After all above tests are complete, the Contractor shall complete the following documentation:
1. NFPA 72-2013, "Record of Completion" Form. No substitutions are acceptable. Form shall confirm (a) it was installed and tested per Code and (b) the Code required 100% test was performed. The fire alarm installer shall sign Form in the applicable locations. If a representative of the Owner witnesses the tests, they sign the last line of the form to signify that fact only (annotating the form as needed).
 2. NFPA 72-2013, Inspection and Testing Form.
 3. An HVAC balance report in the smoke control/purge mode (if smoke evacuation system is provided).
 4. The "System Status and Programming Report" described above. This report shall be one generated on the day of the system acceptance inspection.
 5. Battery calculations per NFPA 72.

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6. Written verification that each specific item of the system was tested and successfully completed per the Fire Alarm System Checklist provided in the Attachment B (include actual voltage readings in tabular format, etc. as part of the documentation). Engineer will certify the system based on the checklist.
- I. Once the Engineer has inspected, tested and is satisfied the system is 100% operational, and has met all aspects of the design, the Contractor shall provide the following:
1. The latest copy of Detector Sensitivity Report.
 2. A printout of the current installed site-specific database.
 3. Signed NFPA "Record of Completion" form per NFPA 72.
 4. Current copy of as-built drawings with correct room numbers and device system addresses. Room numbers shall be installed.
 5. Copy of battery calculations.
 6. Copy of record for the Signal Line Circuit voltage measurements taken at the EOL devices during the test. Take readings at the start of the test and every 15 minutes during NAC test. Test shall be 30 minutes minimum. Test shall be conducted with AC power off and under battery power only.
- J. Owner Testing and Inspection:
1. Database and Drawing Inspection: The Owner and UNC-CH Facilities Services Life Safety Shop will require all the above and a minimum of three (3) days for review of the system database and drawing review, prior to scheduling any on-site test.
 - a) Upon completion of the system database and drawing review any discrepancies will be documented and forwarded to the Owner requiring action and corrections from the Contractor. When the required actions and corrections have been addressed and performed a corrected printout of the installed site-specific database and drawings shall be forwarded to the Engineer and UNC-CH Life Safety Shop for re-review. After review and satisfaction that the corrections have been made, then and only then, will the Life Safety Shop schedule their field inspection and test. The Life Safety Shop will notify the Owner of the scheduled date and time.
 2. Owner acceptance commissioning field inspection: A 100% fully functional test of all aspects of the system will be conducted. Therefore, it is expected that the system shall be complete in all aspects. Each function and aspect of system will be tested along with each and every initiating device. Also, all other system functions shall be verified, including but not limited to (where applicable): elevator capture features, control of HVAC systems, door locks, pressurization fans, fire or smoke doors/dampers/shutters, sprinkler systems, etc. The trades' personnel representing the various aspects shall be present. The Engineer's representative does not have to attend but may attend if so desired. The fire alarm vendor's technician who programmed the system shall be present.
- NOTE: If at any time, during the Owner's acceptance commissioning field inspection and test, it appears that the installation contractor has not performed a prior 100% performance test, the current test will be terminated and rescheduled.
- K. System Acceptance:

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1. State Construction Office inspection (where applicable): The above items shall be completed before the State Construction Office inspection. Upon completion of State Construction Office inspection any items or discrepancies shall be corrected. When this obligation has been met the warranty shall begin on the day the University notifies the State Construction Office to that effect.
 - a) Beneficial or partial occupancy acceptations shall require the Contractor to remain responsible for the "live" system.
 2. UNC Central Alarm Receiving System (CARS) Activation: Contractor shall coordinate the requirements with UNC Life Safety Shop to activate the FACP account in the UNC Central Alarm Receiving System (CARS).
- L. System Documentation: The Electrical Contractor shall provide the Engineer and Owner with the following:
1. A current factory approved certification/ training schedule for the specific system installed.
 2. As-Built Drawings: Submit one (1) bound full size set, and (1) one 11"x17" set, and an electronic copy in format compatible with the most recent release of AutoCad, of scaled architectural floor plans depicting final device/module and equipment locations with corresponding system addresses, all circuiting, and pathways, and terminal cabinet locations. Include wiring and riser diagrams with actual field measured battery calculations for the main fire alarm panel and all individual circuits of the Notification Appliance Circuit panels (NAC's).
 - a) Electrical and Electronic circuit diagrams of all control panels, modules, annunciators, communications panels, riser panels, etc.
 3. Three (3) copies of all software required, both for the installed fire alarm system and for any personal computer (PC) necessary to access the fire alarm system for trouble shooting, programming, modifications, monitoring, de-bugging, or similar functions.
 4. Three (3) copies of the complete maintenance, installation, and programming manuals for the installed fire alarm system. If available a CD version is desired and acceptable. Also provide all technical literature on all major parts of the system, including control panels, batteries, detectors, manual stations, alarm indicating appliances, power supplies, and remote alarm transmission means.
 5. Three (3) of each interconnection cables that are required to connect the fire alarm system to a PC.
- M. System Documentation: The Equipment Manufacturer shall provide the Owner with the following:
1. Agreement to License and/or factory certification system training for the Facilities Service Life Safety Shop technicians to maintain and service the equipment installed under this contract.
 2. Direct access and support for the Facilities Service Life Safety Shop technicians from the Manufacturer's or Factory's Technical Services.

3.3 Training

A. The Contractor/Installer shall provide the Owner: with the following:

1. The contractor shall submit a complete site specific system orientation training schedule including dates, times and location for approval by the owner and engineer. which shall include:
 - a) Preventative maintenance and any special servicing and/or maintenance techniques, including methods and means of troubleshooting and replacement of all field wiring and devices and, methods and procedures used for troubleshooting the main fire alarm control panel, including field peripheral devices as to programming, bussing systems, internal panel and unit wiring, circuitry and interconnections.
 - b) Overall system concepts, capabilities, and functions.
 - c) Explanation of all control functions, input or output.
 - d) Any device and/or equipment locations that are not easily found.
 - e) Any programming peculiarities that is inherent in the system.
2. The Contractor/Installer is responsible for ensuring that the manufacturer's authorized representative shall provide a schedule of the available manufacture certification training for attendance by the Owner's designated employees. The training will include the proper programming procedures, operation of the system, troubleshooting and maintenance aspects, and all required periodic maintenance.
 - a) The authorized representative will coordinate training arrangements with the Owner's schedule.
 - b) Location: On-site certification training is preferred and UNC will make available classroom space as needed by the manufacturer. If travel is required, the Life Safety & Access Controls Division will determine the personnel required to be trained.
3. The Contractor/Installer is responsible for ensuring the manufacturer provides the Owner with the following:
 - a) Licenses and/or certifications to maintain and service the equipment installed under this contract.
 - b) Direct access and support for the University Technicians to the Manufacturers Technical Services.
4. Equipment: The Contractor/Installer is responsible for providing a list of all required support equipment necessary to support the fire alarm system installed for this project. This list shall include computers (laptop or desktop), software, connecting cables, accessories and auxiliary equipment necessary to effectively operate the life safety system.

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1.2 WARRANTY

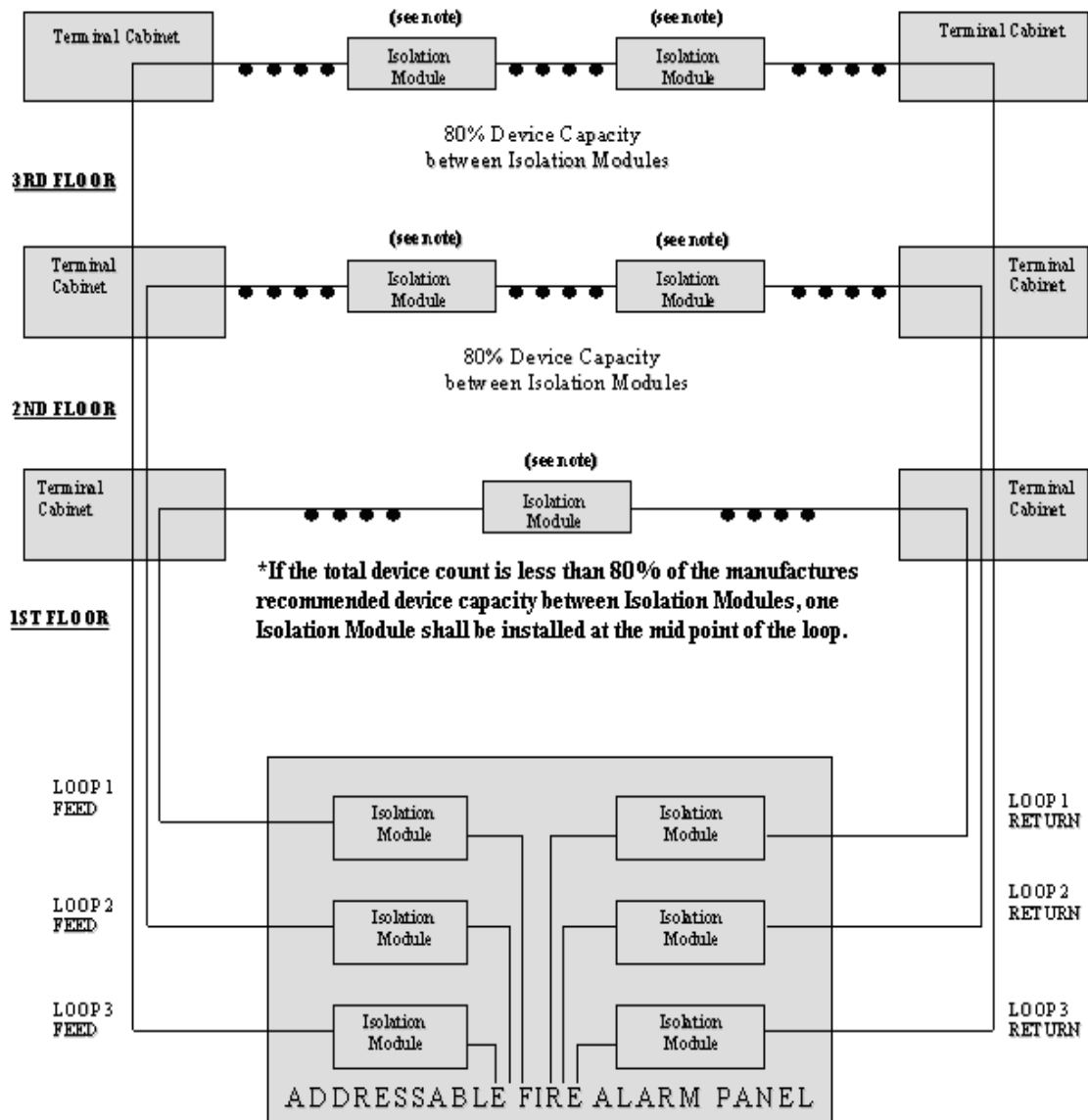
- A. This warranty coverage shall include parts, service, and travel for one (1) year.

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Attachment A:

REQUIREMENTS FOR FIRE DETECTION AND ALARM SYSTEMS

Typical Addressable Fire Alarm System Riser in Large, Multi-story Buildings



***NOTE:** Isolation modules mounted outside terminal cabinets shall be mounted per the same specifications and guidelines described by NCDOT for audio/visual devices.

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Attachment B:

See pages titled “Fire Alarm System Check List” attached.

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FIRE ALARM SYSTEM CHECK LIST



BUILDING NAME: _____ LOCATION: _____

DESIGNER: _____ INSTALLER: _____

INSPECTION BY: _____ DATE: _____

Preparation for Acceptance Test

- Fire authorities have been notified of the system test. Also notify any location where alarms are transmitted. **DO NOT ROLL FIRE TRUCKS BY ACCIDENT.** All building occupants have been clearly notified of the system test.

All required documents are on site for the SCO inspection and review.

- A copy of the project plans and specification
- A copy of the contractor's approved shop drawings including:
 - cut sheets
 - battery size calcs
 - Matrix
 - plans
 - Voltage drop calcs
 - Training Certificates
- A copy of the Fire Alarm system "as built" drawings showing the routing of circuits installed
- Final NFPA 72 "Fire Alarm System Record of Completion" form
- A copy of the System Operation Matrix, giving the FACU response for each initiating device input, has been provided by the fire alarm installer to facilitate testing.
- A copy of the sensitivity report
- A copy of the printout generated by the 100% device testing

NFPA 72 "Record of Completion"

- NFPA 72 "Record of Completion" Form, filled out, with all signatures and at FACU**
- Appropriate year of form is used per year of Building Code permit
- The manufacturer's authorized distributor (the "installer") who made final connections at the FACU and programmed the system gave the owner and AHJ advance notice of the required 100% operational tests, so they could elect to attend.
NOTE: The required 100% testing cannot properly be done by a single technician without a helper, even if the FACU has Walk-Test or an equivalent feature. Query the tech on how testing was performed. Signatures on the form must match the typed/printed names and each section must be complete. Do not accept a company name in place of the responsible individual. The individual must have a certificate. For State Projects, the electrical designer is, by contract, SCO's representative as AHJ. For Community College Projects, the local code official is the AHJ.
- Verify the technician who programmed the alarm system was trained and certified by the manufacturer, for the specific FACU model being installed, within the past 2 years. (A copy of the cert. should have been submitted with the Shop Drawings.) NICET Level III certification will extend this to 36 months.

REVIEW THE FOLLOWING ITEMS FROM THE SHOP DRAWING SUBMITTAL:

- Contractor has submitted battery calculations to the designer, verifying the system meets applicable capacity requirement of NFPA 72. The minimum endurance is 24 hours plus 5 minutes of alarm load. In State buildings, 60 hours of standby is required unless the fire alarm system and all power supplies for the system are on standby or emergency power.
- Battery sizing calculations verifying adequate Amp-Hour rating, indicating that the worst-case NAC voltage on battery is within alarm notification appliance listing, and that NAC alarm load voltage drop at EOL does not exceed **14%** of battery voltage.
- Notification Appliance Circuit (NAC) calculated current draw, demonstrating that none exceed 80% of rated module output.
- If system is the Emergency Voice/Alarm type, amplifier load calculations.
- Copy of factory training certificates for technicians who programmed the system.

REVIEW THE FOLLOWING ITEMS FROM 100% Test:

- System Status and Programming Report, which includes the following 3 elements:**

- Program settings for each alarm initiating device
- Current sensitivity reading of each smoke detector
- System operational matrix, giving response for each alarm input
- If building has smoke purge system, an HVAC balance report in purge mode**
- Two bound copies of the following information on the system (may be combined):**
 - Manufacturer's technical literature (cut sheets) on system components
 - Required maintenance schedule on system, to comply with NFPA 72
 - As-built drawings with loop #'s, device addresses, equipment terminals

COMPARE DOCUMENTS TO INSTALLATION

Shop drawings calcs:	Installed size is:
FACU batteries ___Ahr___@___V each	___Ahr___@___V each
NAC batteries ___Ahr___@___V each	___Ahr___@___V each
DACT batteries ___Ahr___@___V each	___Ahr___@___V each
SLC loops _____class_____	_____class_____
NAC Circuits _____class_____	_____class_____

Check Fire Alarm Control Panel(s)

- VERIFY SYSTEM IS IN TEST MODE AND THE FIRE TRUCKS WILL NOT ROLL.**
- Operating instruction summary is framed and mounted at the FACU.
- Green grounding wire is bonded to FACU cabinet and connected to designated terminal on motherboard (if any).
- AC Power
 - Branch circuit to FACU does not share conduit with 24vdc alarm initiating circuits or notification appliance circuits.
 - Circuit breaker(s) serving FACU (and associated equipment) have lock on clips and red dot beside breakers. (Do not paint the circuit breaker)
 - Placard on the FACU gives the following info on this circuit: **Panelboard location, panelboard identification, and branch circuit number** (The same applies to SNAC panels and any other system cabinets or power supplies)
 - Surge arrestor model listed in project spec (feed-through type with "pi" configuration) is installed at electrical panelboard, on the 120vac branch circuit to FACU. Arrestor leads are trimmed as short as practical. See attached wiring diagram for more info.
- Fire alarm control unit (FACU) is powered up and clear of alarms, supervisory signals, and trouble conditions.
- Have ground fault put on any alarm initiating or notification appliance (horn-strobe) circuit. FACU must indicate "ground" and general "trouble."
- Record battery size and verify date of installation is marked on each battery (Marking of the date of manufacture of the battery is a code requirement – so you will find 2 dates)
- Have technician disconnect a battery lead and verify the FACU indicates a local trouble signal within one minute of that action.
- Reconnect battery, **then** turn off 120vac. Batteries should measure approx. 13 volts and differ ≤ 0.4 volt. (Also check batteries in any booster power supplies.)
- Have technician confirm FACU is programmed to send an AC power failure trouble signal to Remote Supervising Station if power loss continues for 1 hour minimum to 3 hours maximum.

- The FACU and any transponders, sub-panels, DACT and "ADA" booster power supplies must be protected by a smoke detector within 15 feet of their location, measured horizontally, as required by Code (NFPA 72).
- Addressable loop circuits are Class "A", with isolation modules at FACU on the outgoing and return loop, after each 20 addressable devices (max) on the loop, and (if ≤ 20 devices) at midpoint.
 - Have the technician apply a short circuit on the SLC loop. This will force two isolation modules to clamp. The test is to verify their operation and device count between the two that clamp.
 - With AC power off, there will be multiple troubles on the system. The total count will increase during this test. Exclude the count prior to the short.
 - On retrofit and repair work where the AHJ has approved the use of a class B SLC wiring design the isolation modules will not be installed.
 - Verify the number of devices between Isolation modules meets the specification requirement.
- While on battery power, initiate Alarm. Batteries should remain at 12+ volts each but dropping slowly. Let alarm continue during next step.
- Verify the Notification Appliance Circuit (NAC) voltage drop at the EOL is ≤ 3 volts. Do this separately for each NAC. Look at the shop drawing to find the worst-case scenarios when spot checking at a final.
- Silence the alarm and verify that any Remote Supervising Station has received a fire alarm signal. Reset the FACU and verify the Station receives a subsequent "restore" signal, indicating the alarm condition has been cleared.
- Verify requirements on wire type and gauge were followed and that the color code for circuits is proper throughout the system. (Review specifications and shop drawing requirements.).
- Have installing technician demonstrate that the system is programmed so all **spot-type** smoke detectors have automatic drift compensation and FACU will indicate when prescribed sensitivity limits are reached or exceeded.
- If system has provisions for "alarm verification" algorithm, arm it only if needed for the environment. Do **not** apply it to multi-sensor or multi-criteria smoke detectors, elevator capture detectors, or duct smoke detectors.
- If any addressable control relays are installed, verify their contact ratings are suitable for connected load. (Some are rated for resistive loads only.) Also, if they require separate 24vdc power for operation, verify the circuit is electrically supervised. Compare their installed location to the design intent.
- All field wiring in the system has wire markers where landed at the FACU and in the terminal cabinet(s) on each floor of multistory buildings.
- If system uses an LED "zone" annunciator to provide a quick visual overview of the fire scenario for responding public safety personnel (general fire area and type of alarms), a framed directory or typed/engraved LED labels provide clear information on "zone" (area) boundaries and the type(s) of alarms (i.e., smoke, waterflow, etc.)
- During the walk through of the site verify that there are **no** splices in the system wiring other than at terminal blocks which are installed in identified terminal cabinets. "Wire nuts" and butt splices are not permitted on new work.
- All circuits are properly and securely terminated. Approved terminal fittings are used for any stranded wire terminations at screw posts that lack pressure connectors.

- Each fire extinguishing system, such as in a kitchen hood, is connected to give building fire alarm. Have contractor demonstrate that this functions properly, by manually operating the monitored switch, without releasing extinguishing agent.

NOTE: Kitchen hood fire extinguishing system activation must shut off the gas, if used, and, for wet chemical type also operates a shunt trip breaker to shut off the electric power to all protected appliances under the hood. The exhaust fan(s) keep running but the make-up air must shut down. These functions are to be done directly by fire extinguishing system, rather than the FACU, since it is not appropriate to cut off the gas supply or to operate the shunt trip for other types of alarms not involving the kitchen hood extinguishing system (e.g., smoke detectors, fire alarm boxes, etc.).

- Verify that fire alarm system monitors power to any fire suppression system shunt trip breakers. (Look for kitchen hood systems and sprinklered elevator spaces.)
- If remote alarm annunciator in building, verify proper operation, including the audible "Trouble" signal. Check its "Lamp Test" and "Trouble Silence" features, if provided.
- If a Fire Pump is part of the sprinkler system – verify that NFPA 20 certification was provided and testing has been successfully completed

OTHER SUPPRESSION SYSTEMS

- Pre-action suppression system – If installed and if it has an independent control panel it will require a separate NFPA 72 certificate from the building Fire Alarm Panel
- Dry Chemical suppression system – If installed and if it has an independent control panel it will require a separate NFPA 72 certificate from the building Fire Alarm Panel

PROPER INSTALLATION OF DEVICES

- Verify all dust covers have been removed. If still installed how was the 100% test done?
- Spot type smoke detectors shall not be located within 3 feet of a supply or return air diffuser, nor in a strong air stream from a supply diffuser at any distance.
- Wall-mounted smoke detectors must be installed between the ceiling and 12 inches below from the ceiling (measured to the nearest edge of the detector), as required by NFPA 72.
- Wall mounted detectors shall not have wall-mounted luminaires or other obstructions below.
- All smoke detectors are analog addressable model(s) having a separate plug-in head, concealed locking device, and terminal strips for circuit connections.
NOTE: Snap-ring mounted models with removable terminal strip plug for connection to loop conductors do not comply with the intent of this requirement and typically do not have a locking device to deter tampering.
- Verify that the isolation modules and addressable initiating device interface and relay modules are in a conditioned space (not attics, boiler rooms, unheated warehouses, damp locations, outside corridors, parking decks, etc.). Exception: Any devices that are specifically listed for the ambient conditions expected (or likely) in the area where installed.
- Verify that all detectors, modules and pull stations installed outside or in non-conditioned spaces are listed for use at the both ends of the expected temperature. (e.g. Typically, addressable pull stations are not listed for use in parking decks because the low end is 32 degrees.)
- Verify that any strobes in walk-in coolers or freezers are listed for that environment or provided with heated Lexan enclosures for which they are specifically listed.
- Check any outside alarm bells and strobes for operation. Verify outside strobe is the weatherproof type with at least 100cd output, double flash, with clear lens.

DUCT SMOKE DETECTORS

- Intake tube has its holes /slots facing into the air stream, and a stopper installed to seal its far end.
- If the tube is over 36 inches long, the far end must be supported for stability. If support is provided by extending the intake tube through the far side of HVAC duct (best for inspection, cleaning, testing), the duct penetration must be sealed.
- Initiate alarm on a representative sample of devices by operating manual fire alarm box, blowing smoke into detector, flowing water from sprinkler system inspector's test station, etc., except do not test any non-restorable, fixed temperature heat detector. (get total counts from 72 form)
 - Photo smoke _____/_____ Duct smoke _____/_____ Heat detector _____/_____
 Ionization smoke _____/_____ Other detector _____/_____ Flow switch _____/_____
 Pull Station _____/_____ tamper switch _____/_____ _____/_____
- For each device tested have FACU operator read out the FACU display and the LED display. (Radios are very helpful at this point.) There should be a clear indication of device type, device number and location for each device tested.
 - Individual detectors of all types shall be identified on their bases (Loop # -- Device #), in sequence on the loop from the FACU
- While spot testing devices in the facility verify operation of audible-visible alarm notification appliances.
 - Audible alarm devices must be 15 dBA above normal ambient sound level in all occupiable areas of building. (Use meter if in doubt.)
 - Indoor strobes must flash 60-120 times/minute and those installed in a single space (room, corridor, etc.) must be synchronized and remain synchronized throughout the test.
- Also verify HVAC shutdown and closure of (any) smoke doors. These functions must be done by the FACU, rather than by integral smoke detector relay contacts.
 - Shutdown must occur within 20 seconds, except gas pack units can be arranged for up to 60 seconds delay before the fan stops, to prevent heat exchanger damage.
 - After verifying the HVAC shutdown is operational it is acceptable to activate the HVAC bypass to avoid excessive restarting of large air handler systems.

ELEVATORS

- Elevator control key and technician must be on site for the following tests to take place
- Elevator lobby detectors must be within 21 feet of each elevator door
- Test detector(s) located at elevator lobby that will initiate elevator recall
 - Verify recall to a primary floor
 - Verify recall to alternate floor
 - Verify illumination of "Fire Hat"
- Test detector(s) located in shaft & elevator machine room
 - Verify recall to designated floor
 - Verify flashing illumination of "Fire Hat"
- Heat Detectors installed in a shaft or machine room and used for shunt trip activation shall be located within 2 feet of each sprinkler head. (Verify the power source for the shunt trip breaker is supervised and reports a supervisory alarm) (Verify heat setting is less than sprinkler setting per code req.)

SPRINKLER SYSTEMS

- If a sprinkler system is present, check the operation of the waterflow alarm switches by flowing water from Inspectors Test connection(s), unless dry pipe system. Alarm sounds in 20-45 seconds and any outside water motor gong rings properly in \leq 300 seconds.
- Inspectors Test Connection flow is limited to 1/2" stream (or actual orifice size of the sprinklers in the system, if different) by a valve or sight glass marked accordingly, or by a sprinkler head (minus deflector) mounted at discharge. NOTE: If a pipe union with an internal restrictor plate is used for this purpose, have the sprinkler contractor take at least one apart for inspection, to verify the orifice size.
- Close any electrically supervised sprinkler control valves to verify supervisory alarm at FACU within 2 turns of control wheel or, for Post Indicator Valve (PIV), within 1/5 of valve control mechanism's travel

distance. Then reopen to verify “restore” signal. (Completely close the PIV and verify that the supervisory alarm does not restore for the full travel distance. It should only restore when the valve is open)

- If dry pipe or pre-action sprinkler system, have contractor demonstrate waterflow alarm functions, and that both high and low air pressure are supervised as required.
-
- Each duct smoke detector has a Remote Alarm Indicator Light (RAIL) in nearest corridor or other public space. (Because addressable, test switch is **not** required.)
- At each duct detector a 12”x12” minimum access door, hinged or latched type, is provided to facilitate sampling tube inspection and cleaning.
- Air flow direction is permanently indicated on the duct by stencil or decal, to help assure the sampling tubes are installed and maintained in the correct orientation.

ALARM COMMUNICATION TRANSMISSION

- Transmission Verification:** Verify communication pathways are present and supervised per NFPA 72.
- Verify that transmission means are connected and functioning properly, to transmit fire alarm, supervisory, and trouble signals as separate, distinct events.
- Verify two transmission means are present and labeled when sprinkler is installed.
- Verify that transmission means are programmed for 24-hour silent test call to the supervising station.
- Verify each type of signal is properly received and coded at the receiving station. (Supervisory signals include sprinkler valve tamper, fire pump off-normal, hi-low air pressure, etc.)
- Verify transmission means have backup power per NFPA 72.

PRINTER

- The specification should require that systems with more than 100 addressable points, or in a building that exceeds 3 occupied floors or 60,000SF, an event printer is to be provided which uses ordinary non-thermal paper. In a high-rise building, the printer must be FACU-monitored and on a generator-supported circuit.
 - NOTE: Printer does not have to be adjacent to FACU and, except for high rise buildings, does not have to be electrically supervised.

OTHER SYSTEMS

- For dormitories and residence halls, there will be special testing required for the sounder bases and the handicapped notification which uses higher candela strobes. Even if system is dual event it must dial out on 1st alarm.
- For institutions check for keys to the lockable pull stations if they are installed.
- Where smoke “sniffer” systems are used - create a test procedure with the help of the designer.
- Where beam detectors are used, verify they are not on walls subject to movement and are not subject to direct sunlight.
- Where smoke evacuation &/or AHU bypass is used verify that the panel can be locked, and operation limited to qualified people.
- Mass Notification systems require special procedures and testing to verify proper operation.

TRAINING ETC

- Verify that the Owner's designated personnel have received training in system operation: How to interpret, silence, and reset FACU signals, how to obtain service, etc.
- Verify that when required by specification, owner's personnel have received more thorough, detailed training in system troubleshooting and repair, plus installation manuals and other documentation, as applicable. (This is standard for the UNC-Chapel Hill campus.)
- Contractor has provided electronic copy of system's site-specific programming. (CD, flash drive)
- Contractor has provided spare parts in accordance with the specification for the project.

REFERENCE INFORMATION TO ASSIST SYSTEM INSPECTION

After the required 100% system operational test the contractor submits a "final" copy of NFPA 72* "Fire Alarm System Record of Completion" form. This form is to verify the proper operation of all (restorable) alarm initiating devices, audible and visible notification appliances, and other system functions including HVAC control, closure of smoke doors and dampers, pressurization fans, remote signaling, etc.

*Use only the NFPA form, or an identical reprint. The NFPA 72 form will vary with the year the project was permitted. The year required should be listed in the project specification.

NC Building Code. Chapter 16 Referenced Standards set the NFPA 72 version requirements

Projects permitted under NC Building Code 2002 - NFPA72 1999

Projects permitted under NC Building Code 2006 - NFPA72 1999

Projects permitted under NC Building Code 2009 - NFPA72 2002

Projects permitted under NC Building Code 2012 - NFPA72 2007

Projects permitted under NC Building Code 2018 – NFPA72 2013

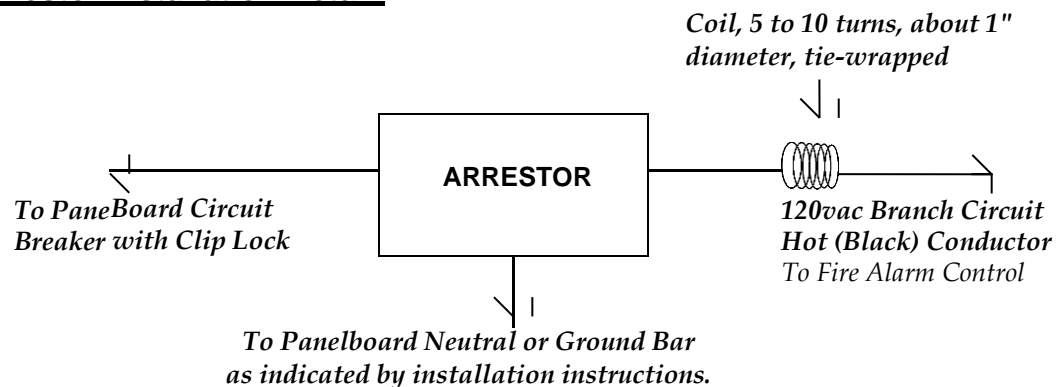
NFPA 72 Chapters (note they vary by version year)

(1999) Chapters: 1-Fundamentals, 2-Initiating Devices, 3- Protected Premises, 4-Notification Appliances, 5- Supervising Station FA system, 6- Public FA reporting systems, 7-Inspection and Testing, 8-FA for Dwelling units, 9-Reference publications_____

(2002) Chapters: 1- Administration, 2-Referenced Publications, 3- Definitions, 4- Fundamentals, 5- Initiating Devices, 6- Protected Premises, 7- Notification Appliances, 8- Supervising Station FA system, 9- Public FA reporting systems, 10- Inspection and Testing, 11- Single and Multiple Station & Household_____

(2007) Chapters: 1- Administration, 2-Referenced Publications, 3- Definitions, 4- Fundamentals, 5- Initiating Devices, 6- Protected Premises, 7- Notification Appliances, 8- Supervising Station FA system, 9- Public FA reporting systems, 10- Inspection and Testing, 11- Single and Multiple Station & Household_____

Transient Arrestor Installation Detail:



NOTE: Securely mount transient arrestor in accessible junction box or other proper metal enclosure adjacent to the electrical panelboard, and provide engraved label indicating its location

REFERENCE INFORMATION TO ASSIST SYSTEM INSPECTION

Wiring: All addressable system wiring shall be color coded in accordance with following scheme, which must be maintained throughout system, without color change in any run:

- Addressable Loop Controller Circuits: Cable per spec, with Red Jacket
- One-way Voice/Alarm and Two-way (Fireman's Telephone): Wire per specifications

The following circuits use THHN / THWN conductors, of the size and color indicated:

- Alarm Notification Appliance Circuits: AWG 14 or 12, Blue (+) and Black (-) conductors
- AHU Shutdown, Elevator Capture, other control functions: These are now done by addressable control relays on the loop. The relays may require separate power circuits, in which case use AWG 14 conductors, with Yellow (+) and Brown (-) color code. **NOTE: Check any power circuits to addressable relays for electrical supervision by disconnecting 1 lead.**
- Circuits that power door magnets from the FACU or SNAC panels: AWG 14, Orange
- Circuits from ZAM's to normally open contact initiating devices: AWG 14, Red (+), White (-)

☞ NOTE: Most manufacturers either require or recommend low capacitance, twisted, shielded pair cable for Signaling Line Circuits (addressable loops). All shielded cable must have the grounded "drain" wire maintained continuously around the loop. If unshielded cable was used, verify that the manufacturer's installation instructions require or state a preference for use of unshielded cable. For addressable system retrofit when a non-addressable system had previously been in service, if existing single-conductor wiring from the old system was used (sometimes done if in fine condition, properly color coded, with terminal strips, etc.), verify that the manufacturer's SLC modules are listed using straight-lay cable.

Spare: Provide the following spare parts with the system, each individually packaged and labeled. For multi-building project calculate separately for each building with FACU:

- Fuses (If Used).....2 of each size in system
- Manual Fire Alarm Boxes.....2% of installed quantity
- Addressable Control Relays.....4% of installed quantity
- Indoor Horns/Speakers with Strobes Lights.....4% of installed quantity
- Indoor Strobe-only Notification Appliances.....4% of installed quantity
- Monitor Modules (Addressable Interface).....4% of installed quantity
- Isolation Modules / Isolation Bases.....4% of installed quantity
- Addressable, Electronic Heat Detectors.....4% of installed quantity
- Spot-Type Smoke Detectors / Sounder Bases.....6% of installed quantity

NOTE: Increase decimal quantities of all spare parts to next higher whole number when calculating.

NOTE: No spares are required for projected beam, air sampling, or duct type smoke detectors

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END OF SECTION

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