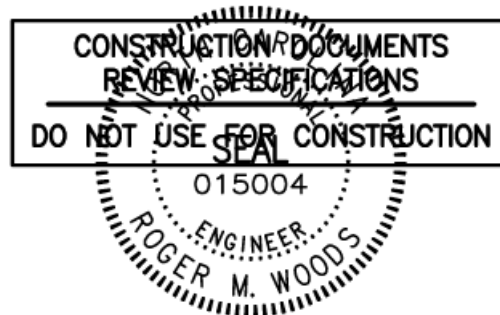


PROJECT MANUAL
including
SPECIFICATIONS
for

Lenoir Youth Development Center Retro-Commissioning

NC DEPARTMENT OF CRIME CONTROL AND PUBLIC SAFETY
Lenoir, NC



Divisions 00, 01 and 23



1620 Midtown Place
Raleigh, NC 27609
919-832-8118
salasobrien.com
license (NC): F-1434

DATE: June 9, 2022

PROJECT NUMBERS

SO: 2022-01328

SCO: 22-24440-01A

JO# 4258

C#11453

Owner: NC Department of Crime Control
and Public Safety

SET:



Send all project communication to:
Salas O'Brien

Copyright © 2022, Salas O'Brien.

DIVISION 00 - GENERAL CONDITIONS**Title**

-
- Notice to Bidders
 - General Conditions
 - Instruction to Bidders and General Conditions of the Contract
 - Supplementary Instructions to Bidders and General Conditions of the Contract
 - Security Requirements
 - NCDPS Central Engineering Special Conditions
 - Vendor-Contractor Compliance with Executive Order 224
 - Form of Proposal
 - MBE Guidelines 2002
 - MBE Forms 2010 July:
 - Identification of HUB Certified / Minority Business Participation
 - Affidavit A - Listing of the Good Faith Effort
 - Affidavit B - Intent to Perform Contract with Own Workforce
 - Affidavit C – Portion of the Work to be Performed by Minority Firms
 - Affidavit D – Good Faith Efforts
 - Appendix E – MBE Documentation for Contract Payments
 - Form of Construction Contract
 - Sheet for Attaching Insurance Certificates

DIVISION 01 - GENERAL REQUIREMENTS**Section Title**

011100	Summary of the Work
012300	Alternates
013100	Project Management and Coordination
015000	Temporary Facilities and Controls
017700	Project Closeout
019913	General Requirements
019916	Work in Existing Buildings
019926	Owner Instruction and Training

DIVISION 23 - HVAC TECHNICAL SPECIFICATIONS**Section Title**

230210	HVAC Summary of Work
230510	HVAC Basic Requirements
230593	HVAC Testing, Adjusting and Balancing
230596	HVAC Systems Commissioning
230900	Building Management System
230900A	Appendix-Combined Guidelines

END OF TABLE OF CONTENTS

NOTICE TO BIDDERS

Sealed proposals will be received by the North Carolina Department of Public Safety in Raleigh NC, in the office of NCDPS Central Engineering, Door #4, 2020 Yonkers Road, Raleigh, NC (hand delivered); 4216 Mail Service Center, Raleigh, NC 27699-4216 (mailing address) up to 2:00 PM 07/12/2022 and immediately thereafter publicly opened and read for the furnishing of labor, material and equipment entering into the construction of:

SCO ID#22-24440-01A, C#11453, Job Order#4258
Lenoir Youth Development Center Retro-Commissioning

Replace existing control system with new control system, rebalance, and recommission system.

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

Pre-Bid Meeting

A mandatory pre-bid meeting will be held for all interested bidders on **06/22/2022 at 10:00 AM at the Lenoir Youth Development Center located at 3060 Dobbs Farm Rd. Kinston NC 28504**. The meeting will address project specific questions, security, issues, bidding procedures and bid forms. **Failure to attend the Pre-Bid Conference will disqualify your company from bidding.**

The meeting is also to identify preferred brand alternates and their performance standards that the owner will consider for approval on this project.

In accordance with General Statute GS 133-3, Specifications may list one or more preferred brands as an alternate to the base bid in limited circumstances. Specifications containing a preferred brand alternate under this section must identify the performance standards that support the preference. Performance standards for the preference must be approved in advance by the owner in an open meeting. Any alternate approved by the owner shall be approved only where (i) the preferred alternate will provide cost savings, maintain or improve the functioning of any process or system affected by the preferred item or items, or both, and (ii) a justification identifying these criteria is made available in writing to the public.

In accordance with GS133-3 and SCO procedures the following preferred brand items are being considered as Alternates by the owner for this project:

A. Distech ECB Series Controls: The owner uses Distech Controls on other facilities and desires consistency for training, parts and maintenance.

Complete plans, specifications, and contract documents available:

- **Carolinas AGC/Reed Construction Data/Construct Connect**
 - content@constructconnect.com
 - <https://www.sendthisfile.com/f.jsp?id=eCdnvwFhCQseJfgyoHiwahiC>
 - Website: <https://www.isqft.com/start/>
- **McGraw Hill Dodge**
 - <https://upload.construction.com/dfmgr/login>
 - <https://www.construction.com/dodge/submit-project.asp>
 - Website: <https://www.construction.com/>

HUB Plan Rooms

- **East Coast Digital (Projects within Greenville / Eastern NC areas)**
210 E. 14th St., Suite D, Greenville, NC 27858; Tel. 252-758-1616
 - plans@speedyblue.com
 - Website - <https://www.speedyblue.com/East-Coast-Digital-Planroom-c39065011>
- **The Institute (Projects within Durham, Person, Orange, Chatham, and Wake Counties)**
 - dstafford@theinstitutenc.org
 - kgantt@theinstitutenc.org
 - Website - <https://theinstitutenc.org/calendar/category/bid-opportunities/>

HUB PARTICIPATION RECORDING REQUIREMENTS:

NCDPS requires that, for construction contracts with a value of \$5000 or greater, the contractor shall comply with the document Guidelines for Recruitment and Selection of Minority Businesses for Participation in State Construction Contracts including Identification of Minority Business Participation, Affidavits A, B, C, and D, and Appendix E. These forms provided herein are hereby incorporated and made a part of this contract. A bidder's failing to comply with this requirement will be considered non-responsive and will result in bid rejection.

The NCDPS imposed contract threshold of \$5000 for HUB recruitment supersedes any reference to a higher threshold that may be noted in the bid documents, within referenced documents, or within any regulatory requirement.

Provide one of the following with Bid Form Proposal:

Identification of HUB Participation and Affidavit A – Listing of Good Faith Efforts OR
Affidavit B- Intent to Self-Perform with Own Forces

Provide one of the following upon Contract Award:

Affidavit C - Percentage of HUB Participation OR Affidavit D – Good Faith Efforts>

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 Unlimited.

NOTE--SINGLE PRIME CONTRACTS: 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. EXCEPT: 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](#)

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 60 days.

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

Project Manager:

Taylor Oldham
NC Department of Public Safety -
Central Engineering
(919)716-3400

Owner:

NC Department of Public Safety
Central Engineering
2020 Yonkers Road, Raleigh, NC 27604
(919)716-3400

Designer:

Roger M. Woods, PE
Salas O'Brien
1620 Midtown Place
Raleigh, NC 27619
919-832-8120

SCO-Notice To Bidders 2010 – (Updated Dec. 2010)



GENERAL CONDITIONS

The General Conditions of this Contract Agreement between the “Bidding Contractor” and NCDPS Central Engineering shall follow the State Construction Office North Carolina Department of Administration Form OC-15 Twenty-Fourth Edition dated January 2013 – “Instructions to Bidders and General Conditions of the Contract”.

Form OC-15 Attached within this Document – See next page

INSTRUCTIONS TO BIDDERS
AND
GENERAL CONDITIONS OF THE CONTRACT
STANDARD FORM FOR CONSTRUCTION PROJECTS
STATE CONSTRUCTION OFFICE
NORTH CAROLINA
DEPARTMENT OF ADMINISTRATION

Form OC-15

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

Twenty Fourth Edition January 2013

INSTRUCTIONS TO BIDDERS

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

1. PROPOSALS

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

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

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

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

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

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

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

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

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

2. EXAMINATION OF CONDITIONS

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

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

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

3. BULLETINS AND ADDENDA

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

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

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

4. BID SECURITY

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

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

5. RECEIPT OF BIDS

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

6. OPENING OF BIDS

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

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

7. BID EVALUATION

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

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

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

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

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

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

8. PERFORMANCE BOND

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

9. PAYMENT BOND

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

10. PAYMENTS

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

11. PRE-BID CONFERENCE

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

12. SUBSTITUTIONS

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

Submittals for proposed substitutions shall include the following information:

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

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

GENERAL CONDITIONS OF THE CONTRACT

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

TABLE OF CONTENTS

ARTICLE	TITLE	PAGE
1	Definitions.....	9
1	Intent and Execution of Documents	11
2	Clarifications and Detail Drawings	12
3	Copies of Drawings and Specifications.....	12
4	Shop Drawings, Submittals, Samples, Data	13
5	Working Drawings and Specifications at the Job Site	13
6	Ownership of Drawings and Specifications	14
7	Materials, Equipment, Employees	14
8	Royalties, Licenses and Patent	15
9	Permits, Inspections, Fees, Regulations	15
10	Protection of Work, Property and the Public	16
11	Sedimentation Pollution Control Act of 1973	17
12	Inspection of the Work.....	17
13	Construction Supervision and Schedule	18
14	Separate Contracts and Contractor Relationships.....	22
15	Subcontracts and Subcontractors	23
16	Contractor and Subcontractor Relationships.....	23
17	Designer's Status	24
18	Changes in the Work	25
19	Claims for Extra Cost	27
20	Minor Changes in the Work	29
21	Uncorrected Faulty Work.....	29
22	Time of Completion, Delays, Extension of Time	29
23	Partial Utilization: Beneficial Occupancy	30
24	Final Inspection, Acceptance, and Project Closeout	31
25	Correction of Work Before Final Payment	31
26	Correction of Work After Final Payment	32
27	Owner's Right to Do Work	32
28	Annulment of Contract	32
29	Contractor's Right to Stop Work or Terminate the Contract	33
30	Requests for Payments	33
31	Certificates of Payment and Final Payment.....	34
32	Payments Withheld.....	36
33	Minimum Insurance Requirements.....	36
34	Performance Bond and Payment Bond.....	37
35	Contractor's Affidavit.....	38
36	Assignments	38
37	Use of Premises.....	38
38	Cutting, Patching and Digging.....	38
39	Utilities, Structures, Signs	38
40	Cleaning Up.....	40
41	Guarantee	41

42	Codes and Standards	41
43	Indemnification.....	41
44	Taxes	41
45	Equal Opportunity Clause.....	42
46	Employment of the Handicapped	42
47	Asbestos-Containing Materials (ACM)	43
48	Minority Business Participation.....	43
49	Contractor Evaluation	43
50	Gifts	43
51	Auditing Access to Persons and Records.....	44
52	North Carolina False Claims Act	44
53	Termination for Convenience	45

ARTICLE 1 - DEFINITIONS

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

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

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

ARTICLE 2 - INTENT AND EXECUTION OF DOCUMENTS

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

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

ARTICLE 3 - CLARIFICATIONS AND DETAIL DRAWINGS

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

ARTICLE 4 - COPIES OF DRAWINGS AND SPECIFICATIONS

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

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

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

ARTICLE 5 - SHOP DRAWINGS, SUBMITTALS, SAMPLES, DATA

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

ARTICLE 6 - WORKING DRAWINGS AND SPECIFICATIONS AT THE JOB SITE

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

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

ARTICLE 7 - OWNERSHIP OF DRAWINGS AND SPECIFICATIONS

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

ARTICLE 8 - MATERIALS, EQUIPMENT, EMPLOYEES

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

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

ARTICLE 9 - ROYALTIES, LICENSES AND PATENTS

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

ARTICLE 10 - PERMITS, INSPECTIONS, FEES, REGULATIONS

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

ARTICLE 11 - PROTECTION OF WORK, PROPERTY AND THE PUBLIC

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

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

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

ARTICLE 12 - SEDIMENTATION POLLUTION CONTROL ACT OF 1973

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

ARTICLE 13 - INSPECTION OF THE WORK

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

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

ARTICLE 14 - CONSTRUCTION SUPERVISION AND SCHEDULE

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

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

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

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

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

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

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

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

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

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

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

ARTICLE 15 - SEPARATE CONTRACTS AND CONTRACTOR RELATIONSHIPS

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

ARTICLE 16 - SUBCONTRACTS AND SUBCONTRACTORS

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

ARTICLE 17 - CONTRACTOR AND SUBCONTRACTOR RELATIONSHIPS

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

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

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

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

ARTICLE 18 - DESIGNER'S STATUS

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

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

ARTICLE 19 - CHANGES IN THE WORK

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

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

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

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

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

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

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

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

ARTICLE 20 - CLAIMS FOR EXTRA COST

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

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

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

ARTICLE 21 - MINOR CHANGES IN THE WORK

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

ARTICLE 22 - UNCORRECTED FAULTY WORK

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

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

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

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

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

ARTICLE 24 - PARTIAL UTILIZATION/BENEFICIAL OCCUPANCY

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

ARTICLE 25 - FINAL INSPECTION, ACCEPTANCE, AND PROJECT CLOSEOUT

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

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

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

ARTICLE 26 - CORRECTION OF WORK BEFORE FINAL PAYMENT

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

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

ARTICLE 27 - CORRECTION OF WORK AFTER FINAL PAYMENT

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

ARTICLE 28 - OWNER'S RIGHT TO DO WORK

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

ARTICLE 29 - ANNULMENT OF CONTRACT

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

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

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

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

ARTICLE 31 - REQUEST FOR PAYMENT

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

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

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

ARTICLE 32 - CERTIFICATES OF PAYMENT AND FINAL PAYMENT

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

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

ARTICLE 33 - PAYMENTS WITHHELD

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

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

ARTICLE 34 - MINIMUM INSURANCE REQUIREMENTS

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

a. Worker's Compensation and Employer's Liability

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

b. Public Liability and Property Damage

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

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

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

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

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

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

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

d. Deductible

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

e. Other Insurance

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

f. Proof of Carriage

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

ARTICLE 35 - PERFORMANCE BOND AND PAYMENT BOND

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

ARTICLE 36 - CONTRACTOR'S AFFIDAVIT

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

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

ARTICLE 37 - ASSIGNMENTS

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

ARTICLE 38 - USE OF PREMISES

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

ARTICLE 39 - CUTTING, PATCHING AND DIGGING

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

ARTICLE 40 - UTILITIES, STRUCTURES, SIGNS

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

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

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

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

ARTICLE 41 - CLEANING UP

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

ARTICLE 42 - GUARANTEE

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

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

ARTICLE 43 - CODES AND STANDARDS

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

ARTICLE 44 - INDEMNIFICATION

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

ARTICLE 45 - TAXES

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

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

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

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

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

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

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

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

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

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

ARTICLE 46 - EQUAL OPPORTUNITY CLAUSE

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

ARTICLE 47 - EMPLOYMENT OF INDIVIDUALS WITH DISABILITIES

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

ARTICLE 48 - ASBESTOS-CONTAINING MATERIALS (ACM)

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

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

ARTICLE 49 - MINORITY BUSINESS PARTICIPATION

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

ARTICLE 50 – CONTRACTOR EVALUATION

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

ARTICLE 51 – GIFTS

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

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

ARTICLE 52 – AUDITING-ACCESS TO PERSONS AND RECORDS

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

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

ARTICLE 53 – NORTH CAROLINA FALSE CLAIMS ACT

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

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

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

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

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

ARTICLE 54 – TERMINATION FOR CONVENIENCE

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

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

SUPPLEMENTARY INSTRUCTIONS TO BIDDERS AND GENERAL CONDITIONS OF THE CONTRACT

PART 1 - GENERAL CONDITIONS OF THE CONTRACT

1.1 ARTICLE 14 – CONSTRUCTION SUPERVISION AND SCHEDULE

- A. 14.f: If the project is a single prime construction contract, the single prime contractor by default is the project expeditor. See General Conditions Article 1.i.
- B. 14g: Delete the references to a CPM Schedule. The schedule for this project is only required to be a Bar Chart Schedule. See Section 01 3100.
- C. 14j: Delete the references to a CPM Schedule. The schedule for this project is only required to be a Bar Chart Schedule. See Section 01 3100.

1.2 ARTICLE 23 – TIME FOR COMPLETION, DELAYS, EXTENSIONS OF TIME

- A. Article 23.a: The time for completion of the Work shall be **100** consecutive calendars days from the date of the Notice to Proceed to Final Acceptance.
- B. Article 23.b: Liquidated damages shall accrue at the rate of **\$500.00** per day for each calendar day in excess of the number of calendar days designated in Article 23.a.

1.3 ARTICLE 35 – PERFORMANCE BOND AND PAYMENT BOND

- A. If an awarded bid is over three hundred thousand dollars (\$300,000), the 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 provided by the State. An authorized agent of the bonding company who is licensed to do business in North Carolina shall countersign all bonds.

1.4 ARTICLE 38 – USE OF PREMISES

- A. Article 38.d: Contractor shall post a sign indicating Firearms are prohibited on the construction site. See security requirements under Section 01 1100 Security Requirements.

END OF DOCUMENT 00 2213

SECURITY REQUIREMENTS

PART 1 - GENERAL

1.1 SUMMARY

- A. Section includes North Carolina Department of Public Safety (NCDPS) Security Requirements for Contractors while working on NCDPS property.
- B. The purpose of this document is to provide SECURITY requirements for the Contractor and his Subcontractors. Depending on the scope of work and location not all rules may apply. At the pre-construction conference these requirements will be reviewed.
- C. Related Requirements:
 - 1. Division 01 Section "01 5000" for Temporary Facilities and Controls.

1.2 SECURITY CLEARANCE AND REQUIREMENTS

- A. Security Clearance - All persons entering a North Carolina Department of Public Safety (NCDPS) property MUST provide and executed "Contractor NC Department of Public Safety Criminal History Record Check Form HR 004" and receive approval for entry.
 - 1. At least seven days prior to their appearance at the DPS facility to start work, the Contractor is requested to provide in writing on the "NC Department of Public Safety Criminal History Record Check Form HR 004," the following information for all crew members and supervisors who will be working on this project at the site. including subcontractors and their personnel; employee's name, Social Security number and driver's license number. The NCDPS will perform, or have performed, a security check of the prospective Contractor employee. If the Contractor is informed that any of these persons are declared undesirable by the NCDPS, this person will not be allowed to work on this construction project. The NCDPS reserves the right to deny entry to any employee of the Contractor or his subcontractors, if the NCDPS feels security of the facility will be compromised in any way. Every person entering the NCDPS facility will be required to present photo identification every time they enter and leave the facility.
 - 2. The "NC Department of Public Safety Criminal History Record Check Form HR 004," is located immediately following this Section.
 - 3. The NCDPS project manager will provide the awarded contractor with contact and transmittal information specific to the facility where the work will be conducted. The facility will assign one point of contact to receive, process and notify all parties of security clearances. The contractor shall transmit completed HR 004 forms only to the facility contact provided by the NCDPS project manager.
- B. Security Requirements - All persons entering a NCDPS property must thoroughly read this Section, understand the content, and sign the "Signature Form". It is the responsibility of the Supervisor for the Contractor to ensure that this document is read and understood, that signatures are obtained, and that copies are maintained at the job site at all times. Signatures are required for Contractor and their Subcontractor's supervision and employees who enter the NCDPS property.
 - 1. "Signature Form" is located at the end of this Section.

1.3 ASSIGNED REPRESENTATIVES

- A. Assigned Contractor Representative - The Supervisor for the Contractor, (to be named at pre-construction conference) is to act as spokesperson and liaison between the Contractor and the North Carolina Department of Public Safety, here-in-after referred to as the NCDPS.
- B. NCDPS Representative — This representative will be named at pre-construction conference and will be the on-site NCDPS representative for this project.
- C. Communications - All communications regarding security between the Contractor and the NCDPS are to be handled through these representatives. This NCDPS representative or his designee will be responsible for contacting the Superintendent or the Assistant Superintendent of the NCDPS facility, concerning operations and security issues as they relate to the performance of this project.
 - 1. The Contractor shall submit to the designated NCDPS representative at his earliest convenience the name of the Job Superintendent and a responsible person or contact in the home office. A general crew number size should be provided to the NCDPS representative and notification should be given if the crew size will fluctuate by a large amount during any special work period.
 - 2. Anytime any Subcontractor is on site, the Contractor must provide supervision.
- D. The Designer is to be contacted for all other inquiries relating to the contract and contract documents, i.e., drawings and specifications.

1.4 CONDUCT REQUIREMENTS

- A. Roaming around the NCDPS property is not permitted and may result in that person being escorted from the site and revocation of the security clearance.
- B. All Contractor personnel are expected to observe proper conduct on the job site. Indecent language, acts or dress will not be tolerated. Shirts are required at all times. Anyone guilty of such violations will be immediately removed from the property.
- C. The Contractor is reminded that no food or canteen type items will be available to construction personnel through the NCDPS.
- D. Contractor is reminded that any dealings with the media or press while on site shall be approved or otherwise addressed by the NCDPS representative or his designee.
- E. Noise must be kept minimal or as reasonably achievable.
- F. Contraband - The Contractor is instructed that it is a violation of North Carolina law to allow any person to bring firearms, alcoholic beverages of any type, or drugs other than those prescribed by a doctor onto the premises including the parking lot of a NCDPS property.
- G. Inmate Fraternization - The Contractor is instructed that no construction personnel are to communicate in any way with inmate personnel of the facility. Construction personnel are also requested to remain within the construction area at all times during working hours. Communication with inmate personnel" shall include but not be limited to the following:
 - 1. Borrowing from or lending anything to an offender
 - 2. Accept any gift/personal service from an offender, unless authorized by law, or give gifts or personal service
 - 3. Tip an offender
 - 4. Sell or give any offender any intoxicating drink, barbiturate or stimulant drug, or any narcotic, poison or poisonous substance, except upon the prescription of a physician and approval of the Superintendent or designee

1. Convey to or from an offender any letters or oral messages or any instrument or weapon by which to affect an escape, or that will aid in an assault or riot
 2. Trade with an offender for clothing or stolen goods
 3. Sell to an offender any article forbidden by Division of Prisons
 4. Use abusive, indecent or profane language, or profane gestures, in the presence of an offender
 5. Curse an offender
 6. Knowingly make or maintain contact with or in any way associate with a member of an offender's family or close associates, unless duties so require or authorization to do so have been obtained by the Division Director or designee
 7. Engage in sexual relations of any kind with an offender
 8. Knowingly enter into a business relationship with an offender or their family member of close associate
- H. Smoking - Smoking is prohibited in mechanical rooms. Smoking will only be permitted in areas designated by the NCDPS.
- I. Tool Control - The Contractor will be responsible for control and accountability of all of his tools, equipment, and materials of construction.
1. As few tools as possible to accomplish the required work should be brought into the NCDPS facility.
 2. Some of the Contractor's tools may be subject to special restrictions such as all cordless powder activated tools and tools classified by the NCDPS as hazardous or Class "A" The Contractor should control those tools carefully, and account for them daily, and remove them, or secure them to the satisfaction of the NCDPS Representative at the end of each working day.
 - a. Class "A" tools are tools that can be used by inmates either in effecting an escape or in causing serious injury or death to either staff, visitors, or other inmates and include, but are not limited to:
 - 1) Ladders
 - 2) Jacks
 - 3) Hacksaw Blades
 - 4) Pipe Wrenches
 - 5) Knives
 - 6) Metal Cutting Equipment
 - 7) Wire Cutters
 - 8) Files
 - 9) Cutting Torches and Cutting Tips
 - 10) Pipe Cutters and Bolt Cutters
 - 11) Axes/Emery Wheels and Drill Bits
 - 12) Portable Grinders or Similar Machines
 3. The NCDPS reserves the right to request all tools be removed at the completion of each workday. A list of tools classified as hazardous or Class A is attached See the NCDPS site representative for further requirements.
- J. Photography - The Contractor so desiring may take progress pictures of construction; however, the Contractor is warned that to photograph an inmate of a correctional facility without permission is a violation of North Carolina law.
- K. Vehicle Keys - Vehicle keys for Contractor's vehicles parked within the facility shall be housed at the Gate House or officer station at the entrance or area designated by the NCDPS representative. Vehicles or equipment frequently moved within the facility for the performance of work shall have the keys stored at an approved location under NCDPS Custody control when the vehicle is not in use.

1.5 WORKING HOURS

- A. A definite consistent time pattern of working days and hours is to be established and agreed upon between the Contractor and the NCDPS facility consistent with the contract. In the event that a job condition requires a variation of these hours on a day-to-day basis, or work on a weekend, it is requested that the Contractor notify the NCDPS site representative of the necessary change in working hours as far in advance as practical. The NCDPS reserves the right to deny a variation of the standard work hours and especially a Contractor's request to work on a weekend may be subject to be denied.

1.6 USE OF PROPERTY

- A. The site is to be organized and debris minimized. It is important that all construction debris be controlled and kept from any area accessible to an inmate unless it is under direct and constant observation. Any spills of chemicals or fuel by the Contractor will be his to clean and properly dispose of. The Contractor is required to report any spills to the NCDPS.
- B. The Contractor shall notify the NCDPS of any hazardous materials / chemicals to be brought on site.
- C. Storage and Staging Areas - On-site storage is limited and shall be allocated, and approved by the NCDPS Site representative at the beginning of the job.
 - 1. The Contractor shall use extreme caution when moving equipment in or out of the project site and buildings and shall coordinate these activities with the NCDPS Site Representative.
 - 2. Absolutely no shipments of materials, etc., will be received or cared for by any NCDPS personnel at the facility. Shipments coming into the site after working hours will not be received and will be sent back for delivery the next working day.
- D. Existing Drives, Parking, and Roadways - The driveways and roadways around the property are not to be blocked completely at any time during the course of the project. Keep streets clean, free of mud and debris on a timely basis. Any blockage of streets or roadways is to be coordinated with the NCDPS.
 - 1. Unless otherwise addressed by an approved contract, damage to sidewalks, driveways, or other conveyance, and underground utilities, will be the responsibility of the Contractor to repair.
 - 2. A specific parking area will be set aside for the construction personnel and the Contractor must assist in enforcing that all construction personnel park within this area. All vehicles must be locked at all times and no keys left in any vehicle at any time.
- E. Toilet Facilities - The Contractor and the NCDPS representative will establish appropriate restroom usage protocol for the contractor's staff while on site.
- F. Utility Disruptions - Site emergency water cut-off locations are available upon request. Utility disruptions required by the job shall be coordinated with the NCDPS before the disruption at least 48 hours in advance. Special circumstances may require this notification to be extended.
 - 1. The Contractor is responsible for the repair of any utility or service disturbed or disconnected.
 - 2. Restoration of utility service is expected within the same day unless alternate arrangements have been accepted by the NCDPS.
- G. Temporary Controls - The Contractor will use orange mesh fencing or other approved means to segregate and control the work area.

Signature Page (See Article 1.2.B)

SIGNATURES: To be signed after reading, or receiving an explanation, of the above security rules. (Note 1.):

Contractor Supervisor: _____	Date: _____
Crew Member: _____	Date: _____
Crew Member: _____	Date: _____
Crew Member: _____	Date: _____
Crew Member: _____	Date: _____
Crew Member: _____	Date: _____
Crew Member: _____	Date: _____
Crew Member: _____	Date: _____
Crew Member: _____	Date: _____

Notes:

1. Required for Contractor and their Subcontractor's supervision and employees who enter the NCDPS facility. Copy this signature sheet as required.



North Carolina Department of Public Safety

Central Engineering



NC Department of Public Safety Criminal History Record Check

Section I (To be completed by Manager or designee)

Division _____ Section _____
Manager Name _____ Phone # _____
Purpose ☐ Employment ☐ Intern
☐ Investigation ☐ Volunteer

Section II (Completed by Applicant/Employee)

Information is used for criminal history verification purposes. Only authorized employees and hiring authorities have access to submitted information.

Full Name Last _____ First _____ Middle _____
Maiden _____ ALL previously used last names _____
Race/Ethnic Origin _____ Description of "Other" _____
Date of Birth _____ Full SSN _____ Driver's License State _____ Number _____
Place of Birth City _____ State _____ High School City _____ State _____
☐ Female
☐ Male Height Feet _____ Inches _____ Weight _____ Color of Hair _____ Eyes _____
List/describe all scars/tattoos/marks (If none, enter N/A)

Have you ever been employed by NCDPS/Division of (Check all that apply and complete items below) : ☐ AC/JJ ☐ Admin. ☐ LE
☐ No ☐ Yes If "Yes," enter dates: Start _____ End _____
☐ No ☐ Yes If "Yes," enter dates: Start _____ End _____

NOTE: Enter **CURRENT ADDRESS** in the first line of the table below. If you have lived at your "Current Address" for less than five (5) years, you **must** enter all previous addresses to cover a minimum of five (5) years. If additional space is required, enter the information on the back of this form.

Street	City	State	Zip	County

I verify that the information provided is true, accurate and complete to the best of my knowledge.

Signature _____ Date _____

Section III (DCI Operator Use Only)

Date of Request _____

- ☐ Clean Record - No convictions / No traffic violations
☐ Clean Record other than Minor traffic violations (list below).

DCI Operator's Name _____

Possible Record ☐ Pending ☐ Unserved ☐ Disposed

SID # _____ FBI# _____

Date DCI Completed _____

NCDPS CENTRAL ENGINEERING SPECIAL CONDITIONS DOCUMENT

PART 1 - SPECIAL CONDITIONS

DEFINITIONS

- A. The definition of the word “Contractor” used throughout this informal contract agreement is hereby defined as the “Bidding Contractor Installer, Manufacturer, Supplier, Trainer, and Warrantor.”
- B. The definition of the word “Subcontractor” used throughout this contract agreement is hereby defined as any third party under contractual agreement with the “Contractor.”
- C. 14.j: Delete the references to a CPM Schedule. The schedule for this project is only required to be a Bar Chart Schedule. See Section 01 3100.

CONFIDENCE IN BID PROPOSAL

- D. It is understood and agreed that, by submitting a bid, the Contractor has examined these contract documents, drawings and specifications and has visited the site of the work and has satisfied himself relative to the work to be performed

HUB REQUIREMENTS

- E. NCDPS requires that, for construction contracts with a value of \$5000 or greater, the contractor shall comply with the document Guidelines for Recruitment and Selection of Minority Businesses for Participation in State Construction Contracts including Identification of Minority Business Participation, Affidavits A, B, C, and D, and Appendix E.
- F. These forms provided herein are hereby incorporated and made a part of this contract. A bidder’s failing to comply with this requirement will be considered non-responsive and will result in bid rejection.
- G. The NCDPS imposed contract threshold of \$5000 for HUB recruitment supersedes any reference to a higher threshold that may be noted in the bid documents, within referenced documents, or within any regulatory requirement.

SAFETY REQUIREMENTS

- H. The Contractor shall be responsible for the entire site and the building or construction of the same and provide all the necessary protections as required by laws or ordinances governing such conditions and as required for any damage to the Owner’s property, or that of others on the job, by himself, or personnel or his contractors, and shall make good such damages.
- I. 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 (Code of Federal Regulations, Part 1926 published in Volume 39, Number 122, Part 11, June 24, 1974, Federal Register), and revisions thereto as adopted by General Statutes of North Carolina 95-126 through 155.
- J. The Contractor shall provide all necessary safety measures for the protection of all persons on the work, 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.

LIABILITY AND PROPERTY DAMAGE INSURANCE REQUIREMENTS

- K. The Contractor shall not commence work until he has obtained all insurance required, and such insurance has been approved by the Owner, nor shall the Contractor allow any subcontractor to commence work on his subcontract until all similar insurance required of the subcontractor has been obtained.
- L. The Contractor shall provide and maintain during the life of this contract Workmen's Compensation Insurance, or all employees employed at the site of the project under his contract.
- M. The Contractor shall provide and maintain during the life of this contract such Public Liability and Property Damage Insurance as shall protect him and any subcontractor performing work covered by this contract, from claims for damage for personal injury, including accidental death, as well as from claims for property damages which may arise from operations under this contract, whether such operation be by the Contractor himself or by any subcontractor, or by anyone directly or indirectly employed by either of them and the amounts of such insurance shall be as follows:
 - 1. Public Liability Insurance in an amount not less than \$300,000 for injuries, including accidental death, to any one person and subject to the same limit for each person, in amount not less than \$500,000 on account of one accident; and Property Damage Insurance in an amount not less than \$100,000/\$300,000.
- N. The Contractor shall furnish such additional insurance as may be required by General Statutes of North Carolina, including motor vehicle insurance in amounts not less than statutory limits.
- O. The insurance certificate, in the "Description and Operations" block, shall identify the following:
 - 1. Job Services Description: HVAC Control System Replacement
 - 2. NCDPS Job Order Number: 4258
 - 3. NCDPS Contract Number: C11453
- P. Each Certificate of Insurance shall bear the provision that the policy cannot be cancelled, reduced in amount or coverage eliminated in less than thirty (30) days after mailing written notice to the insured and/or the Owner of such alteration or cancellation, sent by registered mail.
 - 1. The North Carolina Attorney General's Office in concurrence with the Department of Insurance has developed the following acceptable and required verbiage concerning the cancellation of insurance coverage.
 - 2. Contractor to provide insurance certificate(s) to this office with language appropriately inserted in the insurance certificate block provided for Special Provisions, as follows: "Notwithstanding the preprinted cancellation provisions on this form, coverages afforded under the policies will not be cancelled, reduced in amount nor will any coverages be 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."
 - 3. This language can be continued on an attached and properly titled continuation sheet as long as the first clause ("Notwithstanding.... form,") is on the face of the form or if space will not allow, then at a minimum, insert in the block for Special Provisions,

- “Cancellation and notice provisions on the attached endorsements control over language on this form.” Then attach the required language provided in 2 above.
4. The Contractor shall furnish the Owner with satisfactory proof of carriage of the insurance required before written approval is granted by the Owner.

APPLICATIONS FOR PAYMENT AND INVOICES

- Q. See Section 01 2900 Payment Procedures.
- R. Final Application for Payment - The Final Payment Application shall be accompanied by the contractor’s affidavit. The contractor’s affidavit shall state: “This is to certify that all costs of materials, equipment, labor, and all else entering into the accomplishment of this contract, including payrolls, have been paid in full.”
- S. Executed contract documents, insurance certification and, upon completion and acceptance of the work, invoices and other information requested are to be sent to:
1. Ms. Kim Owoh; NCDPS Central Engineering; 2020 Yonkers Road; MSC 4216; Raleigh, NC 27699 by mail and a scanned copy to taylor.oldham@ncdps.gov.
 2. It is imperative that contract documents, invoices, etc., be sent only to this address in order to assure proper and timely delivery and handling.

CONTRACTOR USE OF PROPERTY

- T. Use of Site may be restricted. Work hours are limited to 7:00AM to 4:30PM Monday through Friday, unless discussed otherwise. Specific site access requirements will be discussed at the Pre-Bid Meeting.
- U. See Section 01 1100 - SECURITY REQUIREMENTS.

COVID REQUIREMENTS

- V. Mask Use – All visitors are required to wear a cloth covering that covers the nose and mouth at all times that they are on state property.
- W. Social Distancing – Whenever possible maintain social distancing of a minimum of six feet from any other person on state property.
- X. Temperature Check – All visitors will be subject to a temperature check prior to entering an institution.
- Y. Medical Questions Before Entry - Visitors may be asked the following COVID 19 related questions:
1. Have you or anyone in your household had any of the following symptoms in the last 21 days: sore throat, cough, chills, body aches for unknown reasons, shortness of breath for unknown reasons, loss of smell, loss of taste, fever at or greater than 100 degrees Fahrenheit?
 2. Have you or anyone in your household been tested for COVID-19?
 3. Have you or anyone in your household visited or received treatment in a hospital, nursing home, long-term care, or other health care facility in the past 30 days?
 4. Have you or anyone in your household traveled in the U.S. in the past 21 days?
 5. Have you or anyone in your household traveled on a cruise ship in the last 21 days?
 6. Are you or anyone in your household a health care provider or emergency responder?
 7. Have you or anyone in your household cared for an individual who is in quarantine or is a presumptive positive or has tested positive for COVID-19?

8. Do you have any reason to believe you or anyone in your household has been exposed to or acquired COVID-19?
 9. Do you have any reason to believe you or anyone in your household has been exposed to or acquired COVID-19?
- Z. Contractor will be required to complete and submit the “Vendor/Contractor Compliance with Executive Order 224” Form (located on next page) weekly. Contractors that do not provide this will not be allowed onsite.

END OF DOCUMENT



**NORTH CAROLINA DEPARTMENT OF PUBLIC SAFETY
CENTRAL ENGINEERING
Mail Service Center 4216
RALEIGH, N.C. 27699-4216**

Vendor/Contractor Compliance with Executive Order 224

Completed by Central Engineering contract administrator

Job Order: _____

Contract #: _____ (or PO#)

Project Name: _____

For the Week of: _____ to _____ *Sunday to Saturday*

Contract Administrator: _____

Attestation by vendor (must be an authorized individual of the party who executed the contract)

As the responsible party for the contract on the project cited above, I affirm that all employees, sub-contractors, sub-vendors, and related personnel entering state owned facilities associated with the work performed under this contact are in compliance with Section Four of Governor Cooper's Executive Order 224 (EO224).

EO224 can be found at:

<https://files.nc.gov/governor/documents/files/EO224-COVID-19-Measures.pdf>

Signature:

Printed Name: _____

Date: _____

FORM OF PROPOSAL

Retro-Commissioning
Lenoir Youth Development Center

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 the Department of Public Safety** 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 **Retro-Commissioning** 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 **Department of Public Safety** 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. (Strike out "Add" and write "deduct" if appropriate.)

Alternate No. 1: Distech ECB Series Controls – Preferred Brand

(Add) _____ Dollars (\$)_____

UNIT PRICES

Unit prices quoted and accepted shall apply throughout the life of the contract, except as otherwise specifically noted. Unit prices shall be applied, as appropriate, to compute the total value of changes in the base bid quantity of the work all in accordance with the contract documents.

No. 1 Fire Alarm Control Module Unit Price (\$)_____

No. 2 Fire Alarm test of 10% of Initiation Devices Unit Price (\$)_____

The bidder further proposes and agrees hereby to commence work under this contract on a date to be specified in a written order of the designer and shall fully complete all work thereunder within the time specified in the Supplementary General Conditions Article 23. Applicable liquidated damages amount is also stated in the Supplementary General Conditions Article 23.

MINORITY BUSINESS PARTICIPATION REQUIREMENTS

Provide with the bid - Under GS 143-128.2(c) the undersigned bidder shall identify **on its bid** (Identification of Minority Business Participation Form) the minority businesses that it will use on the project with the total dollar value of the bids that will be performed by the minority businesses. **Also** list the good faith efforts (Affidavit **A**) made to solicit minority participation in the bid effort.

NOTE: A contractor that performs all of the work with its own workforce may submit an Affidavit (**B**) to that effect in lieu of Affidavit (**A**) required above. The MB Participation Form must still be submitted even if there is zero participation.

After the bid opening - The Owner will consider all bids and alternates and determine the lowest responsible, responsive bidder. Upon notification of being the apparent low bidder, the bidder shall then file within 72 hours of the notification of being the apparent lowest bidder, the following:

An Affidavit (**C**) that includes a description of the portion of work to be executed by minority businesses, expressed as a percentage of the total contract price, which is equal to or more than the 10% goal established. This affidavit shall give rise to the presumption that the bidder has made the required good faith effort and Affidavit **D** is not necessary;

*** OR ***

If less than the 10% goal, Affidavit (**D**) of its good faith effort to meet the goal shall be provided. The document must include evidence of all good faith efforts that were implemented, including any advertisements, solicitations

and other specific actions demonstrating recruitment and selection of minority businesses for participation in the contract.

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:

By: _____

Signature

Name: _____

Print or type

Title _____

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

Address _____

ATTEST:

By: _____

License No. _____

Title: _____

(Corp. Sec. or Asst. Sec. only)

Federal I.D. No. _____

Email Address: _____

(CORPORATE SEAL)

Addendum received and used in computing bid:

Addendum No. 1 _____ Addendum No. 3 _____ Addendum No. 5 _____ Addendum No. 7 _____

Addendum No. 2 _____ Addendum No. 4 _____ Addendum No. 6 _____ Addendum No. 8 _____

MINORITY BUSINESS CONTRACT PROVISIONS (CONSTRUCTION)

APPLICATION:

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

MINORITY BUSINESS SUBCONTRACT GOALS:

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

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

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

OR

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

OR

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

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

MINIMUM COMPLIANCE REQUIREMENTS:

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

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

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

State of North Carolina AFFIDAVIT A – Listing of Good Faith Efforts

County of _____

(Name of Bidder)

Affidavit of _____

I have made a good faith effort to comply under the following areas checked:

Bidders must earn at least 50 points from the good faith efforts listed for their bid to be considered responsive. (1 NC Administrative Code 30 I.0101)

- ☐ **1 – (10 pts)** Contacted minority businesses that reasonably could have been expected to submit a quote and that were known to the contractor, or available on State or local government maintained lists, at least 10 days before the bid date and notified them of the nature and scope of the work to be performed.
- ☐ **2 --(10 pts)** Made the construction plans, specifications and requirements available for review by prospective minority businesses, or providing these documents to them at least 10 days before the bids are due.
- ☐ **3 – (15 pts)** Broken down or combined elements of work into economically feasible units to facilitate minority participation.
- ☐ **4 – (10 pts)** Worked with minority trade, community, or contractor organizations identified by the Office of Historically Underutilized Businesses and included in the bid documents that provide assistance in recruitment of minority businesses.
- ☐ **5 – (10 pts)** Attended prebid meetings scheduled by the public owner.
- ☐ **6 – (20 pts)** Provided assistance in getting required bonding or insurance or provided alternatives to bonding or insurance for subcontractors.
- ☐ **7 – (15 pts)** Negotiated in good faith with interested minority businesses and did not reject them as unqualified without sound reasons based on their capabilities. Any rejection of a minority business based on lack of qualification should have the reasons documented in writing.
- ☐ **8 – (25 pts)** Provided assistance to an otherwise qualified minority business in need of equipment, loan capital, lines of credit, or joint pay agreements to secure loans, supplies, or letters of credit, including waiving credit that is ordinarily required. Assisted minority businesses in obtaining the same unit pricing with the bidder's suppliers in order to help minority businesses in establishing credit.
- ☐ **9 – (20 pts)** Negotiated joint venture and partnership arrangements with minority businesses in order to increase opportunities for minority business participation on a public construction or repair project when possible.
- ☐ **10 - (20 pts)** Provided quick pay agreements and policies to enable minority contractors and suppliers to meet cash-flow demands.

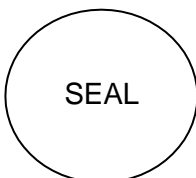
The undersigned, if apparent low bidder, will enter into a formal agreement with the firms listed in the Identification of Minority Business Participation schedule conditional upon scope of contract to be executed with the Owner. Substitution of contractors must be in accordance with GS143-128.2(d) Failure to abide by this statutory provision will constitute a breach of the contract.

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

Date: _____ Name of Authorized Officer: _____

Signature: _____

Title: _____



State of _____, County of _____

Subscribed and sworn to before me this _____ day of _____ 20____

Notary Public _____

My commission expires _____

**State of North Carolina --AFFIDAVIT B-- Intent to Perform Contract
with Own Workforce.**

County of _____

Affidavit of _____
(Name of Bidder)

I hereby certify that it is our intent to perform 100% of the work required for the _____
_____ contract.
(Name of Project)

In making this certification, the Bidder states that the Bidder does not customarily subcontract elements of this type project, and normally performs and has the capability to perform and will perform all elements of the work on this project with his/her own current work forces; and

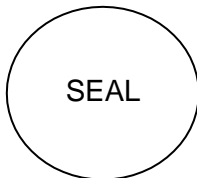
The Bidder agrees to provide any additional information or documentation requested by the owner in support of the above statement. The Bidder agrees to make a Good Faith Effort to utilize minority suppliers where possible.

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

Date: _____ Name of Authorized Officer: _____

Signature: _____

Title: _____



State of _____, County of _____

Subscribed and sworn to before me this _____ day of _____ 20____

Notary Public _____

My commission expires _____

State of North Carolina - AFFIDAVIT C - Portion of the Work to be Performed by HUB Certified/Minority Businesses

County of _____

(Note this form is to be submitted only by the apparent lowest responsible, responsive bidder.)

If the portion of the work to be executed by HUB certified/minority businesses as defined in GS143-128.2(g) and 128.4(a),(b),(e) is equal to or greater than 10% of the bidders total contract price, then the bidder must complete this affidavit.

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

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

(Project Name)
Project ID# _____ Amount of Bid \$ _____

I will expend a minimum of _____% of the total dollar amount of the contract with minority business enterprises. Minority businesses will be employed as construction subcontractors, vendors, suppliers or providers of professional services. Such work will be subcontracted to the following firms listed below.

Attach additional sheets if required

Name and Phone Number	*Minority Category	**HUB Certified Y/N	Work Description	Dollar Value

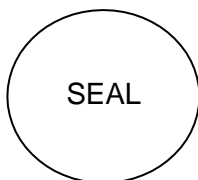
*Minority categories: Black, African American (**B**), Hispanic (**H**), Asian American (**A**) American Indian (**I**), Female (**F**) Socially and Economically Disadvantaged (**D**)

**** HUB Certification with the state HUB Office required to be counted toward state participation goals.**

Pursuant to GS143-128.2(d), the undersigned will enter into a formal agreement with Minority Firms for work listed in this schedule conditional upon execution of a contract with the Owner. Failure to fulfill this commitment may constitute a breach of the contract.

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

Date: _____ Name of Authorized Officer: _____



Signature: _____

Title: _____

State of _____, County of _____

Subscribed and sworn to before me this _____ day of _____ 20

Notary Public _____

My commission expires _____

State of North Carolina

AFFIDAVIT D – Good Faith Efforts

County of _____

(Note this form is to be submitted only by the apparent lowest responsible, responsive bidder.)

If the goal of 10% participation by HUB Certified/ minority business **is not** achieved, the Bidder shall provide the following documentation to the Owner of his good faith efforts:

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

(Project 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 Y/N	Work Description	Dollar Value

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

**** HUB Certification with the state HUB Office required to be counted toward state participation goals.**

Examples of documentation that may be required to demonstrate the Bidder's good faith efforts to meet the goals set forth in these provisions include, but are not necessarily limited to, the following:

- Copies of solicitations for quotes to at least three (3) minority business firms from the source list provided by the State for each subcontract to be let under this contract (if 3 or more firms are shown on the source list). Each solicitation shall contain a specific description of the work to be subcontracted, location where bid documents can be reviewed, representative of the Prime Bidder to contact, and location, date and time when quotes must be received.
- Copies of quotes or responses received from each firm responding to the solicitation.
- A telephone log of follow-up calls to each firm sent a solicitation.
- For subcontracts where a minority business firm is not considered the lowest responsible sub-bidder, copies of quotes received from all firms submitting quotes for that particular subcontract.
- Documentation of any contacts or correspondence to minority business, community, or contractor organizations in an attempt to meet the goal.
- Copy of pre-bid roster
- Letter documenting efforts to provide assistance in obtaining required bonding or insurance for minority business.
- Letter detailing reasons for rejection of minority business due to lack of qualification.
- Letter documenting proposed assistance offered to minority business in need of equipment, loan capital, lines of credit, or joint pay agreements to secure loans, supplies, or letter of credit, including waiving credit that is ordinarily required.

Failure to provide the documentation as listed in these provisions may result in rejection of the bid and award to the next lowest responsible and responsive bidder.

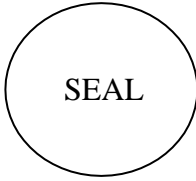
Pursuant to GS143-128.2(d), the undersigned will enter into a formal agreement with Minority Firms for work listed in this schedule conditional upon execution of a contract with the Owner. Failure to fulfill this commitment may constitute a breach of the contract.

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

Date: _____ Name of Authorized Officer: _____

Signature: _____

Title: _____



State of _____, County of _____

Subscribed and sworn to before me this _____ day of _____ 20

Notary Public _____

My commission expires _____

APPENDIX E

MBE DOCUMENTATION FOR CONTRACT PAYMENTS

Prime Contractor/Architect: _____

Address & Phone: _____

Project Name: _____

Pay Application #: _____ Period: _____

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

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

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

Date: _____ Approved/Certified By: _____

Name

Title

Signature

SUBMIT WITH EACH PAY REQUEST & FINAL PAYMENT

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 University of North Carolina at Chapel Hill 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 campus attorney; certificate by the Campus Office of Budget Affairs, and drawings, titled:

Lenoir Youth Development Center Retro-Commissioning
SCO ID #22-24440-01A

Consisting of the following sheets:

G001, G002, H001, H100, H110, H300, H301, H302, H303, M0000, M1101, M1102, M2101,

M6101, M6102

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 100 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 No. 1	\$
<hr/>	
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)

(CORPORATE SEAL)

The State of North Carolina through

(Agency, Department or Institution)

Witness: _

By: _____

Title: _____

—

Sheet for Attaching Insurance Certificates

Lenoir Youth Development Center Retro-Commissioning

Summary of the Work

SECTION 011100 - SUMMARY OF THE WORK**RELATED DOCUMENTS**

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

WORK COVERED BY CONTRACT DOCUMENTS

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

Replace existing HVAC Control system including smoke control system to be in compliance with UL864. Test and Balance and retro-commissioning of the system is to be performed after the completion of the HVAC Control System installation. Special inspections are required for the smoke control system.

PHASED CONSTRUCTION

The Work shall be conducted in phases, with each phase substantially complete as indicated:

The building will remain occupied during construction. The contractor will phase construction to minimize disruption to the operation of the facility. The contractor shall not take down more than one AC unit/system in the living areas at a time. The VAV system phasing shall be coordinated with the owner to minimize disruption.

The contractor shall submit a written phasing plan within 30 days of notice to proceed. Before commencing Work of each phase, submit an updated copy of Contractor's construction schedule showing the sequence, commencement and completion dates for all phases of the Work. Include projected dates and durations for Owner to move out and into areas of work.

ACCESS TO SITE

Contractor shall have full use of Project site for construction operations during construction period per the approved phasing plan submitted to the owner prior to construction. Contractor's use of Project site is limited only by Owner's right to perform work or to retain other contractors on portions of Project.

WORK RESTRICTIONS

General Work Restrictions: Comply with limitations on use of public streets and with other requirements of authorities having jurisdiction.

Owner's work rules and/or restrictions on construction operations, as appended at the end of this Section, must be adhered to by all Contractor personnel.

Controlled Substances: Use of tobacco products and other controlled substances on Project site is not permitted.

Employee Identification: Provide identification tags for Contractor personnel working on Project site. Require personnel to use identification tags at all times.

Lenoir Youth Development Center Retro-Commissioning

Summary of the Work

1
2
3
4
5
6
7
8
9
10

PART 2 - PRODUCTS (Not Used)

PART 3 - EXECUTION (Not Used)

END OF SECTION 011000

SECTION 012300 - ALTERNATES**PART 1 – GENERAL****RELATED DOCUMENTS**

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

SUMMARY

This section includes administrative and procedural requirements for alternates.

DEFINITION

Alternate: An amount proposed by bidders and stated on the Form of Proposal for certain work defined in the bidding requirements that may be added to or deducted from the base bid amount if Owner decides to accept a corresponding change either in the amount of construction to be completed or in the products, materials, equipment, systems, or installation methods described in the Contract Documents.

Alternates described in this Section are part of the Work only if enumerated in the Agreement. The cost or credit for each alternate is the net addition to or deduction from the Contract Sum to incorporate alternate into the Work. No other adjustments are made to the Contract Sum.

PROCEDURES

Revise or adjust affected adjacent work as necessary to completely integrate work of the alternate into Project.

Include as part of each alternate, miscellaneous devices, accessory objects, and similar items incidental to or required for a complete installation whether or not indicated as part of alternate.

Immediately following award of the Contract, notify each party involved, in writing, of the status of each alternate. Indicate if alternates have been accepted, rejected, or deferred for later consideration. Include a complete description of negotiated revisions to alternates.

Execute accepted alternates under the same conditions as other work of the Contract.

A schedule of alternates is included at the end of this Section. Specification Sections referenced in schedule contain requirements for materials necessary to achieve the work described under each alternate.

PART 2 - PRODUCTS (Not Used)**PART 3 - EXECUTION****SCHEDULE OF ALTERNATES**

Alternate No. 1: Preferred Brand Alternate: Distech ECB Series Controls.

END OF SECTION 012300

SECTION 013100 – PROJECT MANAGEMENT AND COORDINATION**PART 1 - GENERAL****RELATED DOCUMENTS**

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

SUMMARY

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

- Coordination procedures.
- Coordination drawings.
- Requests for Information (RFIs).
- Request for Proposal (RFP).
- Project meetings.

INFORMATIONAL SUBMITTALS

Subcontractor & Material Suppliers List: Prepare a written summary identifying individuals or firms proposed for each portion of the Work, including those who are to furnish products or equipment fabricated to a special design. Include the following information in tabular form:

- Name, address, and telephone number of entity performing subcontract or supplying products.
- Number and title of related Specification Section(s) covered by subcontract.

Key Personnel Names: Prepare a list of key personnel assignments, including superintendent and other personnel in attendance at Project site. Identify individuals and their duties and responsibilities; list addresses and telephone numbers, including home, office, and cellular telephone numbers and e-mail addresses. Provide names, addresses, and telephone numbers of individuals assigned as alternates in the absence of individuals assigned to Project.

GENERAL COORDINATION PROCEDURES

Coordination: Coordinate construction operations included in different Sections of the Specifications to ensure efficient and orderly installation of each part of the Work. Coordinate construction operations, included in different Sections, that depend on each other for proper installation, connection, and operation.

- Schedule construction operations in sequence required to obtain the best results where installation of one part of the Work depends on installation of other components, before or after its own installation.

- Coordinate installation of different components to ensure maximum performance and accessibility for required maintenance, service, and repair.

- Make adequate provisions to accommodate items scheduled for later installation.

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

- Preparation of Contractor's construction schedule.
- Preparation of the schedule of values.
- Installation and removal of temporary facilities and controls.

Lenoir Youth Development Center Retro-Commissioning**Project Management and Coordination**

Delivery and processing of submittals.
Progress meetings.
Pre-installation conferences.
Project closeout activities.
Startup and adjustment of systems.

COORDINATION DRAWINGS

Coordination Drawings: Prepare coordination drawings according to requirements in individual Sections, and additionally where installation is not completely shown on Shop Drawings, where limited space availability necessitates coordination, or if coordination is required to facilitate integration of products and materials fabricated or installed by more than one entity.

Prepare project-specific information, drawn accurately to a scale large enough to indicate and resolve conflicts. Do not base coordination drawings on standard printed data. Include the following information, as applicable:

Use applicable Drawings as a basis for preparation of coordination drawings. Prepare sections, elevations, and details as needed to describe relationship of various systems and components.

Coordinate the addition of trade-specific information to the coordination drawings by subcontractors in a sequence that best provides for coordination of the information and resolution of conflicts between installed components before submitting for review.

Indicate functional and spatial relationships of components of architectural and engineered systems.

Indicate space requirements for routine maintenance and for anticipated replacement of components during the life of the installation.

Show location and size of access doors required for access to concealed dampers, valves, and other controls.

Indicate required installation sequences.

Indicate dimensions shown on the Drawings. Specifically note dimensions that appear to be in conflict with submitted equipment and minimum clearance requirements. Provide alternate sketches indicating proposed resolution of such conflicts. Minor dimension changes and difficult installations will not be considered changes to the Contract.

REQUESTS FOR INFORMATION (RFIs)

Upon discovery of the need for additional information or interpretation of the Contract Documents, Contractor shall prepare and submit an RFI in the form specified below. Coordinate and submit RFIs in a prompt manner so as to avoid delays in Contractor's work or work of subcontractors. Include a detailed, legible description of item needing information or interpretation and the following:

Project name.
Designer and Owner project numbers.
Date.
RFI number, numbered sequentially.
RFI subject.
Specification Section number and title and related paragraphs, as appropriate.
Drawing number and detail references, as appropriate.
Field dimensions and conditions, as appropriate.
Contractor's suggested resolution. If Contractor's suggested resolution impacts the Contract Time or the Contract Sum, Contractor shall state impact in the RFI.
Contractor's signature.
Attach sketches, descriptions, measurements, photos, Product Data, Shop Drawings, coordination drawings, and other information necessary to fully describe items needing interpretation.

Lenoir Youth Development Center Retro-Commissioning**Project Management and Coordination**

1 Prepare, maintain, and submit a tabular log of RFIs organized by the RFI number. Submit log as part of
2 documentation for monthly meetings. Include the following on the RFI log:

- 3
- 4 Project name.
- 5 Designer and Owner project numbers.
- 6 Name and address of Contractor.
- 7 Name and address of Designer.
- 8 RFI number including RFIs that were returned without action or withdrawn.
- 9 RFI description.
- 10 Date the RFI was submitted.
- 11 Date Designer's response was received.
- 12

13 On receipt of Designer's response, update the RFI log and immediately distribute the RFI response to affected
14 parties. Review response and notify Designer within seven days if Contractor disagrees with response.
15

REQUEST FOR PROPOSAL (RFP)

16
17
18
19 In the event that a change is required in the project scope, the Designer shall generate a written request for
20 Contractor's proposal for additional work. Contractor shall prepare and submit a proposal in the form specified below.
21 Coordinate and submit proposals in a prompt manner so as to avoid delays in Contractor's work or work of
22 subcontractors. Include a detailed, legible description of proposed work, with the following:
23

- 24 Project name.
- 25 Designer and Owner project numbers.
- 26 Date.
- 27 Proposal number, numbered sequentially.
- 28 Description of work.
- 29 Complete breakdown of costs for materials, with units and quantities.
- 30 Complete breakdown of labor costs, with hours rates and burden.
- 31 Overhead & Profit.
- 32 Impact on Contract Time.
- 33

34 Prepare, maintain, and submit a tabular log of proposals organized by the proposal number. Submit log as part of
35 documentation for monthly meetings. Include the following on the proposal log:

- 36
- 37 Project name.
- 38 Designer and Owner project numbers.
- 39 Name and address of Contractor.
- 40 Name and address of Designer.
- 41 Proposal number, including proposals that were returned without approval or withdrawn.
- 42 Proposal description.
- 43 Date the proposal was submitted.
- 44 Date each Designer's response was received.
- 45 Date Designer's approval was received.
- 46 Date Owner's approval was received.
- 47
- 48

PROJECT MEETINGS

49
50
51 Preconstruction Conference: The Designer shall schedule and conduct a pre-construction conference before starting
52 construction.

53
54 Authorized representatives of Owner Designer, and their consultants; Contractor and its superintendent; major
55 subcontractors; suppliers; and other concerned parties shall attend the conference. Participants at the conference shall
56 be familiar with Project and authorized to conclude matters relating to the Work.
57
58

Lenoir Youth Development Center Retro-Commissioning**Project Management and Coordination**

The agenda shall include items of significance that could affect progress, including the following:

- Designation of key personnel and their duties.
- Lines of communications.
- Procedures for processing field decisions and Change Orders.
- Procedures for RFIs.
- Procedures for testing and inspecting.
- Procedures for processing Applications for Payment.
- Distribution of the Contract Documents.
- Submittal procedures.
- Tentative construction schedule.
- Phasing.
- Critical work sequencing and long-lead items.

Monthly Progress Meeting: The Designer shall conduct a monthly meeting at the jobsite. These meetings shall be open to subcontractors, material suppliers and any others who can contribute toward maintaining required job progress. The Contractor be represented by both home office and project personnel. These representatives shall have authority to act on behalf of the Contractor. It shall be the purpose of these meetings to effect coordination, cooperation and assistance in maintaining progress of the project on schedule in order to complete the project within the contract time. The format of these meetings shall include the following:

- Review minutes of last job conference and resolve all uncorrected problems.
- Review of work in last and next 30 days.
- Review the construction schedule and update when necessary.
- Review of Designer's Logs. (Submittals, RFI's, RFP's, Proposals)
- Review any pending change orders or field orders.

Weekly Construction Meeting: Contractor shall schedule and conduct meetings and conferences at Project site for discussing progress of construction and coordination items. Contractor shall inform participants and others involved, and individuals whose presence is required, of date and time of each meeting. Notify Owner and Designer of scheduled meeting dates and times.

- Prepare the meeting agenda and distribute to all invited attendees.
- Review progress since the last meeting. Determine whether each activity is on time, ahead of schedule, or behind schedule, in relation to Contractor's construction schedule. Determine how construction behind schedule will be expedited; secure commitments from parties involved to do so. Discuss whether schedule revisions are required to ensure that current and subsequent activities will be completed within the Contract Time.
- Record significant discussions and agreements achieved. Distribute the meeting minutes to everyone concerned, including Owner and Designer, within three days of the meeting.

PART 2 - PRODUCTS (NOT APPLICABLE)**PART 3 - EXECUTION (NOT APPLICABLE)**

END OF SECTION 013100

SECTION 015000 - TEMPORARY FACILITIES AND CONTROLS**PART 1 - GENERAL****RELATED DOCUMENTS**

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

SUMMARY

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

SUBMITTALS

Site Plan: Show proposed temporary facilities, utility hookups, staging areas, and parking areas for construction personnel.

Fire Protection Plan: Show compliance with requirements of NFPA 241 and authorities having jurisdiction. Indicate Contractor personnel responsible for management of fire-prevention program.

Moisture and Mold Protection Plan: Describe procedures and controls for protecting materials and construction from water absorption and damage.

Describe delivery, handling, and storage provisions for materials subject to water absorption or water damage.

Indicate procedures for discarding water-damaged materials, protocols for mitigating water intrusion into completed Work, and replacing water-damaged Work.

Dust and Contamination Control Plan: Submit coordination drawing and narrative that indicates the dust control measures proposed for use, proposed locations, and proposed time frame for their operation.

Project Identification Sign: Submit details of Project identification sign, including construction and installation.

PART 2 - PRODUCTS**MATERIALS**

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

Provide corrugated vertical vinyl inserts (slats) for fencing to limit viewing of construction areas. Inserts color shall be selected by the A/E.

Polyethylene Sheet for Dust Control: Reinforced, fire-resistive sheet, 6-mil minimum thickness, with flame-spread rating of 15 or less per ASTM E 84 and passing NFPA 701 Test Method 2.

TEMPORARY STORAGE AND FABRICATION UNITS

Provide sheds, storage containers, etc. sized, furnished, and equipped to accommodate materials and equipment for construction operations. Store combustible materials apart from building.

Lenoir Youth Development Center Retro-Commissioning

Temporary Facilities and Controls

PART 3 - EXECUTION**GENERAL**

Comply with NFPA 241, *Standard for Safeguarding Construction, Alterations, and Demolition Operations* and ANSI A10 Series standards for *Safety Requirements for Construction and Demolition*.

TEMPORARY UTILITIES

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

Water Supply: Water may be taken from the building service lines. Contractor shall provide and install all piping to convey water to point of use as required, shall be responsible for all damage to mains or water system caused by him or his sub-contractors, and upon completion, shall remove any temporary piping. Damage caused to mains or water system shall be repaired without additional cost to Owner. The point of connection shall be as designated by the Owner.

Electrical Power and Lighting: Electrical power required during construction may be taken from sources available on the Project site. This service shall be installed by a qualified electrical Contractor. Lighting shall be provided by Contractor in all spaces at all times where necessary for good and proper workmanship, for inspection, or for safety. No temporary power shall be used off temporary lighting lines without specific approval of A-E.

Temporary electrical power and lighting shall be installed by the Division 26 contractor and comply with NECA Electrical Design Library *Temporary Electrical Facilities* and with NEMA UL standards and regulations for temporary electrical service. Install service in compliance with NFPA 70, *National Electric Code*.

TEMPORARY FACILITIES INSTALLATION

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

Parking for construction activities must be within construction line limits. Contractor's personnel will not at any time park in any Owner parking lot without the prior express consent of Owner. Any personnel violating this requirement, do so at their own risk and should be aware that their vehicles may be towed at their own expense.

Provide Project signs as indicated. Unauthorized signs are not permitted.

Identification Sign: Provide Project identification sign as indicated on Drawings.

Temporary Signs: Provide other signs as indicated and as required to inform public and individuals seeking entrance to Project. Provide temporary, directional signs for construction personnel and visitors.

Sign Maintenance: Maintain and touchup signs so they are legible at all times.

Sanitary Provisions: Contractor shall provide, unless specifically indicated otherwise, and maintain adequate temporary portable toilets with holding tanks in approved locations for use of those engaged on work. Enclosures shall be weatherproof and kept in constant sanitary-approved condition in accordance with Local and State Health Department Regulations.

Waste Disposal Facilities: Provide waste-collection containers in sizes adequate to handle waste from construction operations. Provide adequate, separate cycling containers for all recyclable waste generated during construction. Containers shall be regularly emptied and construction debris shall not be allowed to accumulate on the Project site. Comply with requirements of authorities having jurisdiction.

Lenoir Youth Development Center Retro-Commissioning**Temporary Facilities and Controls****FIRE PROTECTION DURING CONSTRUCTION**

Building contents and all elements of new and/or existing construction must be thoroughly protected from construction procedures that produce sparks, flames, or excessive heat. Such procedures include, but are not limited to, welding, soldering, flame-cutting, using grinders or metal cutting saws, and heating of work spaces. Contractor shall maintain fire watch and/or portable fire-suppression devices, as required, during these operations.

The Contractor shall develop, provide, and post a written plan in compliance with NFPA 241 and requirements of the local authorities having jurisdiction for fire protection during construction.

Develop and supervise an overall fire-prevention and -protection program for personnel at Project site. Review needs with local fire department and establish procedures to be followed. Instruct personnel in methods and procedures required to prevent fires and how to deal with them if they occur.

Provide and maintain portable, UL rated; with class and extinguishing agent as required by locations and classes of fire exposures. Comply with NFPA 10 *Standard for Portable Fire Extinguishers*. Locate fire extinguishers where convenient and effective for their intended purpose, but not less than one extinguisher on each floor or area at or near each usable stairwell.

Store combustible materials in containers in fire-safe locations.

Maintain unobstructed access to fire extinguishers, fire hydrants, temporary fire-protection facilities, stairways, and other access routes for fighting fires.

SECURITY AND SAFETY DURING CONSTRUCTION

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

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

Temporary Enclosures: Provide temporary enclosures for protection of construction, in progress and completed, from exposure, foul weather, other construction operations, and similar activities. Provide temporary weathertight enclosure for building exterior. Where heating or cooling is needed and permanent enclosure is incomplete, insulate temporary enclosures.

MOISTURE AND MOLD CONTROL DURING CONSTRUCTION

Exposed Construction Phase: Before installation of weather barriers, when materials are subject to wetting and exposure and to airborne mold spores, protect as follows:

Protect porous materials from water damage.

Protect stored and installed material from flowing or standing water.

Keep porous and organic materials from coming into prolonged contact with concrete.

Keep roof, wall, and/or openings covered or dammed.

Partially Enclosed Construction Phase: After installation of weather barriers, but before full enclosure and conditioning of building, when installed materials are still subject to infiltration of moisture and ambient mold spores, protect as follows:

Do not load or install porous materials or components, or items with high organic content, into partially enclosed building.

Keep interior spaces reasonably clean and protected from water damage.

Periodically collect and remove waste containing cellulose or other organic matter.

Lenoir Youth Development Center Retro-Commissioning**Temporary Facilities and Controls**

Discard or replace water-damaged material.

Do not install material that is wet.

Discard, replace, or clean stored or installed material that begins to grow mold.

Perform work in a sequence that allows any wet materials adequate time to dry before enclosing the material in drywall or other interior finishes.

Controlled Construction Phase of Construction: After completing and sealing of the building enclosure, maintain as follows:

Control moisture and humidity inside building by maintaining effective dry-in conditions.

Use **temporary** HVAC units or system to control humidity.

Comply with manufacturer's written instructions for temperature, relative humidity, and exposure to water limits.

Hygroscopic materials that may support mold growth that become wet during the course of construction and remain wet for 48 hours are considered defective and must be replaced.

DUST AND CONTAMINATION CONTROL DURING CONSTRUCTION

Prevent dust, fumes, and odors from entering occupied areas or areas in which construction work is more advanced.

Provide floor-to-ceiling dustproof partitions to limit dust and dirt migration and to separate areas occupied by Owner from fumes and noise. Construct dustproof partitions with two layers of 6-mil polyethylene sheet on each side. Cover floor with two layers of 6-mil polyethylene sheet, extending sheets 18 inches up the sidewalls. Overlap and tape full length of joints. Cover floor with fire-retardant-treated plywood.

Maintain negative air pressure within the work area using HEPA-equipped air-filtration units, starting with commencement of temporary partition construction, and continuing until removal of temporary partitions is complete.

Use vacuum collection attachments on dust-producing equipment. Isolate limited work areas using portable dust-containment devices.

Perform daily construction cleanup and final cleanup using approved, HEPA-filter-equipped vacuum equipment.

Coordinate general construction activities with the work of Divisions 21-28 to avoid contamination and/or degradation of building engineered systems by dust, over-spray of insulation or paint, etc. **Costs for the cleaning and/or component replacement of engineered systems required by contamination and/or degradation by general construction activities shall be assigned to the General Contractor.**

TEMPORARY PLUMBING SYSTEMS DURING CONSTRUCTION

Toilet facilities shall be provided and maintained in a sanitary condition during construction, as follows:

Number of Workers	Minimum Number of Facilities
Less than 20	1
20-200	1 toilet and 1 urinal for each 40 employees
201+	1 toilet and 1 urinal for each 50 employees

Temporary facilities may be portable, enclosed, chemically treated tank-tight units. Portable toilets shall be enclosed, screened, and weatherproofed and provided with interior door latches.

Lenoir Youth Development Center Retro-CommissioningTemporary Facilities and Controls

TEMPORARY HVAC SYSTEMS DURING CONSTRUCTION

The HVAC systems in the building are currently operational. If due to the project, HVAC systems must be taken down for an extended period that will in the owner's determination affect the operation of the facility and require temporary air conditioning, the contractor shall provide temporary air conditioning at no additional cost to the project.

OPERATION, TERMINATION, AND REMOVAL OF TEMPORARY FACILITIES

Operation: Maintain temporary facilities in good operating condition until removal.

Termination and Removal: Remove each temporary facility when need for its service has ended, when it has been replaced by authorized use of a permanent facility, or no later than Substantial Completion. Complete or, if necessary, restore permanent construction that may have been delayed because of interference with temporary facility. Repair damaged Work, clean exposed surfaces, and replace construction that cannot be satisfactorily repaired.

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

END OF SECTION 015000

SECTION 017700 - PROJECT CLOSEOUT**RELATED DOCUMENTS**

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

INSPECTION CERTIFICATES, WARRANTIES, BONDS, AND GUARANTEES

Before Final Payment will be made, Contractor must submit a proper Certificate of Occupancy or a copy of all appropriate inspection certificates to A-E, signed by proper authorities, together with warranties, bonds, and/or guarantees as required.

FINAL PAYMENT

Properly documented Final Certificate for Payment shall include the following:

- Certificate of Completion/Compliance by Architect/Engineer
- Consent of Surety Company to Final Payment (as applicable)
- Prime Contractor's Affidavit of Release of Liens
- Prime Contractor's Affidavit of Payment of Debts and Claims
- Builder's Risk Insurance Cancellation Notice
- Inspection Certificates (as applicable)
- Warranties, Bonds and Guarantees
- Operating and Maintenance Data
- Documentation of Owner Instruction and Training
- Contractor's As-built Drawings

END OF SECTION 017700

SECTION 019913 - GENERAL REQUIREMENTS FOR DIVISIONS 23 WORK**PART 1 - GENERAL****RELATED DOCUMENTS**

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

The requirements specified herein shall govern all Sections in Division 23, whether stated therein or not.

Where items specified in the other sections of this Division conflict with requirements of this Section, the former shall govern.

REVIEW OF CONTRACT DOCUMENTS

The Contract Documents may represent imperfect data and may contain errors, omissions, conflicts, inconsistencies, code violations and improper use of materials. Such deficiencies will be corrected by the A-E when identified. The Contractor shall carefully study and compare the individual Contract Documents with each other and report at once in writing to the A-E any deficiencies the Contractor may discover. The Contractor shall require each subcontractor to likewise study the documents and report at once any deficiencies discovered. The Contractor shall resolve all reported deficiencies with the A-E prior to starting any work. **Any work performed prior to receipt of instructions from the A-E will be done at the Contractor's risk.** If the Contractor performs any construction activity knowing it involves a recognized error, inconsistency, or omission in the Contract Documents without such notice to the A-E, the Contractor shall assume appropriate responsibility for such performance and shall bear an appropriate amount of the attributable costs for correction.

The Contractor shall be responsible for maintaining habitable structures under this Contract rainproof, and for making equipment and utility installations properly perform the intended function. If he is prevented from so doing by any limitations of the drawings or specifications, the Contractor shall immediately notify the A-E in writing of such limitations before proceeding with construction in the area where the problem or limitation exists.

DEFINITIONS

Mechanical Work: Work required by this Contract as defined by specification Division 23 (Heating, Ventilating, and Air-Conditioning).

Labeled: Appliances, equipment, materials or products to which has been attached a label, symbol, or other identifying mark of an organization acceptable to the North Carolina Building Code Council and concerned with product evaluation, that maintains periodic inspection of production of labeled equipment or materials and by whose labeling the manufacturer indicates compliance with identified standards or has been tested and found suitable for a specified purpose.

Listed: Appliances, equipment, materials or products included in a list published by an organization acceptable to the North Carolina Building Code Council and concerned with product evaluation, that maintains periodic inspection of production of listed equipment or materials, and whose listing states either that the equipment or material meets appropriate designated standards or has been tested and found suitable for a specified purpose.

Concealed: Work within or behind various construction elements or in crawl spaces or trenches that is not exposed to view when the project is complete.

Exposed: Not "concealed" as defined above, or anything exposed to view when the project is complete.

Wiring: Cable, raceways, fittings, mechanical supports, wire, junction boxes, device boxes, outlet boxes, switches, cutouts, and related items.

Lenoir Youth Development Center Retro-Commissioning

General Requirements for Divisions 23 Work

CODES, LAWS, REGULATIONS, AND STANDARDS

Work on and for the project shall conform to requirements of each applicable volume of the *North Carolina Building Code*; shall comply with the regulations of the N.C. Department of Labor, including the latest revisions and interpretations of the *Occupational Safety and Health Act of North Carolina*; and be in accordance with all other codes, laws, rules and regulations that apply to this project.

"Confined spaces" and "permit-requiring confined spaces", as defined by U.S. Occupational Safety and Health Administration (USOSHA) may exist in the work area or may be created by the construction of this Project. The Contractor shall be responsible for identification of any permit-requiring confined spaces and for establishing all required procedures for meeting the requirements of USOSHA relative to these spaces, including written confined space entry program(s).

Codes, laws, regulations, and/or industry standards referenced in the Specification or on the Drawings shall be considered to be part of the Project requirements. Applicable edition of the referenced volume is the edition that is/was in effect at the time the construction permit was issued or at the time of approval of the Contract Documents by the Authority Having Jurisdiction.

INTENT AND WORKMANSHIP

The words "furnish," "furnish and install," "install," and "provide" or words with similar meaning shall be interpreted, unless otherwise specifically stated, to mean "furnish and install complete in-place and ready for service."

The work of all trades under this Contract shall be coordinated in such a manner as to obtain the best workmanship possible.

Miscellaneous items and accessories that are not specifically shown on the drawings or specified herein, but which are essential to produce a complete and properly operating installation, or usable structure or plant, providing the indicated function, shall be furnished and installed without change in the Contract price. Such miscellaneous items and accessories shall be of the same quality standards, including material, style, finish, strength, class, weight and other applicable characteristics, as specific for the major component of which the miscellaneous item or accessory is an essential part. The above requirement, however, is not intended to include major components not covered by or inferable from the drawings and specifications.

WELDER QUALIFICATION

Where welding is required on vessels or piping with an ASME P- or S- stamp, qualify welders for welding procedures complying with ASME *Boiler and Pressure Vessel Code*, Section IX. Submit *Welder's Performance Qualification Record* required by the ASME *Boiler and Pressure Vessel Code*.

For piping and structural supports welding, qualify welders in accordance with AWS QC7 *Standard for AWS Certified Welders* for welding procedures complying with ASME B31.1 or ASME B31.9, as applicable. Submit *Welder's Performance Qualification Record* required by ASME B31.1 or B31.9 and a copy of the most recent *Maintenance of Welder Certification* form submitted to AWS.

In addition, submit each welder's assigned number, letter, or symbol used to identify the work of the welder. This symbol shall be stamped in or adjacent to each completed weld.

QUALITY ASSURANCE

The Contract Drawings indicate the extent and general arrangement of the Work. The Contractor shall coordinate the Work under his Contract so as to avoid conflicts between his work and the work of other trades. He shall carefully examine the Drawings and shall be responsible for the proper fitting of materials and equipment into the space provided. If any departures from the Contract Drawings are deemed necessary by the Contractor, detail drawings of such departures and the reasons therefore shall be submitted as soon as practicable to the A-E for his review. No such departures shall be made without this review and written clarification or change order.

Lenoir Youth Development Center Retro-Commissioning

General Requirements for Divisions 23 Work

If manufacturer recommended details or installation instructions differ from the contract drawings or specifications, then the contractor shall notify the A-E immediately of any discrepancies.

The Drawings and Specifications shall be considered supplementary, one to the other, so that materials and/or labor indicated, called for, or implied by one and not the other shall be provided as though specifically called for in both.

Firestop Materials Codes and Standards: Comply with ASTM Standard E814 and applicable categories of UL's current *Fire Resistance Directory*, Vol. I and II, for compliance with ANSI/UL Standard 1479.

Access Doors Fire-Resistance Ratings: Where fire-resistance rating is indicated for construction penetrated by access units, provide Listed and Labeled units.

OBSERVATION

All work shall be done by skilled technicians, continuously supervised by the Contractor and subject to observation and final acceptance by the A-E. Such final acceptance shall in no way relieve the Contractor from responsibility for defects in either workmanship or material that may subsequently develop.

SUBMITTALS

Submittals shall demonstrate compliance with technical requirements by reference to each subsection of this specification. Material and equipment schedules, catalog cuts, manufacturers' data and shop drawings, and field working drawings as required by individual Sections shall be provided.

Shop drawings, technical data and other such submittals required by individual Sections of the Divisions listed above shall be provided.

Equipment drawings, manufacturer's installation instructions as shipped with the equipment, field working and location drawings, wiring diagrams, and coordination drawings shall be provided by the Contractor for items of equipment, sleeves, foundations, curbs, wiring, ductwork, piping, etc., as necessary for information and coordination of all trades. These drawings shall be provided sufficiently in advance of installation to avoid delays and removal and reworking of installed work, and so as to provide information to other trades when and as required. No work shall be done until these drawings have been coordinated by the Contractor.

Submittals shall be checked before submission by technically qualified employees of Contractor for accuracy, completeness and compliance with Contract requirement. **All submittals shall be accompanied by the "Submittal Cover Form" provided at the end of this Section, signed by Contractor.**

Contractor shall submit complete lists or schedules of all proposed sub-contractors and material suppliers, and of all proposed construction materials and equipment. Materials and equipment lists shall be complete with trade names and/or catalog numbers of each item. Processing of the second and subsequent Certificate for Payment will be withheld until substantial portions of these lists have been submitted.

Products furnished shall be essentially the standard product of the manufacturer. Where two or more units of the same class of equipment are required, these units shall be products of a single manufacturer.

Products proposed by the Contractor shall be new except where specifically noted otherwise. Contractor(s) shall provide products only from manufacturers who have published data showing compliance with specified requirements or who certify in writing to such compliance (including laboratory and/or in-place testing, if applicable). All electrical products shall be both labeled and listed, as defined above. **Prior to purchase of major materials, equipment or systems, submit manufacturer's data to the A-E for review as hereinafter specified.**

Products of the specified type and for the specified application offered by the Contractor(s) for use on this Project shall comply with the following requirements:

Product shall have had satisfactory performance in applications of similar character to that specified for a period of at least three (3) years.

Lenoir Youth Development Center Retro-Commissioning

General Requirements for Divisions 23 Work

Product shall be from an established national or regional manufacturer. The A-E's experience with the manufacturer on prior projects relative to product performance, technical support, etc. may be taken into account to establish suitability of the offered product for this Project.

Product shall be provided through an authorized representative of the manufacturer. The representative shall be capable of providing technical support relative to the installation, operation, and maintenance of the product. The A-E's experience with the representative on prior projects relative to product performance, technical support, etc. may be taken into account to establish suitability of the offered product for this Project.

Repair parts and service for the product shall be available within twenty-four (24) hours of notice.

The manufacturer and his authorized representative shall furnish satisfactory evidence in support of these conditions when requested. The A-E's decision relative to the suitability and acceptability of any product is final and acceptance of this limitation is implicitly acknowledged by the contractor and the manufacturer and/or his representative offering the product for use on this Project.

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 by being marked "**NON-COMPLYING FEATURE**." This indication shall be applied to the submittals at the appropriate location in a color contrasting with the remainder of the submittal. Additional information that might assist the Engineer in product evaluation may be included with the submittal. This information should indicate how a specific non-complying feature is believed by the Contractor to meet the intent of the specification.

It is the Contractor's responsibility to demonstrate compliance with the specifications and to clearly indicate any features that do not meet the specifications. It is not the Engineer's responsibility to identify non-compliance. Substantial non-compliance, as determined by the Engineer, is grounds for rejection of the submittal. Discovery of non-complying features that have not been properly identified as such on submittals may require, at any stage of construction, the removal and replacement of the non-complying item(s).

The A-E will review shop drawings, manufacturer's data, and samples with reasonable promptness. This review is only for general conformance with the design concept of the project and general compliance with the information given in the Contract Documents. Corrections or comments made on the shop drawings during this review do not relieve contractor from compliance with the requirements of the plans and specifications. Approval of a specific item shall not include approval of an assembly of which the item is a component. Contractor is responsible for dimensions to be confirmed and correlated at the jobsite; information that pertains solely to the fabrication processes or to the means, methods, techniques, sequences and procedures of construction; coordination of his or her Work with that of all other trades; and for performing all work in a safe and satisfactory manner. The Contractor is responsible for any delay caused by his failure to observe submittals requirements and the time for completion of his Contract will not be extended because of such delays.

The A-E's submittals review stamp categories shall be interpreted as follows:

Reviewed: Fabrication and installation or erection may be undertaken.

Exceptions indicated, revise and proceed: Fabrication and installation of erection may be undertaken. However, Contractor shall comply with all notes or corrections indicated.

Exceptions indicated, revise and re-submit: Neither fabrication, installation, nor erection shall be undertaken. Re-submit corrected copies for review. Corrections shall be limited to items marked, except that changes required in order to coordinate the corrections indicated shall be made. All changes, other than those indicated, shall be called specifically to the A-E's attention.

Rejected, re-submit: Neither fabrication, installation, nor erection shall be undertaken. Revise entire submission to comply with information given in the Contract Documents and re-submit.

Lenoir Youth Development Center Retro-Commissioning**General Requirements for Divisions 23 Work**

Submittals returned to the Contractor with the A-E's "reviewed" or "exceptions indicated, revise and proceed" stamp need not be resubmitted, except that corrected copies of "exceptions indicated, revise and proceed" submittals shall be furnished for record when requested.

Submittals returned to the Contractor with the A-E's "revise and re-submit" or "rejected, re-submit" stamp shall be corrected to comply with Contract requirements and re-submitted to the A-E for review. The Contractor shall direct specific attention, in writing or on re-submitted shop drawings, product data or samples, to revisions other than those requested by the A-E on previous submittals.

Shop drawings of work that involves more than one subcontractor shall be coordinated by the Contractor and submitted to A-E under one cover. No items shall be fabricated, nor any portion thereof shipped to site, prior to receipt by the Contractor of all applicable submittals, including manufacturer's data, samples and shop drawings bearing the A-E's "reviewed" or "exceptions indicated" stamp only.

Manufacturer's data submitted as required by the technical specifications sections or requested by A-E shall consist of four (4) copies of certificates, schedules, catalog cuts, manufacturer's specifications and installation instructions for each type of product or material. Include maintenance recommendations, fire ratings and other reports when applicable to show compliance with the Specifications. When catalog cuts are submitted, the specific item to be considered shall be identified. Items that are not so identified will be returned to the Contractor without action.

Firestop Systems: Submit data on products. Provide manufacturer's certification of UL classification(s) required, including copies of UL systems listings and schedule defining each UL system proposed and the applicable type of penetration.

Access Units: Submit manufacturer's technical data and installation instructions for each type of access door assembly, including setting drawings, templates, instructions and directions for installation of anchorage devices.

Contractor shall submit for review any samples required by the technical specification sections or that may be requested by the A-E.

With each electrical testing and compliance submittal, Contractor shall submit evidence of compliance that each manufactured item or component of electrically-operated equipment and that each fabricated assembly of electrically operated equipment furnished complies with the testing requirements.

FIRE RATINGS

Fire rating of walls and floors, as indicated on the Drawings, are for reference only. Refer to Architectural Drawings for exact construction and fire ratings.

Where fire resistive insulation or other coverings have been applied to a structural element to obtain a fire rating and this insulation or covering is removed or otherwise disturbed, the Contractor shall be responsible for restoring the material to a condition that matches the original fire protective ability.

USE OF BRAND NAMES

Brand names, where scheduled as "basis of design," are to be considered for information purposes and are not intended to be a product specification.

Where the Contractor proposes to use an item of equipment other than that indicated as basis of design that may require redesign of the structure, partitions, foundations, piping, wiring, or any other part of the mechanical, electrical, or architectural layout, all such redesign and all new drawings and detailing required shall be prepared by the Contractor at his own expense and submitted for review by the A-E.

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

Lenoir Youth Development Center Retro-Commissioning**General Requirements for Divisions 23 Work**

Brand names, where used as a product specification, are intended to denote the standard of quality required for the particular material or product.

Where the term "equal" or "equivalent" is present, such specification does not restrict the Contractor to a specific brand and equivalent products by other manufacturers may be acceptable. The term "equal" or "equivalent" shall be interpreted to mean a material or product that is similar and equal in type, quality, size, capacity, composition, finish, color, and other performance characteristics to the material or product specified by brand name, and that, **in the opinion of the A-E**, is suitable for the same use and capable of performing the same function as the material or product specified. **Proposed equivalent items must be reviewed by the A-E before they are purchased or incorporated into the work.**

EQUIPMENT SUBSTITUTIONS AND CHANGES/EXTRA COSTS FOR CHANGES IN BUILDING SERVICES

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

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

It is the responsibility of the Contractor to notify the A-E in all cases where the requirements of proposed equipment differ from the requirements specified, shown, or implied on the Drawings or within the Specifications. **Failure of the Contractor to notify the A-E shall not relieve the Contractor of the responsibility of providing compatible equipment at no additional cost as described above.**

OPERATION AND MAINTENANCE DATA

For each Division of the Work, provide four (4) copies of Operating Manuals, Maintenance Manuals, and Test Reports, bound in suitable covers, to the A-E at least two (2) weeks **prior** to the final inspection of the project.

Each manual shall include a cover sheet listing the following:

Project name and location.

Division of Work covered by the manual.

Contractor data, including name, address, phone and fax numbers, and service contact information (24-hour number, email address, etc.)

Date of project completion.

Each manual shall include a table of contents.

Operating manual: Provide all relevant information needed for day-to-day operation and management of the building systems. Include the following for each system:

System Description: Identify the areas of the building the system serves, the locations of performance checkpoints, the expected performance readings at the design load conditions and, where applicable, at part-load conditions. The system's operation during the day, night, and weekend, as well as seasonal start-up and shutdown, safety devices and their function, control devices and their function, pollution control devices, etc., also shall be described. The function of the controls for individual systems shall be described alongside the description of the system function.

Operating Routines and Procedures: Identify activities associated with the normal operation of systems and equipment. Operating checklists and operating logs shall be provided for each system and all performance standards shall be identified.

Lenoir Youth Development Center Retro-Commissioning**General Requirements for Divisions 23 Work**

- Seasonal Start-Up and Shutdown: List seasonal start-up and shutdown procedures, including any "mothballing" procedures required.
- Special Procedures: Special procedures related to environmental control, health and safety, productive work environment, etc., shall be codified.
- Troubleshooting Procedures: This section shall include questionnaires and diagnostics to allow users to isolate probable causes of operating problems in an efficient manner.
- Maintenance manual: The maintenance manual shall be divided into two parts:
- Part I shall contain information related to the equipment data sheets, nameplate data, operating data, etc. Include the original purchase order number; date of purchase; name, address, and phone number of vendor; and warranty information.
- Part II shall support a maintenance program. The manual shall contain information prepared by the equipment manufacturers, but shall be supplemented by information provided by the Contractor. Each item of equipment shall be identified and an individual "Equipment Maintenance Sheet" shall be prepared for each, with the following information:
- Description each system and system component, consisting of easily read schematic drawings showing all components, identified to match Part I data, that requires maintenance.
 - Recommended preventative and predictive maintenance procedures and their recommended frequency of application for each system component.
 - Recommended list of spare parts with part numbers and place(s) they can be obtained.
 - Copy of manufacturer's Installation instructions for each component.
 - Any other information requested by the A/E to support the operation and maintenance of the equipment.
- Test reports: Provide copies of the test protocols used in the construction and commissioning of the systems. Arrange data so as to allow the results of ensuing tests to be easily added.

PART 2 - PRODUCTS**MACHINERY DRIVES**

- V-Belt Drives: Provide ANSI/Rubber Manufacturers Association (RMA) standard or raw edge cogged V-belts with properly-selected motor pulley and driven sheave. Belts shall be constructed of reinforced cord and rubber.
- The drive shall be rated for the motor horsepower indicated on the Drawings, plus the recommended ANSI/RMA service factor (but, not less than 20%), in addition to the ANSI/RMA allowances for pitch diameter, center distance, and arc of contact.
- Drives 1 horsepower and smaller may be provided with single standard V-belt. Drives 1-1/2 horsepower and larger shall be provided with raw edge cogged V-belts, the number of belts necessary to transmit the required power with 95% minimum efficiency, but in no case less than 2.
- Exception: Belt drives for fans utilized as part of smoke control and/or smoke venting systems shall be rated for the motor horsepower indicated on the Drawings, plus 50% additional service factor, in addition to the ANSI/RMA allowances for pitch diameter, center distance, and arc of contact, and shall have at least 2 belts.**

Lenoir Youth Development Center Retro-Commissioning**General Requirements for Divisions 23 Work**

Multiple belts shall be matched to ANSI/RMA specified limits by measurement on a belt measuring fixture. Seal matched sets together to prevent mixing or partial loss of sets. Replacement, when necessary, shall be an entire set of new matched belts.

Sheaves and pulleys shall be fixed pitch type, statically and dynamically balanced, and constructed as follows:

Construction of pressed steel or close grained cast iron.

Bore shall be fixed or bushing type for securing to shaft with keys.

Groove spacing for driving and driven pulleys shall be the same.

Maximum belt speed shall not exceed 5000 feet per minute.

Minimum motor sheave diameter shall comply with ANSI/RMA recommendations as follows:

Shaft Couplings: Shaft couplings for direct drive equipment driven by polyphase motors shall be flexible type capable of absorbing vibration, rated for the motor horsepower indicated on the Drawings plus an additional 50% service factor. Couplings shall be drop-out type to allow disassembly and removal without removing equipment shaft or motor.

Drive Guards: Drive guards shall be provided for belt drives and shaft couplings.

Belt guards shall comply with OSHA and SMACNA requirements of diamond-mesh wire screen welded to steel angle frame or equivalent, prime coated. Secure to fan or fan supports without short circuiting vibration isolation. Include provisions for adjustment of belt tension, lubrication, and use of tachometer with guard in place.

Coupling guards shall be constructed steel and comply with ANSI B15.1, Section 8, and OSHA 1910.219. Guards shall be easily removable for access and service and provided with openings for speed checks, etc. without removal.

FIRESTOPPING SYSTEMS

Firestop systems shall be used in locations including, but not limited to, the following:

Penetrations through fire resistance rated floor assemblies and roof assemblies (where required by code) including both empty openings and openings containing penetrants.

Penetrations through fire resistance rated wall assemblies including both empty openings and openings containing penetrants.

Membrane penetrations in fire resistance rated wall assemblies where items penetrate one side of the barrier.

Membrane penetrations in fire resistance rated ceiling assemblies.

Systems or devices must be listed in the UL Fire Resistance Directory and must conform to construction type, penetrant type, annular space requirements and fire rating involved in each separate instance. System must be symmetrical for wall applications.

Systems or devices must be asbestos-free and all products must be from a single manufacturer.

Products must withstand the passage of cold smoke, either as an inherent property of the system or by the use of a separate product included as part of the UL system or device, and designed to perform this function.

Lenoir Youth Development Center Retro-Commissioning**General Requirements for Divisions 23 Work**

Cracks, Voids, or Holes Up to 4" Diameter: Putty or caulking, one-piece intumescent elastomer, non-corrosive to metal, compatible with synthetic cable jackets, Listed, and capable of expanding 10 times when exposed to flame or heat.

Openings 4" or Greater: Sealing system capable of passing 3-hour fire test in accordance with ASTM E-814, consisting of wall wrap or liner, partitions, and end caps capable of expanding when exposed to temperatures of 250 to 350 deg. F (121 to 177 deg. C), Listed.

Wall Boxes:

Metallic boxes used in fire-rated walls or floors must be listed in the UL Fire Resistance Directory under category CEYY.

Listed single and double gang metallic device and outlet boxes with metallic or nonmetallic cover plates may be used in bearing and nonbearing wood stud and steel stud walls with ratings not exceeding 2 hours. The metallic outlet or switch boxes shall be securely fastened to the studs and the opening in the wallboard facing shall be cut so that the clearance between the box and the wallboard does not exceed 1/8 in. The surface area of individual metallic outlet or switch boxes shall not exceed 16 sq. in. The aggregate surface area of the boxes shall not exceed 100 sq. in. per 100 sq. ft. of wall surface.

Metallic boxes located on opposite sides of walls or partitions shall be separated by a minimum horizontal distance of 24 in. This minimum separation distance between metallic boxes may be reduced when "Wall Opening Protective Materials" listed in the UL Fire Resistance Directory under category CLIV are installed according to the requirements of the Classification.

Metallic boxes shall not be installed on opposite sides of walls or partitions of staggered stud construction unless "Wall Opening Protective Materials" are installed with the metallic boxes in accordance with Classification requirements for the protective materials.

WALL AND FLOOR ACCESS DOORS

Where floors, walls and ceilings must be penetrated for access to engineering work, provide types of access doors indicated, including floor doors if any. Furnish sizes indicated or, where not otherwise indicated, furnish 24" x 24" panels. Furnish manufacturer's complete units, of type recommended for application in indicated substrate construction, in each case, complete with anchorages and hardware.

Except as otherwise indicated, fabricate wall/ceiling door units of welded steel construction with welds ground smooth, 16-gage frames and 14-gage flush panel doors, 175 deg. swing with concealed spring hinges, flush screw-driver-operated cam locks, factory-applied rust-inhibitive prime-coat paint finish.

Provide rated access doors where installed in fire resistance rated floor and wall assemblies to meet fire rating.

PART 3 – EXECUTION**GENERAL**

Comply with NFPA 241, *Standard for Safeguarding Construction, Alterations, and Demolition Operations*; ANSI A10 Series standards for *Safety Requirements for Construction and Demolition*; and Chapter 14 of the *North Carolina State Building Code: Fire Code*.

FIRE PROTECTION DURING CONSTRUCTION

Building contents and all elements of new and/or existing construction must be thoroughly protected from construction procedures that produce sparks, flames, or excessive heat. Such procedures include, but are not limited to, welding, soldering, flame-cutting, using grinders or metal cutting saws, and heating of work spaces. Contractor shall maintain fire watch and/or portable fire-suppression devices, as required, during these operations.

Lenoir Youth Development Center Retro-Commissioning**General Requirements for Divisions 23 Work**

The Contractor shall develop, provide, and post a written plan in compliance with NFPA 241 and Chapter 14 of the *North Carolina State Building Code: Fire Code*.

Develop and supervise an overall fire-prevention and -protection program for personnel at Project site. Review needs with local fire department and establish procedures to be followed. Instruct personnel in methods and procedures required to prevent fires and how to deal with them if they occur.

Provide and maintain portable, UL rated fire extinguishers with class and extinguishing agent as required by locations and classes of fire exposures. Comply with NFPA 10 *Standard for Portable Fire Extinguishers*. Locate fire extinguishers where convenient and effective for their intended purpose, but not less than one extinguisher on each floor or area at or near each usable stairwell.

SECURITY AND SAFETY DURING CONSTRUCTION

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

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

Temporary Enclosures: Provide temporary enclosures for protection of construction, in progress and completed, from exposure, foul weather, other construction operations, and similar activities. Provide temporary weathertight enclosure for building exterior. Where heating or cooling is needed and permanent enclosure is incomplete, insulate temporary enclosures.

MOISTURE AND MOLD CONTROL DURING CONSTRUCTION

Exposed Construction Phase: Before installation of weather barriers, when materials are subject to wetting and exposure and to airborne mold spores, protect as follows:

Protect porous materials from water damage.

Protect stored and installed material from flowing or standing water.

Keep porous and organic materials from coming into prolonged contact with concrete.

Keep roof, wall, and/or openings covered or dammed.

Partially Enclosed Construction Phase: After installation of weather barriers, but before full enclosure and conditioning of building, when installed materials are still subject to infiltration of moisture and ambient mold spores, protect as follows:

Do not load or install porous materials or components, or items with high organic content, into partially enclosed building.

Keep interior spaces reasonably clean and protected from water damage.

Periodically collect and remove waste containing cellulose or other organic matter.

Discard or replace water-damaged material.

Do not install material that is wet.

Discard, replace, or clean stored or installed material that begins to grow mold.

Perform work in a sequence that allows any wet materials adequate time to dry before enclosing the material in drywall or other interior finishes.

Lenoir Youth Development Center Retro-Commissioning**General Requirements for Divisions 23 Work**

Controlled Construction Phase of Construction: After completing and sealing of the building enclosure, maintain as follows:

Control moisture and humidity inside building by maintaining effective dry-in conditions.

Use **temporary** HVAC units or system to control humidity.

Comply with manufacturer's written instructions for temperature, relative humidity, and exposure to water limits.

Hygroscopic materials that may support mold growth that become wet during the course of construction and remain wet for 48 hours are considered defective and must be replaced.

DUST AND CONTAMINATION CONTROL DURING CONSTRUCTION

Prevent dust, fumes, and odors from entering occupied areas or areas in which construction work is more advanced

Provide floor-to-ceiling dustproof partitions to limit dust and dirt migration and to separate areas occupied by Owner from fumes and noise. Construct dustproof partitions with two layers of 6-mil polyethylene sheet on each side. Cover floor with two layers of 6-mil polyethylene sheet, extending sheets 18 inches up the sidewalls. Overlap and tape full length of joints. Cover floor with fire-retardant-treated plywood.

Maintain negative air pressure within the work area using HEPA-equipped air-filtration units, starting with commencement of temporary partition construction, and continuing until removal of temporary partitions is complete.

Use vacuum collection attachments on dust-producing equipment. Isolate limited work areas using portable dust-containment devices.

Perform daily construction cleanup and final cleanup using approved, HEPA-filter-equipped vacuum equipment.

Coordinate general construction activities with the work of Divisions 21-28 to avoid contamination and/or degradation of building engineered systems by dust, over-spray of insulation or paint, etc. **Costs for the cleaning and/or component replacement of engineered systems required by contamination and/or degradation by general construction activities shall be assigned to the General Contractor.**

TEMPORARY HVAC SYSTEMS USE DURING CONSTRUCTION

The use of permanent HVAC systems to support construction activities is prohibited. The need for heating, cooling, dehumidification, and/or ventilation during construction shall be met via use of temporary HVAC units or systems as follows:

Heating: Provide vented, self-contained, liquid-propane-gas or fuel-oil heaters with individual space thermostatic control. Use of gasoline-burning space heaters, open-flame heaters, or salamander-type heating units is prohibited.

Cooling: Provide modular, portable stand-alone direct expansion cooling units with condensers vented to the outdoors.

Ventilation and Humidity Control: Provide temporary ventilation required by construction activities for curing or drying of completed installations or for protecting installed construction from adverse effects of high humidity. Select equipment that will not have a harmful effect on completed installations or elements being installed. Coordinate ventilation requirements to produce ambient condition required and minimize energy consumption.

Lenoir Youth Development Center Retro-Commissioning

General Requirements for Divisions 23 Work

COOPERATION WITH OTHER TRADES

The Contractor shall give full cooperation to other trades and shall furnish any and all information necessary to permit the work of other trades. Information to be provided by the Contractor includes, but is not limited to templates, patterns, setting plans, and shop details as may be necessary for the proper installation of work and for the purpose of coordinating adjacent work. Information required by other trades shall be provided in a timely manner and shall be sufficient to allow the work of such other trades to proceed with the least possible interference or delay.

Where the work of the Contractor will be installed in close proximity to, or may interfere with work of other trades, the Contractor shall assist in working out space conditions to make a satisfactory adjustment. **If the Contractor installs his work before coordination with other trades, he shall make the necessary changes in his work to correct the condition without extra charge.**

MISCELLANEOUS CONCRETE AND STEEL SUPPORTS

All concrete curbs, bases, etc., required for mechanical or electrical equipment and components shall be provided under the Division requiring them except where specifically indicated and/or specified to be provided under a different Division.

"Housekeeping pads", constructed of 3000 psi concrete doweled to floor slab, shall be provided for each floor-mounted component. Pads for air-handling units shall, unless indicated otherwise on the drawings, be 6" high, while pads for all other equipment shall be 4" high. Pads shall be finished smooth with chamfered top edges and corners. Equipment and other floor-mounted elements shall be installed and shall be anchored and grouted to housekeeping pads.

Miscellaneous steel for equipment, pipe, duct, raceway, etc. installation required by the work in any Division shall be provided and placed under that Division except where specifically indicated and/or specified to be provided under a different Division.

Anchors, inserts, supports, attachments, etc., required and but not indicated on the Drawings shall be provided under this Contract.

WIND LOADING

Not applicable.

FIRESTOPPING

Installer should be experienced in installing or applying similar systems, plus: be acceptable to or licensed by manufacturer, state or local authority where applicable; have at least five years experience; and have successfully completed at least five comparable projects using this system.

Firestop systems or devices installation must meet requirements of ASTM E-814, UL 1479 or UL 2079 tested assemblies that provide a fire rating equal to that of construction being penetrated.

Install only after substrate penetrations and supporting brackets have been installed. Do not install firestopping when ambient or substrate temperatures are outside limits permitted by manufacturers or when substrates are wet. Where floor openings without penetrating items are more than 4 inches wide and subject to traffic or loading, install firestopping materials capable of supporting same loading as floor. Protect materials on surfaces subject to traffic.

SMOKE-RESISTIVE SYSTEMS

The space around items penetrating non-fire rated walls and floors shall be filled with an approved material to limit the free passage of smoke, heat and flame in locations including, but not limited to, the following:

Lenoir Youth Development Center Retro-Commissioning**General Requirements for Divisions 23 Work**

1 Penetrations through non-rated floors including both empty openings and openings containing penetrants.

2

3 Penetrations through non-rated smoke partitions and wall assemblies including both empty openings and
4 openings containing penetrants.

5

6

7 **WALL AND FLOOR ACCESS DOORS**

8

9 Comply with manufacturer's instructions for installation of access doors, floor doors, and removable access plates.

10

11 Set frames accurately in position and securely attach to supports with face panels plumb or level in relation to
12 adjacent finish surfaces.

13

14 Adjust hardware and panels after installation for proper operation.

15

16 Remove or replace panels or frames that are warped, bowed, or otherwise damaged.

17

18

19 **PATCHING**

20

21 Repair, patching, and finishing of walls, floors, and/or ceilings affected by demolition, cutting after installation of new
22 work, etc. shall be done by technicians skilled in the applicable trades and shall match surrounding or adjoining
23 materials in composition, texture, color, and finish.

24

25

26 **CONTRACTOR AS-BUILT DRAWINGS**

27

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

30

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

34

35 Give particular attention to information on concealed elements that would be difficult to identify or measure
36 and record later.

37

38 Accurately record information in an acceptable drawing technique.

39

40 Record data as soon as possible after obtaining it.

41

42 Record and check the markup before enclosing concealed installations.

43

44 Cross-reference record prints to corresponding archive photographic documentation.

45

46 Types of items requiring marking include, but are not limited to, the following:

47

48 Dimensional changes.

49

50 Revisions to details.

51

52 Locations and depths of underground utilities.

53

54 Revisions to routing of piping and conduits.

55

56 Revisions to electrical circuitry.

57

58 Actual equipment locations.

59

60 Duct size and routing.

Lenoir Youth Development Center Retro-Commissioning

General Requirements for Divisions 23 Work

1 Locations of concealed internal utilities.

2

3 Additional information that was either shown schematically or omitted from original Drawings.

4

5 Note Construction Change Directive numbers, alternate numbers, Change Order numbers, and similar
6 identification, where applicable.

7

8 Submit Contractor As-built Drawings to A/E for review **at least two (2) weeks prior to Project final inspection.**

9

10

11 **END SECTION 019913**

Lenoir Youth Development Center Retro-Commissioning

General Requirements for Divisions 23 Work

SUBMITTAL COVER FORM

PROJECT: NC Department of Crime Control and Public Safety
Lenoir Youth Development Center Retro-Commissioning

PROJECT NO.: SO#2022-01328 SCO#22-24440-01A JO#4258 C#11453

TO: SALAS O'BRIEN
1620 Midtown Place
Raleigh, NC 27609

FROM:

_____ CONTRACTOR _____ SUBCONTRACTOR

We submit for your consideration the following product for the above project:

SPECIFICATION SECTION	SPECIFICATION PARAGRAPH	DESCRIPTION
_____	_____	_____

TYPE OF SUBMITTAL:

_____ Specified Brand Product
_____ Proposed Equivalent Product to Specified Brand
_____ Product Meeting Performance Specification (No Brand Specified)

We warrant the following:

- a. We have personally investigated the proposed product, and determined that it is equal in all respects to that specified and/or performance specification requirements;
- b. We will provide the specified guarantee for this product;
- c. We will coordinate installation of this product into the work, making such changes as may be required for the work to be complete in all respects;
- d. We have clearly indicated by marking as "Non-Complying Feature" each and every requirement of the Specifications that this product does not meet;
- e. And, we waive all claims for additional costs related to this product which subsequently become apparent.

Attached hereto are complete technical data, including applicable laboratory reports, to demonstrate compliance with project requirements.

SUBMITTED BY:

SIGNATURE

DATE

SUBMITTAL REVIEW

(SAMPLE FORM - ORIGINAL WITH COMMENTS WILL BE ATTACHED TO
SUBMITTAL BY A/E)

PROJECT:

PROJECT #:

SUBMITTAL ID#:

SPECIFICATION PARAGRAPH:

DESCRIPTION:

Submittal has been reviewed only for conformance with design intent of the contract documents. See Section 019913 "GENERAL REQUIREMENTS FOR ENGINEERED WORK" for complete definition of Submittal Review.

- ☐ Reviewed
- ☐ Exceptions Noted - Revise & Proceed
- ☐ Exceptions Noted - Revise & Resubmit
- ☐ Rejected

DATE:

BY:

REVIEW COMMENTS:

THESE COMMENTS SHALL NOT BE REMOVED FROM THIS DOCUMENT

SECTION 019916 - DIVISION 23 WORK IN EXISTING BUILDINGS**PART 1 - GENERAL****RELATED DOCUMENTS**

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

SUMMARY

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

The requirements specified herein shall govern all Sections in Division 23, whether stated therein or not.

Where items specified in the other sections of this Division conflict with requirements of this Section, the former shall govern.

SUBMITTALS

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. Identification requirements for non-complying features of items are very specific. See Section 019913 for exact requirements.

Submit a written description of each roof covering system to be disturbed and/or repaired. Description shall include each type of roofing material that will be required for repair, including but not limited to decking, membrane, insulation, substrate and flashing, and a repair sequence for each. Submit Manufacturer's warranty for each type of material to be used for repair of each roof covering system. Submit letter of qualification for each roofing contractor.

Submit data for each distinct lay-in ceiling suspension system and acoustical unit type indicated. Submit the following samples:

Acoustical ceiling units: 12-inch-square samples of each type required.

Exposed suspension and trim elements: 12-inch-long samples of each type and finish required.

For steel stud framing:

Submit product information and installation instructions from manufacturers for each item of cold-formed metal framing and accessories.

Submit shop drawings, including placing drawings for framing members showing size and gauge designations, number, type, location, and spacing. Indicate supplemental strapping, bracing, splices, bridging, accessories, and details required for proper installation.

Submit samples of brick and concrete masonry units for owner/engineer approval.

Submit manufacturer's technical data sheets for replacement carpet floor tile required. Submit sample of each type and/or color of floor covering required, along with samples of *adjacent existing floor covering*.

Submit manufacturer's technical data sheets for each paint coating, material analysis including vehicle type and percentage by weight and by volume of vehicle, resin, and pigment. Application instructions including mixing, surface preparation, compatible primers and topcoats, recommended wet and dry film thickness, recommended application methods. Submit documented evidence that paints and coatings are low V.O.C. types.

Provide for each paint coating system, color, and texture and applied to representative substrate samples.

Lenoir Youth Development Center Retro-Commissioning

Division 23 Work in Existing Buildings

1 Provide color selection board for paint and any other finishes. Prepare samples to show bare, prepared
2 surface, and each successive coat. Label each sample with coating name and color.

3
4 Submit manufacturer's technical data sheets for each vinyl wall covering, complete with material analysis. Provide
5 samples of each proposed wall covering, along with samples of *adjacent existing wall covering*.

6
7
8 **DEFINITIONS**

9
10 Remove: Detach items from existing construction and legally dispose of them off-site unless indicated to be removed
11 and salvaged or removed and reinstalled.

12
13 Remove and Salvage: Carefully detach from existing construction, in a manner to prevent damage, and deliver to
14 Owner.

15
16 Remove and Reinstall: Detach items from existing construction, prepare for reuse, and reinstall where indicated.

17
18 Existing to Remain: Existing items of construction that are not to be permanently removed and that are not otherwise
19 indicated to be removed, removed and salvaged, or removed and reinstalled.

20
21
22 **MATERIALS OWNERSHIP**

23
24 Unless otherwise indicated, demolition waste becomes property of Contractor. Materials removed during demolition
25 shall be accumulated in the demolition area for examination by the Owner. The Owner may choose to retain selected
26 items. Items not selected to be retained by the Owner become the property of the Contractor and shall be removed
27 from the site in a timely manner. All disposal fees and/or permits shall be the responsibility of the Contractor.

28
29
30 **QUALITY ASSURANCE**

31
32 Refrigerant Recovery Technician Qualifications: Certified by an EPA-approved Section 608 certification program.

33
34
35 **FIELD CONDITIONS**

36
37 Existing facilities shall remain in use during all phases of construction under this Contract. **All and any of existing**
38 **building safeties such as exit signage, exit lights, fire alarm, fire sprinkler etc., must remain operational**
39 **CONTINUOUSLY in order to retain building occupancy status. All required exits and exit signs must be kept**
40 **available and free of obstruction at all times.** The Contractor shall cooperate with the Owner in every way
41 possible to keep interruption of, and interference with, normal functions, activities, and operations to a minimum.

42
43 Where construction or attendant work interrupts normal functions in any area, a schedule of work shall be submitted
44 for approval of the Owner and after approval, strictly followed. Modification to existing work shall be done as
45 required. All work shall be performed in such a manner as to prevent any interruption of any service or utility. Where
46 it is necessary to interrupt service for demolition, cut-in, or changeover, the work shall be scheduled well in advance
47 of the interruption and the interruption approved by the Owner. As required by the Owner, such work shall be done
48 during night, weekends, holidays, or other off peak period as approved.

49
50 Existing piping, ductwork, raceway and wiring, etc., shall be modified as indicated on the Drawings and/or as required
51 by new and modified construction. Existing piping, ductwork, raceway and wiring, etc., shall be modified as required
52 and put in first class operating condition. No equipment shall be disconnected without approval of the Owner's
53 Representative. Temporary relocation of equipment and temporary piping, ductwork, wiring and raceway, etc.,
54 required for continued operation of the facility shall be provided as required.
55

Lenoir Youth Development Center Retro-Commissioning

Division 23 Work in Existing Buildings

ROOFING WARRANTIES

Existing Warranty: *Remove, replace, patch, and repair materials and surfaces during roofing repairs by methods and with materials so as not to void existing roofing system warranty.* Notify warrantor before proceeding. Notify warrantor of existing roofing system on completion of reroofing, and obtain documentation verifying that existing roofing system has been inspected and warranty remains in effect. Submit documentation at Project closeout.

New Warranty: All new roofing work shall be guaranteed for five (5) years.

PART 2 - PRODUCTS (Not Used)**PART 3 - EXECUTION****PERFORMANCE REQUIREMENTS**

Comply with governing EPA notification regulations before beginning selective demolition.

Comply with hauling and disposal regulations of authorities having jurisdiction.

GENERAL CONSTRUCTION DEMOLITION

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

Neatly cut openings and holes plumb, square, and true to dimensions required. Use cutting methods least likely to damage construction to remain or adjoining construction. Use hand tools or small power tools designed for sawing or grinding, not hammering and chopping, to minimize disturbance of adjacent surfaces. Temporarily cover openings to remain.

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

Do not use cutting torches until work area is cleared of flammable materials. At concealed spaces, such as duct and pipe interiors, verify condition and contents of hidden space before starting flame-cutting operations. Maintain fire watch and/or portable fire-suppression devices, as required, during flame-cutting operations.

Maintain adequate ventilation when using cutting torches.

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

Remove structural framing members and lower to ground by method suitable to avoid free fall and to prevent ground impact or dust generation.

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

Dispose of demolished items and materials promptly.

Protect construction indicated to remain against damage and soiling during demolition.

MECHANICAL DEMOLITION

Remove or relocate all mechanical elements (devices, fixtures, controls, etc.) from walls or floors indicated as being demolished.

Lenoir Youth Development Center Retro-Commissioning**Division 23 Work in Existing Buildings**

1 Thermostats and sensors containing mercury shall be disposed in accordance with EPA Resource Conservation and
2 Recovery Act (RCRA). Contractor shall refer to EPA web site for handling procedures for disposal and spill
3 management of projects containing mercury.
4

5 Extend or relocate any existing piping and or ductwork serving existing equipment to remain or other items where
6 such circuits are disrupted due to demolition.

7 Remove all abandoned piping back to the point of supply or back to the point where other remaining piping is
8 connected. For existing piping imbedded existing walls or floors that are not to be demolished, remove piping to
9 behind finish surface, cap, and patch wall or floor as specified hereinafter.

10
11 Existing HVAC systems serving both occupied areas and construction areas shall be modified as required to isolate
12 the construction area. Ducts shall be sealed by closing dampers, disconnecting ducts and sealing openings with 6-
13 mil polyvinyl sheeting, etc.

14
15 HVAC equipment in construction areas that is required to be reused shall be de-energized and protected from
16 construction dust and debris with 6-mil polyvinyl sheeting during construction. HVAC systems that are modified
17 during renovation shall be sealed until modifications are made and then resealed until start-up is required. After
18 unsealing of equipment, coils and drain pans of air-handling equipment shall be cleaned.

19
20 Recover and recycle refrigerants from existing equipment to be demolished. All demolition work of existing systems
21 containing refrigerant must be conducted in accordance with Section 608 of EPA Clean Air Act under supervision of
22 an EPA certified technician. Provide documentation with types, quantities and dates for the engineers and owners
23 record.

24
25 Control or monitoring systems that protect equipment and/or occupants must be maintained until associated
26 equipment is removed.
27

ELECTRICAL DEMOLITION

28
29
30
31 Coordinate all electrical outages with the Owner to facilitate reworking of existing system. No service, feeder, or
32 branch circuit may be de-energized unless specific approval has been obtained from the Owner's representative.

33
34 Dispose of Removed Equipment and Material: Materials removed and not indicated by Drawings to be reinstalled,
35 stored, or retained by the Owner, shall be removed from the site in a timely manner at the Contractor's expense.

36
37 The Owner may choose to retain selected items or equipment. The Contractor shall remove and deliver
38 such items and/or equipment to a location on site as requested by the Owner.
39

40 Thoroughly inspect electrical systems in reworked areas and bring to the attention of the A-E all defective or
41 unserviceable material not scheduled for removal or replacement.
42

43 Remove all abandoned wiring, both exposed and concealed.
44

45 Remove all abandoned raceway and any related items, both exposed and concealed. Where existing raceway is
46 concealed in concrete or masonry, remove wiring as required above and abandon in place. Cut abandoned raceway
47 off ½" into wall, ceiling, or floor to allow patching to completely cover cut off end of raceway.
48

49 Repair surfaces and finishes to match existing surrounding surfaces or finish in all areas where items are removed.
50 After repairs are made no evidence of previous use of surfaces shall be visible.
51

52 Provide touch-up painting as required where new items are installed adjacent to existing items to remain.
53

54 Clean new, damaged, and/or disturbed areas and apply primer, intermediate, and finish coats at each
55 location.
56

57 Surface preparation and timing of application of successive coats of paint shall be in accordance with paint
58 manufacturer's instructions.
59

Lenoir Youth Development Center Retro-Commissioning**Division 23 Work in Existing Buildings**

1 Use zinc-rich paint to repair damage to galvanized finishes. Follow written instructions of paint
2 manufacturer.

3
4 Repair paint finishes for other items, surfaces, or equipment as necessary. Follow written instructions of
5 paint manufacturer.

6
7 Provide blank cover plates to match device plates used in the adjoining areas where outlet, device, junction, or other
8 boxes are to remain,

9
10 Perform the electrical demolition as described below:

11
12 Remove all electrical raceway, cable, wiring, devices, junction boxes, fittings, and related items from all
13 locations indicated on the Drawings as being renovated. Existing raceway, junction boxes, fittings, and
14 similar items may only be reused for the present project where explicitly indicated on the Drawings,
15 provided:

16
17 The existing item is in good condition and is suitable for reuse.

18
19 The existing items meets the requirements of the Specifications for similar items which might be
20 provided new in other locations on the project. Additional support and/or fire stopping may be
21 required to meet this condition.

22
23 The existing item is located in the same position as required in the new configuration as shown on
24 the Drawings.

25
26 Extend or relocate all existing circuits and related items serving existing utilization or other equipment where
27 such circuits or items are disrupted due to demolition activities of any division of the Contract Documents.
28 Relocate all existing junction boxes or similar items that will be rendered inaccessible by new construction
29 furnished under any division of the Contract Documents. Provide any and all temporary electrical supply
30 (supplies) as needed to meet this requirement.

31
32 Remove all abandoned circuits back to the point of supply or back to the point where other remaining loads
33 are connected. Label any unused overcurrent devices as "SPARE". Circuits supplying equipment which is
34 removed or demolished by any division of the Contract Documents is considered as "abandoned" for
35 purposes of this requirement.

36
37 Revise existing panel directories to reflect modifications made as a part of the project. All directory revisions
38 shall be typed.

39
40
41 **ROOF COVERING SYSTEM PATCHING AND REPAIR**

42
43 The Contractor shall remove existing roof covering systems, including but not limited to membrane and insulation, to
44 accommodate new rooftop penetrations and equipment. *Existing roofing shall not be cut, and shall not be left open,*
45 *during periods of precipitation. Roofing operations shall not be started in the event there is a probability of*
46 *precipitation during work.*

47
48 The Contractor shall repair all roof covering assemblies disturbed by new work. The repaired assemblies shall
49 ensure watertight conditions, in accordance with industry standards, the manufacturer's published requirements, and
50 this project manual.

51
52 The Contractor shall ensure the existing substrate and insulation remain dry.

53
54 The application of any roof covering system shall be accomplished by a primary roofing contractor, his roofing
55 foreman, and sufficient applicator technicians who all have been trained and approved by the Manufacturer of the
56 roof covering system. Contractor shall submit letter of qualifications from the repair material Manufacturer.

57
58 Only as much of the new roofing work shall be started as can be made weather tight before the end of each day or
59 before unexpected precipitation.

60

Lenoir Youth Development Center Retro-Commissioning

Division 23 Work in Existing Buildings

1 All surfaces to be bonded/adhered shall be prepared and cleaned before each roofing repair application.

2
3 The Contractor shall protect the existing roof covering systems during all rooftop work. Roofing materials damaged
4 during the work shall be repaired immediately by the Contractor. Any and all roofing materials that have not been
5 previously identified as being damaged shall be repaired by the Contractor at no expense to the Owner.
6 Substrate Preparation:

7
8 Verify that the substrate is dry, clean, smooth, and free of loose material, oil, grease, or other foreign matter.
9 *Beginning installation work signifies Contractor acceptance of existing conditions.*

10
11 Where damaged/deteriorated insulation, nailers, metal flashing and other existing roof covering system
12 materials are determined to be an unacceptable substrate for roof covering/flashing repair, the Engineer
13 shall be notified, and acceptable repairs shall be made to the substrate.

14
15 The roof covering and flashing repairs shall be installed over the properly prepared substrate. The repair
16 area shall be cleaned at least 3 inches beyond the repair area.

17
18 Scrub roof covering surface with detergent and water or other industry accepted method pre-
19 cleaner.

20
21 Apply splice wash to remove residue from roof covering using natural fiber, white cloth.

22
23 Prime roof covering surface using manufacturer's approved primer.

24
25 Apply splice adhesive to all surfaces that do not have self adhesive surface. Apply using a solvent resistant
26 paint brush, minimum 3 inch wide, or as required by manufacturer.

27
28 General Roof Covering Repair:

29
30 Inspect for wet insulation or other damage before installing new roofing.

31
32 Remove roof covering and flashing materials, old roof covering patch material, etc. around roof penetration
33 or other area of repair as required to install repair material.

34
35 Where wet insulation exists, the Contractor shall notify the A/E immediately. All insulation shall be assumed
36 to be dry unless otherwise identified by the Contractor before initiating work.

37
38 Clean and prepare roof covering and substrate.

39
40 Prime roof covering contact surfaces.

41
42 Apply splice adhesive to roof covering contact surfaces as required.

43
44 Install new roof covering material and flashing/gravel stop as required.

45
46 Fasten roof covering and flashing/gravel stop where required.

47
48 Apply lap sealant as required.

49
50 Contractor shall ensure the water tightness of all roof covering system repair work.

51
52 Remove all debris and excess material from the roof area. Pick up all loose fasteners and sheet metal scraps.

53
54 The Contractor shall protect all roof surfaces from damage from other trades.

55
56
57
58
59
60

Lenoir Youth Development Center Retro-Commissioning

Division 23 Work in Existing Buildings

GYPSUM WALL BOARD INSTALLATION

For miscellaneous cutting and patching due to this project:

Provide GWB panels in maximum lengths and widths available that will minimize joints in each area and correspond with support system indicated. Provide thickness that will allow surface of patch to align with adjacent existing surfaces.

Apply gypsum panels to supports with steel drill screw fasteners, spaced maximum of 6 inches o.c.

Stagger abutting panel end joints not less than one framing member in alternate courses of board.

Treat gypsum board joints, interior angles, edge trim, control joints, penetrations, fastener heads, surface defects, and elsewhere as required to prepare gypsum board surfaces for decoration.

Pre-fill open joints and damaged surface areas.

Apply joint tape over gypsum board joints, except those with trim having flanges not intended for tape.

Apply finish treatment to match that of surrounding ceiling area.

INTERIOR PAINTING

For areas that need restored due to this project:

Store materials not in use in tightly covered containers in well-ventilated areas with ambient temperatures continuously maintained at not less than 45 deg F.

Maintain containers in clean condition, free of foreign materials and residue.

Remove rags and waste from storage areas daily.

Apply paints only when temperature of surfaces to be painted and ambient air temperatures are between 50 and 95 deg F.

Do not apply paints when relative humidity exceeds 85 percent; at temperatures less than 5 deg F above the dew point; or to damp or wet surfaces.

Examine substrates and conditions for compliance with requirements for maximum moisture content and other conditions affecting performance of work.

Verify suitability of substrates, including surface conditions and compatibility with existing finishes and primers.

Begin coating application only after unsatisfactory conditions have been corrected and surfaces are dry. *Beginning coating application signifies Contractor acceptance of substrates and their conditions.*

Preparation:

Comply with manufacturer's written installation instructions and recommendations in MPI *Architectural Painting Specification Manual* applicable to substrates indicated.

Remove plates, machined surfaces, and similar items already in place that are not to be painted. If removal is impractical or impossible because of size or weight of item, provide surface-applied protection before surface preparation and painting.

Do not paint over labels of independent testing agencies or equipment name, identification, performance rating, or nomenclature plates.

Lenoir Youth Development Center Retro-Commissioning

Division 23 Work in Existing Buildings

- 1 Remove incompatible primers and reprime substrate with compatible primers as required to produce paint
2 systems indicated.
- 3
- 4 Steel Substrates: Remove rust and loose mill scale. Clean using methods recommended in writing by paint
5 manufacturer.
- 6
- 7 Galvanized-Metal Substrates: Remove grease and oil residue from galvanized sheet metal fabricated from
8 coil stock by mechanical methods to produce clean, lightly etched surfaces that promote adhesion of
9 subsequently applied paints.
- 10
- 11 Gypsum Board Substrates: Do not begin paint application until finishing compound is dry and sanded
12 smooth.
- 13
- 14 Apply paints according to manufacturer's written instructions.
- 15
- 16 Use applicators and techniques suited for paint and substrate indicated.
- 17
- 18 Paint surfaces behind movable equipment and furniture same as similar exposed surfaces. Before final installation,
19 paint surfaces behind permanently fixed equipment or furniture with prime coat only.
- 20
- 21 Paint front and backsides of access panels, removable or hinged covers, and similar hinged items to match exposed
22 surfaces.
- 23
- 24 Tint each undercoat a lighter shade to facilitate identification of each coat if multiple coats of same material are to be
25 applied. Tint undercoats to match color of topcoat, but provide sufficient difference in shade of undercoats to
26 distinguish each separate coat.
- 27
- 28 If undercoats or other conditions show through topcoat, apply additional coats until cured film has a uniform paint
29 finish, color, and appearance.
- 30
- 31 Apply paints to produce surface films without cloudiness, spotting, holidays, laps, brush marks, roller tracking, runs,
32 sags, ropiness, or other surface imperfections. Cut in sharp lines and color breaks.
- 33
- 34 Cleaning and Protection:
- 35
- 36 At end of each workday, remove rubbish, empty cans, rags, and other discarded materials from Project site.
- 37
- 38 After completing paint application, clean spattered surfaces. Remove spattered paints by washing,
39 scraping, or other methods. Do not scratch or damage adjacent finished surfaces.
- 40
- 41 Protect work of other trades against damage from paint application. Correct damage to work of other trades
42 by cleaning, repairing, replacing, and refinishing, as approved by Architect, and leave in an undamaged
43 condition.
- 44
- 45 At completion of construction activities of other trades, touch up and restore damaged or defaced painted
46 surfaces.
- 47
- 48 Interior Painting Schedule:
- 49

Substrate	Paint System	Prime Coat	Intermediate Coat	Topcoat
Concrete/ Masonry (Non-Traffic Surfaces)	Institutional Low- Odor/VOC Latex: MPI INT 3.1M	Institutional low- odor/VOC interior latex matching topcoat	Institutional low- odor/VOC interior latex matching topcoat	Institutional low- odor/VOC interior latex (flat) (eggshell)
Black Steel	Institutional Low- Odor/VOC Latex: MPI INT 5.1S	Rust-inhibitive primer (water based)	Institutional low- odor/VOC interior latex matching topcoat	Institutional low- odor/VOC interior latex (semigloss)
Galvanized	Institutional Low-	Waterborne	Institutional low-	Institutional low-

Lenoir Youth Development Center Retro-Commissioning

Division 23 Work in Existing Buildings

Substrate	Paint System	Prime Coat	Intermediate Coat	Topcoat
Steel	Odor/VOC Latex: MPI INT 5.3N	galvanized-metal primer.	odor/VOC interior latex matching topcoat	odor/VOC interior latex (semigloss)
Gypsum Wall Board	Institutional Low- Odor/VOC Latex: MPI INT 9.2M	Interior latex primer/sealer	Institutional low- odor/VOC interior latex matching topcoat	Institutional low- odor/VOC interior latex (eggshell)

Painting Completion: After completing painting operations, use workers skilled in the trades involved to reinstall items that were removed. Remove surface-applied protection if any.

ACOUSTICAL LAY-IN CEILING REPLACEMENT AND REPAIR

For ceilings that need replacement or repair due to this project:

Prepare and distribute to affected installers, data necessary for coordination with related work. Include setting diagrams showing placement of attachment devices for acoustical ceiling hangers.

Coordinate ceiling system installation with work of other sections as required, including the following:

- Light fixtures.
- HVAC equipment.
- Partitions.

Within each space to receive specified products, do not begin installation until the following conditions are met:

- Work above ceilings has been finished, tested, and approved.
- Space to receive ceiling system is properly enclosed and protected from weather.

- Any wet work within the space is dry.

Do not begin installation of ceiling system until building's normal operating temperature and humidity levels have been reached and will be maintained.

Examine substrates and conditions under which products of this section are to be installed and verify that the work properly may commence.

Position ceiling components to maximize use of full-sized acoustical units and to provide border units which are equal in size and shape at opposing ceiling edges. Use of acoustical units which are smaller than 1/2 full-width is prohibited at ceiling perimeters. Conform to reflected ceiling plans to greatest extent possible.

Suspension System Installation:

Conform to the requirements of ASTM C 636, manufacturer's installation instructions, and governing regulations.

Install hangers plumb and supported solely by building structure or carrying channels. Do not allow hangers to contact any objects or materials in ceiling plenum which are not actual components of ceiling system.

Splay hangers only where necessary to avoid obstacles. Provide counter-splaying, bracing, or other acceptable devices to compensate for lateral stresses caused by splayed hangers.

Install splay hangers or other means of seismic restraint as required to meet the requirements of ASTM E 580.

Lenoir Youth Development Center Retro-Commissioning

Division 23 Work in Existing Buildings

Do not attach hangers to piping, conduit, or duct. Provide carrying channel trapeze support where obstruction cannot be avoided by splaying hanger 45 degrees from vertical or less.

Space hangers at not more than 48 inches on center and within 6 inches of ends of each direct-hung runner or carrying channel, unless indicated otherwise.

Loop and tie wire hangers securely to building's structural members; to attachment devices indicated; or, where not indicated, to devices suitable for substrate and capable of permanently supporting ceiling weight without failure or deterioration.

Level ceiling suspension system to tolerance of 1/8 inch in 12 feet, with cumulative tolerance not to exceed 1/4 inch. Bending or kinking of hangers is not allowed.

Install grid members square, with ends of members securely interlocked. Remove and replace dented, bent, or kinked members.

Trim Installation:

Install edge moldings and trim units at acoustical ceiling borders, at locations indicated, and where required to cover acoustical unit edges.

Space screws not more than 16 inches on center and within 3 inches of ends of each trim-piece being installed. Install moldings and trim level with suspension system and within tolerance specified for suspension system.

Miter corners and align butt joints carefully to form tight hairline joints.

Face-riveting of trim and moldings is not allowed.

Lay-In Panel Installation: Install acoustical panels for accurate fit with suspension system and trim members. Scribe and cut panels at ceiling perimeter and at obstructions to provide neat, precise fit. Provide installation with panel edges which are hidden from view, by suspension members or trim.

Adjust and Clean:

Use ceiling manufacturer's recommended methods and materials to clean and touch-up exposed components of ceiling system.

Replace existing ceiling system components which are discolored or damaged in any way, in a manner which results in the ceiling system showing no evidence of replacement work.

Patching/Repairing Existing Masonry Construction:

Existing Masonry Unit Removal:

Carefully remove by hand masonry units. Cut out full units from joint to joint and in manner to permit replacement with full size units.

Support and protect masonry to remain that surrounds removal area.

Clean remaining masonry at edges of removal areas by removing mortar, dust, and loose debris in preparation for rebuilding.

Masonry Unit Rebuilding:

Match existing coursing, bonding, color and texture.

Fit replacement units into bonding and coursing pattern of existing. If cutting is required, use motor driven saw designed to cut masonry with clean, sharp unchipped edges.

Lenoir Youth Development Center Retro-Commissioning

Division 23 Work in Existing Buildings

- 1 Lay replacement masonry with completely filled bed, head and collar joints. Butter ends with
- 2 sufficient mortar to fill head joints and shove into place. Do not wet concrete masonry units.
- 3 Maintain joint width for replacement units to match existing.
- 4
- 5 Tool exposed mortar joints in repaired area to match joints of surrounding existing masonry.
- 6
- 7 Repoint new mortar joints in repaired area to match existing mortar joints.
- 8
- 9
- 10 **END OF SECTION 019916**

Lenoir Youth Development Center Retro-Commissioning Owner Instruction and Training for Division 23 Work**SECTION 019926 - OWNER INSTRUCTION AND TRAINING FOR DIVISIONS 23 WORK****PART 1 - GENERAL****RELATED DOCUMENTS**

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

The requirements specified herein shall govern all Sections in Division 23, whether stated therein or not.

Where items specified in the other sections of this Division conflict with requirements of this Section, the former shall govern.

QUALITY ASSURANCE

The Owner instruction and training program shall be developed and coordinated by a firm or individual experienced in training or educating maintenance personnel.

Contractor personnel experienced in the systems and components incorporated in this Project, along with factory-authorized service representatives, shall perform the instruction.

COORDINATION

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

Coordinate content of training modules with content of manufacturers' recommended emergency, operation, and maintenance procedures.

SUBMITTALS

General: 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. Identification requirements for non-complying features of items are very specific. See Section 019913 for exact requirements.

Instructional Program and Instructional Materials: Submit detailed description of instructional program structure, training modules, and instructional materials.

Instructor Qualifications: Submit curriculum vitae for each instructor, specifically defining the experience of each instructor and the training modules for which he or she shall be responsible.

PART 2 - PRODUCTS**INSTRUCTION PROGRAM**

General: **The Contractor(s) for each of Division 23, as applicable, is responsible for instructing Owner's personnel relative to each Division's work, including the following:**

Instruction in the operation of systems, subsystems, and equipment.

Training in maintenance of systems, subsystems, and equipment.

Lenoir Youth Development Center Retro-Commissioning Owner Instruction and Training for Division 23 Work

1 Program Structure: Develop an instruction and training program that includes individual training modules for each
2 Division 23 system, subsystem, and equipment item, including both classroom instruction and "hands-on" demonstra-
3 tions.
4

5 Training Modules: Develop a learning objective and teaching outline for each instruction and training module, taking
6 into consideration the level of proficiency of Owner's maintenance staff. Include a description of specific skills and
7 knowledge that each participant is expected to master.
8

9 For each instruction and training module, include instruction for the following, as applicable to the system, subsystem,
10 equipment, or component:
11

12 **Documentation:** Review the following items in detail:
13

14 Operations manuals.
15

16 Maintenance manuals.
17

18 Project record documents.
19

20 Warranties, bonds, and guarantees.
21

22 Maintenance service agreements and similar continuing commitments.
23

24 **Emergencies:** Include the following, as applicable:
25

26 Instructions on meaning of warnings, trouble indications, and error messages.
27

28 Shutdown instructions for each type of emergency.
29

30 Operating instructions for conditions outside of normal operating limits.
31

32 Sequences for electric or electronic control systems.
33

34 Special operating instructions and procedures.
35

36 **Operations:** Include the following, as applicable:
37

38 Startup procedures.
39

40 Equipment or system break-in procedures.
41

42 Routine and normal operating instructions.
43

44 Regulation and control procedures.
45

46 **Control sequences.**
47

48 Safety procedures.
49

50 Normal start-up and shutdown instructions.
51

52 Operating procedures for emergencies.
53

54 Operating procedures for system, subsystem, or equipment failure.
55

56 Required sequences for electric or electronic control systems.
57

58 Special operating instructions and procedures.
59
60

Lenoir Youth Development Center Retro-Commissioning Owner Instruction and Training for Division 23 Work

Adjustments: Include the following:

Alignments.

Routine adjustments, tightening, etc.

Noise and vibration adjustments.

Economy and efficiency adjustments.

Maintenance: Demonstrate the following:

Inspection procedures.

Preventative maintenance requirements, consisting of the following:

Routine maintenance, which consists of specific procedures that are performed on a regular schedule and are designed to detect, preclude, or mitigate degradation of a system or its components.

Predictive maintenance, which uses routine inspection and evaluation, testing, and analysis to augment routine maintenance procedures by detecting the onset of component degradation and to address problems as they are identified.

Instruction on use of special tools.

Repairs: Include the following:

Troubleshooting and diagnostic instructions.

Test and inspection procedures.

Repair instructions.

Disassembly; component removal, repair, and replacement; and reassembly instructions.

Review of spare parts needed for operation and maintenance.

PART 3 - EXECUTION

Owner will furnish an instructor to describe Owner's operational philosophy.

Owner will furnish Contractor with names and positions of participants to attend instruction and training, not to exceed 4 individuals.

Confirm Topics and Agenda with owner prior to scheduling.

Provide instruction at mutually agreed on times scheduled at least four (4) weeks in advance through the A/E. For systems, subsystem, and/or equipment that requires seasonal operation, provide required instruction at start of each season.

Conduct training on-site in the completed and fully operational facility in classroom/conference space provided by the Owner and using the actual systems, subsystems, and equipment installed.

Conduct training using final operation and maintenance data submittals as the training reference material. If additional training materials are utilized, they shall be incorporated as an appendix to the operation and maintenance data submittals.

Lenoir Youth Development Center Retro-Commissioning Owner Instruction and Training for Division 23 Work

- 1 Provide documentation that Owner instruction and training has taken place. Provide record of dates, topics, and du-
- 2 ration of each training session, the names of Owner's staff who participated, and a signed review form by each partic-
- 3 ipant.
- 4

5
6 **END OF SECTION 019926**

Lenoir Youth Development Center Retro-Commissioning

HVAC Summary of Work

SECTION 230210 – HVAC SUMMARY OF WORK

Engineer of Record for Heating, Ventilating, and Air-Conditioning work is Roger M. Woods, PE, Salas O'Brien, 1620 Midtown Place (27609), P. O. Box 19944, Raleigh, NC 27619. Heating, Ventilating, and Air-Conditioning work shall be defined by drawings numbered with the prefix "H-", the general provisions of the Contract including General Conditions and Supplementary Conditions, Division 1 Specification sections, and Division 23 Technical Specification sections listed below. In addition, Heating, Ventilating, and Air-Conditioning work may be defined by reference to other documents by any of the above-named sources as well as by project addenda.

DIVISION 23 - HVAC TECHNICAL SPECIFICATIONS

Section	Title
230210	HVAC Summary of Work
230510	HVAC Basic Requirements
230593	HVAC Testing, Adjusting and Balancing
230596	HVAC Systems Commissioning
230900	Building Management System
230900-A	Appendix-Combined Guidelines

END OF SECTION 230210

SECTION 230510 – HVAC BASIC REQUIREMENTS**PART 1 - GENERAL****RELATED DOCUMENTS**

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

The requirements specified herein shall govern all Sections in Division 23, whether stated therein or not.

Where items specified in the other sections of this Division conflict with requirements of this Section, the former shall govern.

SUBMITTALS

Submittals shall be made in strict accordance with the requirements of Section 019913. Specific submittal requirements are defined in each section of this Division.

Submit Welder's and Brazer's Qualifications in accordance with Section 019913. Welders' and Brazers' Qualifications: Operators who are to do the welding and/or brazing must be properly qualified to do satisfactory work.

Proof of an operator's qualifications shall be either the Contractor's record of suitable tests passed within the preceding six months while in the employ of the Contractor, or tests made before the start of work.

Submit qualification data for each operator prior to their starting work. Any workman considered by the A-E as not having the skill necessary for the work shall be required to pass an appropriate qualification test or shall be at once barred from further welding and/or brazing on the project.

EQUIPMENT SELECTION

Pump heads and fan static pressures indicated on the Drawings are for estimating purposes and are based on the individual equipment losses as indicated. If the Contractor proposes using equipment, components, pipe or duct routing, etc. that will increase the pump heads and/or fan static pressures, any required pump or fan changes, along with associated motor and power wiring changes, shall be at the Contractor's expense.

TEMPERATURE AND HUMIDITY CRITERIA

Indoor temperature and humidity conditions in occupied spaces, unless specifically specified or indicated otherwise on the Drawings, shall be maintained as follows:

Space/ Area	Indoor Air Condition	Occupied Periods	Unoccupied Periods
General occupied spaces	Dry Bulb Temperature	70-77 deg F	55 deg F, Minimum 85 deg F, Maximum
	Relative Humidity	30-60% RH	65% RH Maximum

Lenoir Youth Development Center Retro-Commissioning

HVAC Basic Requirements

PART 2 - PRODUCTS (Not Used)**PART 3 - EXECUTION****COMMISSIONING PROCESS**

The Owner has retained a Commissioning Authority to develop, implement, and manage the commissioning process for this Division's systems, subsystems, assemblies, and/or components.

In addition to the requirements specified in this Division, the Contractor shall review and accept commissioning process construction checklists, prerequisites to testing, system and assembly tests, and requirements for test reports are specified by the Commissioning Authority in Division 1.

To support the commissioning process, a Commissioning Team, has been organized under the management of the Commissioning Authority. The Contractor shall assign a representative to serve as a member of the Commissioning Team to aid in the commissioning process. In addition, the Contractor shall require that each significant Subcontractor assign a representative to the Commissioning Team and participate in the commissioning process.

Contractor and Subcontractor representatives shall have the expertise and authority to act on behalf of their organizations and shall participate in and perform commissioning process activities including, but not limited to, the following:

Integrate and coordinate commissioning process activities into construction activities and schedules.

Attend and participate in Commissioning Team meetings specified in Division 1.

Complete construction checklists as work is completed and submit to Commissioning Authority.

Accomplish commissioning process test procedures and prepare test reports as specified by the Commissioning Authority.

Evaluate performance deficiencies identified in test reports and recommend corrective action.

SPECIAL INSPECTIONS

The Smoke Control System shall be tested in accordance with the 2018 NC Building Code Section 1705.18

The Owner will engage qualified Special Inspector(s) to conduct required special inspections specified above.

Responsibilities of the Special Inspector(s) includes, but are not necessarily limited to, the following:

Verifying that manufacturer maintains detailed fabrication and quality-control procedures and reviewing the completeness and adequacy of those procedures to perform the Work.

Notifying A/E and Contractor promptly of irregularities and deficiencies observed in the Work during performance of its services.

Submitting a certified written report of each test, inspection, and similar quality-control service to the A/E, with copy to Contractor and to Authorities Having Jurisdiction.

Submitting a final report of special tests and inspections at Substantial Completion that includes a list of unresolved deficiencies.

Interpreting tests and inspections and stating in each report whether tested and inspected work complies with or deviates from the Contract Documents.

Lenoir Youth Development Center Retro-Commissioning

HVAC Basic Requirements

Retesting and re-inspecting corrected work.

A program of special inspections shall not relieve the Contractor or its subcontractors of their responsibilities and obligations for quality control of the Work, their other obligations for supervising the work, for any design work that is included in their scope of services, and for full compliance with the requirements of the Contract Documents. Furthermore, the detection of, or failure to detect, deficiencies or defects in the Work during special inspections shall not relieve the Contractor or its subcontractors of their responsibility to correct all deficiencies or defects, whether detected or undetected, in all parts of the Work, and to otherwise comply with all requirements of the Contract Documents.

The program of special inspections does not apply to the Contractor's equipment, temporary structures used by the Contractor to construct the project, the Contractor's means, methods and procedures, or job site safety.

The Contractor shall cooperate with the Special Inspector and provide reasonable auxiliary services as requested.

The Contractor shall provide free and safe access to the Work for the Special Inspector and all other individuals who are observing the Work or performing structural tests or inspections. The Contractor shall provide all ladders, scaffolding, staging, and up-to-date safety equipment, all in good and safe working order, and qualified personnel to handle and erect them, as may be required for safe access.

The Contractor shall give timely notice to the Special Inspector of when the various parts of the Work will be ready for inspection. The Owner reserves the right to retain funds due the Contractor for additional expense incurred by the Owner for the services of the Special Inspector or those under his direction when work is not reasonably ready for inspection in accordance with the notice provided by the Contractor.

The Contractor shall protect construction exposed by or for testing and inspecting activities.

Upon completion of testing and inspecting, Contractor shall repair damaged construction and restore substrates and finishes in compliance with the requirements of Section 019913 for patching. Provide materials and comply with installation requirements specified in other Specification Sections. Restore patched areas and extend restoration into adjoining areas with durable seams that are as invisible as possible.

OPERATION OF HVAC SYSTEMS

HVAC equipment, subsystems, and/or systems may be started and temporarily operated as necessary to perform the work, testing, balancing, and/or verification as specified in various sections of Division 23. Air systems shall be started **only** after general construction activities in the areas served by the air systems are such that there is low risk of contamination and/or degradation to the system. Generally, the following construction status is required within the entire area served by an individual air system:

Floor/wall/ceiling preparation that requires sanding or other dust producing work is complete.

Wall/ceiling surfaces required to be painted shall at least have one coat of primer applied.

Ceiling spray-on decorative or acoustical coatings, where specified, are complete.

Lay-in ceilings, where specified, have been installed.

Floors finishes (tile, carpet, paint, etc.) shall be complete.

Dust-producing outdoor (site) work has been completed.

During temporary operation of air systems, the following additional measures are required:

Filters shall be installed in fan coil units, air handling units, etc., as specified in Sections 234113 and 234123, as applicable.

Lenoir Youth Development Center Retro-Commissioning

HVAC Basic Requirements

- 1 Install temporary roll media filters (minimum MERV 13) over each air inlet (return or exhaust). Temporary
2 filters shall be replaced regularly in order to minimize pressure losses impose on fans.
3
- 4 Windings of open, drip proof electric motors shall be cleaned using low pressure compressed air at the end
5 of each 72 hours of operation.
6
- 7 Once HVAC systems verification/commissioning has been completed, air systems shall be shut down, temporary
8 filters removed, and air handler filters replaced with new unless specifically directed otherwise by the A-E. **Only**
9 **upon receipt of written approval by the A-E shall HVAC systems be placed into final service prior to**
10 **Substantial Completion of the Project.**
11
12
13 **END OF SECTION 230510**

SECTION 230593 – HVAC TESTING, ADJUSTING AND BALANCING**PART 1 - GENERAL****RELATED DOCUMENTS**

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

DESCRIPTION OF WORK

Extent of testing, adjusting, and balancing (TAB) work includes, but is not necessarily limited to, duct systems, piping systems, and associated equipment and apparatus of HVAC work.

SUBMITTALS

General: 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. Identification requirements for non-complying features of items are very specific. See Section 019913 for exact requirements.

Certification: Submit TAB subcontractor certification.

Instrument Calibration Report: Submit calibration test results for balancing instruments.

TAB Reports: Draft and final test reports

QUALITY CONTROL

TAB work shall be completed by an independent balancing subcontractor certified by the Associated Air Balance Council (AABC)

Commissioning of HVAC systems requires participation by the TAB subcontractor as a member of the "Commissioning Team". See Section 230510 and Division 1 for requirements.

PART 2 - PRODUCTS (Not Used)**PART 3 - EXECUTION****GENERAL**

After systems have been started up and initially adjusted, the Contractor shall perform tests and accomplish the balancing necessary to provide the air and water flows indicated on the Drawings.

TAB subcontractor shall spot check systems with A/E at Final Inspection.

CERTIFIED TEST REPORTS

General: Four copies of the Draft Test and Balance Reports shall be provided to the A/E before the Final Inspection. The reports shall comply with reporting procedures defined in Chapter 13, ASHRAE Standard 111 and as hereinafter specified.

Lenoir Youth Development Center Retro-Commissioning

HVAC Testing, Adjusting and Balancing

After the A/E check of the system at or before the Final Inspection, the Final Test and Balance Reports shall be provided to the A/E. **Additionally, one copy of the Final Test and Balance Report shall be submitted to the authority having jurisdiction and a copy shall be included with each copy of the Operating and Maintenance Manuals.**

Certification: Both Draft and Final Reports shall be certified by the TAB subcontractor and shall:

Be certified proof that the systems have been tested, adjusted, and balanced in accordance with the referenced standards.

Accurately represent how the systems have been installed.

Define how the systems are operating at completion of the TAB procedures.

Draft Reports: Upon completion of TAB procedures, prepare and submit draft reports for review by the A/E. Draft reports may be hand written, but must be complete, factual, and legible. Organize and format draft reports as hereinafter specified.

Final Reports: After review and verification by the field check by the A/E of the Draft Report, submit the Final Reports, organized and formatted as hereinafter specified.

Reports Format: Bind report forms complete with schematic systems diagrams and/or plans and other referenced data in reinforced, vinyl, three-ring binders.

Provide title page listing the name, address, and telephone numbers of the TAB subcontractor. Provide list of all test instruments utilized, along with last date of calibration.

Provide certification page, signed by the TAB project manager, as hereinbefore specified.

Divide contents of the binder into the following divisions, as applicable, separated by divider tabs:

General Information and Summary

Air Systems TAB

Hot Water Systems TAB

Reports Contents:

System Diagrams: Include schematic layouts of air and hydronic distribution systems. Present each system with single-line diagram and include the following:

Quantities of outdoor, supply, return, and exhaust airflows.

Water and steam flow rates.

Pipe and control valve sizes and locations.

Flow and/or Flow Balancing stations.

Location and position of balancing devices (valves, dampers, etc.)

Design Data and Test Results: For each HVAC component and system, provide design data and final adjusted test data, including but not limited to the following:

Component Data	Test Data (Design and Final Adjusted Values)
Air-Handling Units	
Identification	Air flow rate in cfm
Location	System static pressure in inches wg
Manufacturer	Fan rpm.

Lenoir Youth Development Center Retro-Commissioning

HVAC Testing, Adjusting and Balancing

Component Data	Test Data (Design and Final Adjusted Values)
Manufacturer model number and unit size Manufacturer's serial number Unit arrangement and class Discharge arrangement. Fan sheave make, size in inches and bore. Center-to-center dimensions of sheave, and amount of adjustments in inches Number, make, type, and size of drive belts Number, type, and size of filters Motor make, and frame type and size. Motor Horsepower and rpm. Motor volts, phase, and hertz Motor Full-load FLA and service factor Motor sheave make, size in inches and bore	Discharge static pressure in inches wg. Filter static-pressure differential in inches wg Preheat-coil static-pressure differential in inches wg Cooling-coil static-pressure differential in inches wg Heating-coil static-pressure differential in inches wg Outdoor airflow in cfm Return airflow in cfm Outdoor-air damper position Return-air damper position Outdoor-air, wet- and dry-bulb temperatures in deg F Return air, wet- and dry-bulb temperatures in deg F Coils: See requirements below
Water and Refrigerant Coils	
Identification Location Coil type (Water, Steam, Refrigerant) Number of rows Fin spacing in fins per inch Make and model number Face area in sq. ft. Tube size in NPS Tube and fin materials. Circuiting arrangement.	Air flow rate in cfm Average face velocity in fpm Air pressure drop in inches wg Entering-air, wet- and dry-bulb temperatures in deg F Leaving-air, wet- and dry-bulb temperatures in deg F Water flow rate in gpm Water pressure differential in feet of head or psig Entering-water temperature in deg F Leaving-water temperature in deg F Refrigerant expansion valve and refrigerant types. Refrigerant suction pressure in psig Refrigerant suction temperature in deg F
Gas- and Oil-Fired Heat Apparatus	
Identification. Location Manufacturer Manufacturer model number and unit size Manufacturer's serial number. Fuel type Output capacity in Btu/h Ignition type Burner-control types Motor horsepower and rpm Motor volts, phase, and hertz Motor full-load FLA and service factor Sheaves make, sizes in inches and bore. Center-to-center dimensions of sheaves and amount of adjustments in inches	Air flow rate in cfm Entering-air temperature in deg F Leaving-air temperature in deg F Air temperature differential in deg F Entering-air static pressure in inches wg Leaving-air static pressure in inches wg Air static-pressure differential in inches wg. Low-fire fuel input in Btu/h High-fire fuel input in Btu/h Manifold pressure in psig High-temperature-limit setting in deg F Motor voltage at each connection. Motor amps for each phase.
Electric Heating Coil	
Identification. Location. Coil identification. Capacity in kW. Number of stages. Connected volts, phase, and hertz. Rated FLA. Air flow rate in cfm Face area in sq. ft.. Minimum face velocity in fpm	Heat output in kW Air flow rate in cfm Air velocity in fpm Entering-air temperature in deg F Leaving-air temperature in deg F Coil voltage at each connection. Coil amps for each phase.

Lenoir Youth Development Center Retro-Commissioning

HVAC Testing, Adjusting and Balancing

Component Data	Test Data (Design and Final Adjusted Values)
Fans	
Identification Location Fan type Manufacturer Manufacturer model number and size Manufacturer's serial number Arrangement and class Fan sheave make, size in inches and bore Center-to-center dimensions of sheave, and amount of adjustments in inches Motor make, and frame type and size. Motor horsepower and rpm. Motor FLA and service factor Motor sheave make, size in inches and bore. Center-to-center dimensions of sheave, and amount of adjustments in inches Number, make, and size of belts	Total airflow rate in cfm Total system static pressure in inches wg Fan rpm Discharge static pressure in inches wg Suction static pressure in inches wg
Duct Traverse	
Identification (referenced to system diagrams included in TAB reports) System, air-handling-unit, and/or fan identification	Location and zone. Traverse air temperature in deg F Duct static pressure in inches wg Duct size in inches Duct area in sq. ft. Air flow rate in cfm Air velocity in fpm
Air Terminal Device (Register, Grille, Diffuser, etc.)	
System and air-handling unit identification Room/area served Number from system diagram. Manufacturer Type and manufacturer's model number. Size (face and neck) Effective area in sq. ft.	Test method Design air flow rate in cfm Design air velocity in fpm Preliminary measured air flow rate in cfm Preliminary measured velocity in fpm Final air flow rate in cfm Final velocity in fpm Space temperature in deg F
Pumps	
Identification Location Service Manufacturer Manufacturer model number and serial number Required net positive suction head in feet of head or psig Pump rpm Motor make and frame size Motor horsepower and rpm Motor and service factor Seal type	Static head in feet of head or psig Pump shutoff pressure in feet of head or psig Impeller size in inches Flow rate in gpm Total pressure in feet of head or psig Discharge pressure in feet of head or psig Suction pressure in feet of head or psig Motor voltage at each connection Motor amps for each phase
Boiler	
Identification Location Type (water, steam) Configuration (water tube, fire tube) Manufacturer Manufacturer model number and serial number Primary fuel	Water Boiler: Entering water temperature in deg. F Leaving water temperature in deg. F Flow rate in gpm Pressure drop in feet or psig Gas pressure in psig

Lenoir Youth Development Center Retro-Commissioning

HVAC Testing, Adjusting and Balancing

Component Data	Test Data (Design and Final Adjusted Values)
Secondary fuel Burner: Manufacturer Manufacturer model number and serial number Type/description Motor make and frame size Motor horsepower and rpm Motor and service factor	
Condensing Unit	
Identification Location Manufacturer Manufacture model number and serial number Nameplate rated capacity Compressor(s): Number/type of compressors Refrigerant Nameplate data for each compressor including capacity and rated electrical data. Fans: Number/type of fans Motor(s) horsepower and rpm Motor(s) FLA and service factor	Entering air temperature in deg. F Leaving air temperature in deg. F Air flow rate in cfm High side refrigerant pressure in psig at each compressor Low side refrigerant pressure in psig at each compressor Compressor and fan motor(s) voltage at each connection Compressor and fan motor(s) amps for each phase
Air Terminal Unit	
Identification Location Rooms or area served Type (constant volume, variable volume, fan powered, etc.) Manufacturer Manufacturer model number and serial number Fan motor horsepower and rpm Fan motor FLA and service factor	Supply Air: Maximum airflow in cfm Minimum airflow in cfm Primary Air: Maximum airflow in cfm Minimum airflow in cfm Fan: Airflow in cfm Total static pressure in inches wg Motor voltage Motor amps Reheat Coil: See coil requirements above.
Unit Heaters	
Identification Location Room or area served Type (hot water, steam, electric, direct-fired) Manufacturer Manufacturer model number and serial number Fan motor horsepower and rpm Fan motor FLA and service factor	Hot Water Unit Heater : Heat output in Btu/h Entering water temperature in deg. F Leaving water temperature in deg. F Flow rate in gpm Pressure drop in feet or psig Electric Unit Heater: Heat output in kW Coil voltage at each connection. Coil amps for each phase.

Lenoir Youth Development Center Retro-Commissioning

HVAC Testing, Adjusting and Balancing

Component Data	Test Data (Design and Final Adjusted Values)
	Fan: Air flow rate in cfm Air velocity in fpm Entering-air temperature in deg F Leaving-air temperature in deg F Motor voltage Motor amps

TEST AND BALANCE PROCEDURES

Test Instruments Calibration: Instruments for air and water test and balance shall have been calibrated within a period of six months prior to balancing and tested for accuracy prior to start of work. Calibrate vibrometer utilized for vibration testing before each day of testing using calibrator provided with the meter. Calibrate sound meters before each day of testing using calibrator complying with ANSI S1.40 and NIST certification.

Air Systems Test and Balance Procedures:

General: Air handling and distribution systems, including supply, return, ventilation, and exhaust airflows shall be balanced and adjusted in accordance with Chapter 10 of ASHRAE Standard 111 and Section 7.2.2 of ASHRAE Standard 62.1. Maximum air quantities at each outlet or inlet shall not vary more than -5% to +10% from those indicated on the Drawings.

Drive Changes: If the measured cfm of a supply fan, return fan, or exhaust fan varies more than plus 10% or minus 5% from design, adjust the drive of each fan to obtain required cfm. **Any changes in the pulleys, belts and dampers required for correct balance shall be provided by the Contractor, including replacement of fan and/or motor sheaves.**

Water Systems Test and Balance Procedures: Water circuits shall be adjusted for proper flow in accordance with Chapter 11 of ASHRAE Standard 111, within plus or minus 10% of design values.

A/E QUALITY CONTROL CHECK

In the presence of the A/E during or before the Final Inspection, the TAB subcontractor shall verify the balance of the air and water systems as follows:

Each air handler will be checked for proper airflow by an anemometer traverse on the entering side of the cooling coil.

Water flow will be tested by evaluating pressure drops across chillers, coils, etc.

At least 15% of registers, grilles, and diffusers will be checked for proper air flow via calibrated flow hood..

The TAB subcontractor shall provide all test instruments required for the Owner/Engineer check of the air and water systems balance.

During the A/E check, the TAB contractor shall verify the full range of air and water flows for the items selected to be checked. The Contractor shall have the controls sub-contractor present during the A/E check of the air and water systems balance.

END OF SECTION 230593

SECTION 230596 – HVAC SYSTEMS COMMISSIONING

PART 1 – GENERAL

RELATED DOCUMENTS

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

GENERAL

HVAC systems commissioning shall be performed by the Contractor at the direction of the owner and shall include the following:

Establish a commissioning “team” consisting of the installing personnel, the controls subcontractor.

Systematically evaluate all installed HVAC components, equipment, subsystems, and systems to ensure that they are working in accordance with these design documents. This includes measuring temperatures and flow rates from all HVAC devices and calibrating all sensors to a known standard.

Perform commissioning procedures, equipment functional performance tests, and tests of the sequences of operations to verify that the controls are providing the correct interaction between equipment, subsystems, and systems.

PART 2 – DESIGN INTENT

GENERAL

The contract documents define the requirements for HVAC components, equipment, subsystems, and systems, along with the control requirements for each element. It is the intent of the Designer that all HVAC components, equipment, subsystems, and systems shall perform in accordance with the stipulated requirements through the entire operational range of each element, while satisfying temperature, humidity, and etc. per the design documents.

SEQUENCES OF OPERATION

Sequences of operation shall be as indicated on Drawings.

PART 3 – FUNCTIONAL PERFORMANCE

SYSTEMS START-UP

Appendix 230596 outlines basic start up and check out requirements for HVAC systems and equipment. Generally these procedures are the direct responsibility of the Contractor as a basic element of validating that the installation is correct. These items provide a minimum or guideline for development of start up procedures, checklists and tests along with the general requirements indicated above (that are common to all). **Contractor shall synthesize these requirements with that of the manufacturer’s and/or applicable codes and standards to develop specific and itemized start up procedures specific to that installed on this project.**

FUNCTIONAL PERFORMANCE TESTS AND CERTIFICATION

Functional performance tests shall be performed in accordance with the checklists in Appendix 230596 to prove all modes of the sequences of operation and to verify all other relevant contract requirements. Tests shall begin with equipment or components and shall progress through subsystems to complete systems. Upon failure of any functional performance test checklist item, the Contractor shall correct all deficiencies in accordance with the applicable contract requirements. **The checklist shall then be repeated until it has been completed with no errors.**

Functional performance tests shall begin only after all work and testing required in related specification sections have been successfully completed, after all pre-commissioning checks have been successfully completed, after the control systems are fully functional, after the testing, adjusting, and balancing work has been completed and after all test and inspection reports and operation and maintenance manuals required have been submitted and reviewed by the A/E.

The commissioning team shall coordinate HVAC systems commissioning with Division 28 contractor and participate as dictated by that contractor in the functional performance test of smoke control systems required by Section 283100.

Based on the functional performance test checklists in Appendix 230596, the commissioning team shall prepare standardized reporting forms for each item of equipment, subsystem, and system to document the required functional performance tests. Each test shall be certified with the following statement and the signature and date of signing by each member of the commissioning team:

"We the undersigned have witnessed the above functional performance tests and certify that the item tested has met the performance requirements in this section of the specifications.

"Signature and Date:

Mechanical Contractor's Representative
Testing, Adjusting and Balancing Representative
Controls Sub-Contractor Representative
Owners Representative

END OF SECTION 230596

APPENDIX 230596 – HVAC SYSTEMS COMMISSIONING CHECKLISTS

Section	Component
232113/ 232115/232217	Hydronic Piping Systems

START-UP CHECKS

Check expansion tanks to determine that they are not air bound and that the system is completely full of water.

Set automatic fill valves for required system pressure.

Check air vents at high points of systems and determine if all are installed and operating freely (automatic type) or to bleed air completely (manual type).

Set and coordinate automatic fill pressure and relief valve settings.

Remove and clean strainer screens.

Confirm start-up checks for system pump(s) in accordance with this Appendix.

Fill system and confirm that water treatment has been implemented. Provide water treatment report.

Vent system to remove all trapped air.

START-UP PROCEDURES and FUNCTIONAL PERFORMANCE TESTS

Perform pump start-up checks and procedures and functional performance tests in accordance with this Appendix and manufacturer's written instructions.

Section	Component
	Variable Frequency Drives for HVAC Motors

START-UP CHECKS

Verify terminations of field installed wiring and perform a point-to-point continuity test for all field-installed wiring interconnections.

Check for proper torque on connections.

Verify use of shielded cable where specified and check that shields have been terminated properly.

Verify grounding.

Check motor nameplate kW rating against drive input rating.

Manually rotate motor shaft to ensure free rotation.

Check that motor leads are not grounded.

Confirm that VFD is labeled in accordance with Section 230553.

Test insulation resistance for each VFD element, bus, component, connecting supply, feeder, and control circuit.

Test continuity of each circuit.

Perform each electrical test and visual and mechanical inspection stated in NETA ATS, Sections 7.5, 7.6, and 7.16. Certify compliance with test parameters.

START-UP PROCEDURES

Check that voltage between phases varies no more than $\pm 10\%$.

Follow the manufacturers written procedures with the following as a minimum:

Ensure device and system which drive is serving is ready for operation.

Apply input power to VFD for at least 8 hours before operating the served motor.

Adjust the minimum voltage adjustment to enable starting, but not to draw excessive power at start.

Adjust the Volts/Hz adjustment to proper setting.

Adjust the acceleration and deceleration rates to the specified times.

Adjust current limiting to coordinate with the overcurrent device and protect the motor.

Set the maximum and minimum speed pots.

Manually ramp fan speed from minimum to maximum and check for excessive noise and vibration.

Determine any critical speeds to avoid setting these in the drive.

Check for acceptable voltage and current distortion on the power system. Record the input and output voltages and currents showing the harmonic content as a percentage of the base frequency.

FUNCTIONAL PERFORMANCE TESTS

Engage a factory-authorized service representative to inspect field-assembled components and equipment installation, including prestart checks, start-up, and functional performance testing of VFDs.

Prepare a written report to record the following:

Test procedures used.

Test results that comply with requirements.

Test results that do not comply with requirements and corrective action taken to achieve compliance with requirements.

Start fan or pump at minimum speed.

Adjust input control signal to 50% of span and check drive output frequency. Confirm that frequency is 30 Hz.

Adjust input control signal to 100% of span and check drive output frequency. Confirm that frequency is 60 Hz.

Reset controls to design setpoint conditions. Wait 10 minutes to allow system to stabilize and record the following information:

Motor amps, each phase.

Drive input and output voltage, each phase.

Motor speed, rpm.

Drive output frequency, Hz.

Lenoir Youth Development Center Retro-Commissioning

HVAC Systems Commissioning

Section	Component
	Hydronic Pumps

START-UP CHECKS

Check motor for proper rotation. Rotation shall match direction of rotation marked on pump casing.

Check that pump is free to rotate by hand. For pumps handling hot liquids, pump shall be free to rotate with the pump hot and cold. If the pump is bound or even drags slightly, do not operate the pump until the cause of the trouble is determined and corrected.

Clean associated strainers

Check that the proper overloads have been installed in the starter and are the correct size

Perform start-up checks for all associated water piping in accordance with this Appendix.

START-UP PROCEDURES

Start the pump in accordance with the manufacturer's written instructions

Check the general mechanical operation of the pump and motor.

Check noise and vibration levels and ensure they are within the manufacturers recommended tolerances

FUNCTIONAL PERFORMANCE TESTS

Verify strainer inlet/outlet pressure reading (psig).

Verify pump inlet/outlet pressure reading (psig) and compare to TAB report, pump design conditions, and pump submittal data.

Operate pump at shutoff and at 100 percent of designed flow when all components are in full flow. Measure inlet pressure (psig), outlet pressure, and flow rate (gpm), plot these test readings on pump curve, and compare results against readings taken from flow measuring devices and TAB report.

Operate pump at shutoff and at minimum flow or when all components are in full by-pass. Measure inlet pressure (psig), outlet pressure, and flow rate (gpm), plot these test readings on pump curve, and compare results against readings taken from flow measuring devices and TAB report.

Verify motor amperage each phase and voltage phase to phase and phase to ground for both the full flow and the minimum flow conditions.

Describe/document any unusual vibration, noise, etc.

Air Terminal Units

START-UP CHECKS

Check power and control voltages

Check calibration and operation of the controlling elements.

Check control valves for required close-off and fail/normal position

Ensure terminal unit is properly supported and that integrity of vibration isolation has been maintained where applicable.

Lenoir Youth Development Center Retro-Commissioning

HVAC Systems Commissioning

Start fans and ensure proper rotation (as applicable). Measure and record motor amperage and voltage.

Install new filters where required.

START-UP PROCEDURES

Calibrate and adjust the airflow control parameters. Set applicable min and max setpoints.

Check the heating device and control to ensure functionality and proper installation.

Check stroke and range on the valve and ensure it closes and seals tightly.

FUNCTIONAL PERFORMANCE TESTS**Cooling Only VAV Terminal Units:**

Verify VAV box response to room temperature set point adjustment. Turn thermostat to 5 degrees F above ambient and measure maximum airflow. Turn thermostat to 5 degrees F below ambient and measure minimum airflow. Compare these readings to design and TAB data.

Check damper maximum/minimum flow settings.

Fan Powered VAV Terminal Units:

Verify VAV box response to sensor call for heating via set point adjustment. Changes to be cooling setpoint to heating set point and return to cooling set point.

Verify cooling damper closes to minimum position and, upon further drop in space temperature, heating coil activation and deactivation.

Check primary air damper maximum/minimum airflow settings and compare to design and TAB data. Check blower fan flow and compare to design and TAB data.

Verify free operation of fan backdraft damper (insure no primary air is being discharged through the recirculated air intake).

Verify that no recirculated air is being induced when box is in full cooling.

Section	Component
	Boilers

FUNCTIONAL PERFORMANCE TESTS

Start building heating equipment (or implement provisions for "false load") to provide load for boiler.

Hot Water Boiler:

Activate controls system boiler start sequence as follows.

Start hot water pump and establish hot water flow. Verify boiler hot water proof-of-flow switch operation.

Verify control system energizes boiler start sequence.

Verify boiler senses hot water temperature below set point and control system activates boiler start.

Shut off building heating equipment to remove load on hot water system. Verify boiler shutdown sequence is initiated and accomplished after load is removed.

Lenoir Youth Development Center Retro-Commissioning

HVAC Systems Commissioning

Verify boiler inlet pressure (psig), boiler outlet pressure (psig), boiler flow rate (gpm), flue-gas temperature at boiler outlet (degrees F), percent carbon dioxide in flue-gas, draft at boiler flue-gas exit (in. WG), draft or pressure in furnace (in. WG), fuel type, and combustion efficiency readings, compare to TAB report, boiler design conditions, and boiler submittals data.

Record the following information and compare to design and TAB data:

Ambient temperature (degrees F)

Entering hot water temperature (degrees F)

Leaving hot water temperature (degrees F)

Verify temperatures recorded above are in accordance with the specified reset schedule.

Verify proper operation of boiler safeties.

Describe and document any unusual vibration, noise, etc.

Visually check refractory for cracks or spalding and refractory and tubes for flame impingement.

Section	Component
	Air-Handling Units

START-UP CHECKS

Verify proper thermal overload protection is installed in motors, starters, and disconnects.

Disconnect fan drive from motor and verify proper motor rotation direction and verify fan wheel free rotation and smooth bearings operations. Reconnect fan drive system, align belts, and install belt guards.

Lubricate bearings, pulleys, belts, and other moving parts with factory-recommended lubricants.

Adjust and lubricate dampers and linkages for proper damper operation.

Comb coil fins for parallel orientation.

Install clean filters.

Ensure condensate drains properly and that trap is sized correctly..

START-UP PROCEDURES

Lock out fan disconnects.

Check out fans in the following manner:

If split pillow block bearings are installed, perform the following:

Remove bearing housing caps. (**CAUTION:** Make sure to keep the inside of the bearing housing clean.)

Check for proper amount of lubrication. Should be approximately ½ full. Adjust as necessary.

Check to be sure that a stabilizer ring has been installed in only one (1) of the bearing housings.

Check both bearings to be sure that a locking tab has been set on the adapter ring lock nut. Or, If one-piece pillow block bearings are used, check to be sure that the bearing was lubricated. (The seals will purge some grease at start-up.)

Make sure all locking collars and setscrews are properly set.

Lenoir Youth Development Center Retro-Commissioning

HVAC Systems Commissioning

- 1 Check sheaves and belts.
- 2
- 3 Check sheave mounting bolts.
- 4
- 5 Check sheave alignment.
- 6
- 7 Check for proper belt tension and adjust as necessary.
- 8
- 9 Check all mounting bolts for tightness.
- 10
- 11 Fan bearing support.
- 12
- 13 Bearing mounting bolts.
- 14
- 15 Fan casing bolts.
- 16
- 17 Fan mounting bolts to fan base.
- 18
- 19 Motor ramp-mounting bolts.
- 20
- 21 Adjustable motor base mounting bolts.
- 22
- 23 Motor mounting bolts.
- 24
- 25 Belt guard-mounting bolts.
- 26
- 27 Isolation spring mounting bolts.
- 28
- 29 Thrust arrestor mounting bolts (if applicable).
- 30
- 31 Remove inlet screen and check hub set screws.
- 32
- 33 Replace inlet screen and check all screen fasteners.
- 34
- 35 Remove fan lock outs and prepare for full volume run test. Turn on unit and check the following:
- 36
- 37 Record motor line voltage and amperage at full volume and compare to motor nameplate data.
- 38
- 39 Take a pressure profile of entire air handling unit at full volume and record on a skeleton drawing of the air
- 40 handler.
- 41
- 42 Compare total, external, and internal pressures to design data.
- 43

FUNCTIONAL PERFORMANCE TESTS**Variable Volume Air Handling Unit:**

Ensure that a slight negative pressure exists on inboard side of the outside air dampers and a slight positive pressure exists on the inboard side of the relief air dampers throughout the full range of operation of the dampers. Modulate OA, RA, and EA dampers from fully open to fully closed positions.

The following shall be verified when the occupied operating mode is initiated:

All dampers in normal position and VFD modulates fan speed to maintain the required static pressure.

System safeties allow start if safety conditions are met.

VAV fan controller shall "soft-start" fans.

Lenoir Youth Development Center Retro-Commissioning

HVAC Systems Commissioning

- 1 Modulate all VAV boxes to minimum airflow and verify that the static pressure does not exceed the design
- 2 static pressure setpoint.
- 3
- 4 Occupied mode of operation (economizer de-energized):
- 5
- 6 Minimum outside air damper is open and maximum outside air damper is closed.
- 7
- 8 Return air damper open.
- 9
- 10 Relief air damper closed.
- 11
- 12 Fan VAV controller receiving signal from duct static pressure sensor and modulating fan to maintain supply
- 13 duct static pressure set point.
- 14
- 15 Occupied mode of operation (economizer energized):
- 16
- 17 Minimum outside air damper is open and maximum outside air damper and return damper modulates to
- 18 maintain specified discharge air temperature set point.
- 19
- 20 Relief air damper modulates with maximum outside air damper according to sequence of operation.
- 21
- 22 Compressors stage and cycle to maintain supply air temperature set point.
- 23
- 24 Verify furnace modulates to maintain supply air temperature set point.
- 25
- 26 Fan VAV controller receiving signal from duct static pressure sensor and modulating fan to maintain supply
- 27 duct static pressure set point.
- 28
- 29 Occupied mode of operation (minimum ventilation airflow):
- 30
- 31 Return fan airflow tracks with supply fan airflow to maintain fixed differential airflow.
- 32
- 33 Building remains under positive pressure.
- 34
- 35 Unoccupied mode of operation
- 36
- 37 Air handling system is off.
- 38
- 39 All dampers in their normal position.
- 40
- 41 Verify low limit space temperature is maintained as specified in sequence of operation by cycling the unit
- 42 on/off.
- 43
- 44 Measure supply airflow (cfm), minimum outdoor airflow (cfm), and supply air temperature (degrees F) and compare to
- 45 design and TAB data.
- 46
- 47 Verify safety shut down initiated by smoke detectors.
- 48
- 49 Verify safety shut down initiated by low temperature protection thermostat.
- 50
- 51 **Single Zone Constant Volume Air Handling Unit:**
- 52
- 53 The following shall be verified when the occupied operating mode is initiated:
- 54
- 55 All dampers in normal position.
- 56
- 57 All valves in normal position.
- 58
- 59 System safeties allow start if safety conditions are met.
- 60
- 61 Occupied mode of operation (economizer de-energized):

Lenoir Youth Development Center Retro-Commissioning

HVAC Systems Commissioning

- 1 Minimum outside air damper is open and maximum outside air damper is closed.
 2
 3 Return air damper open.
 4
 5 Relief air damper closed.
 6
 7 Gas furnace is maintaining space heating temperature set point.
 8
 9 Occupied mode of operation (economizer energized):
 10
 11 Minimum outside air damper is open and maximum outside air damper and return damper modulates to
 12 maintain mixed air temperature set point.
 13
 14 Relief air damper modulates with maximum outside air damper according to sequence of operation.
 15
 16 Unoccupied mode of operation
 17
 18 Air handling system is off.
 19
 20 All dampers in their normal position.
 21
 22 Verify low limit space temperature is maintained as specified in sequence of operation
 23
 24 Verify cooling coil and heating coil operation by varying thermostat set point from cooling set point to heating set point
 25 and returning to cooling set point.
 26
 27 Verify safety shut down initiated by smoke detectors.
 28
 29 Verify safety shut down initiated by low temperature protection thermostat.
 30

Section	Component
	Packaged Heating and Cooling Units

**START-UP CHECKS, START-UP PROCEDURES, AND
FUNCTIONAL PERFORMANCE TESTS**

- 31
 32
 33
 34
 35
 36 Turn unit ventilation air control to off position.
 37
 38 Turn unit control to cooling position or set unit thermostat 10°F below space temperature.
 39
 40 Measure unit discharge air after unit is in cooling position for at least 5 minutes. This air should be below
 41 60°F. The cooling coil should show condensation if the space dew point is over 50°F.
 42
 43 Turn unit control to heating position or set unit thermostat 10°F above space temperature.
 44
 45 Measure unit discharge air after unit is in heating position for at least 5 minutes. This air should be above 120°F.
 46
 47 Turn unit control to ventilation position. The outside air damper should be open.
 48
 49 Measure unit airflow and compare to design and TAB data.
 50
 51 Measure motor current and compare to motor nameplate data.
 52
 53 Measure the fan static pressure and compare to design data.
 54
 55
 56

Lenoir Youth Development Center Retro-Commissioning

HVAC Systems Commissioning

Section	Component
	Fireman's Smoke Control System

**START-UP CHECKS, START-UP PROCEDURES, AND
FUNCTIONAL PERFORMANCE TESTS**

The Fireman's Smoke Control System shall be tested in all operational modes including manual and automatic modes. The testing shall be in accordance with the 2018 NC Building Code Chapters 9 and 17. The test shall include but are not limited to the following:

1. Component Testing of smoke dampers, exhaust and supply fans, supply fan speed control
2. Damper operation including visually verifying control position for each mode is achieved and verification of end-switch operation
3. Fans shall be examined for correct rotation. Measurements of voltage, amperage, revolutions per minute (RPM) and belt tension shall be made.
4. Fan run status for each mode including visual and current sensor function back to panel and activation of fan based on proving of damper end-switches shall be verified.
5. The complete smoke control sequence shall be demonstrated for the following:
 - a. Normal Mode
 - b. Automatic Smoke Control Mode for first alarm
 - c. Transfer to Standby Power
 - d. Return to normal
 - e. Manual override modes
6. Detection Devices: Smoke and fire detectors that are part of the smoke control system shall be tested in accordance with Chapter 9 of the 2018 NC Building Code.
7. Ducts that are part of the smoke control system shall be traversed using generally accepted practices to determine actual air quantities.
8. Inlets and outlets shall be read using generally accepted practices to determine air quantities.
9. Each smoke zone equipped with an automatic-initiation device shall be put into operations by the actuation of one such device. Each additional device within the zone shall be verified to cause the same sequence without requiring the operation of fan motors in order to prevent damage. Control sequences shall be verified throughout the system, including verification of override from the fire-fighter's control panel and simulation of standby power conditions.
10. Smoke Control System shall be tested by a third party special inspector (working directly for the owner) in accordance with Section 1705.18 of the 2018 NC Building Code. The contractor shall demonstrate the system as directed by the special inspector.

END APPENDIX 230596

SECTION 23 09 00
BUILDING MANAGEMENT SYSTEM

PART 1 GENERAL

1.1 SECTION INCLUDES

- A. Building Management System (BMS), utilizing direct digital controls.

1.2 RELATED WORK SPECIFIED ELSEWHERE(designer to refine based on preference)

- A. Work Required Under Other Divisions Related to This Section:
 - 1. Fire Alarm System wiring and operation as related to the Smoke control system installation.

1.3 SYSTEM DESCRIPTION

- A. Scope: Furnish all labor, materials and equipment necessary for a complete and operating Building Management System (BMS), utilizing Direct Digital Controls as shown on the drawings and as described herein. Drawings are diagrammatic only. All controllers furnished in this section shall communicate on a peer-to-peer bus over a BACnet/MSTP open protocol bus. Controllers shall be of one manufacturer and the latest version as of the date of the bid.
 - 1. The intent of this specification is to provide a system that is consistent with BMS systems throughout the owner's facilities running the Niagara 4 Framework. This may be a new system or an expansion.
 - 2. System architecture shall fully support a multi-vendor environment and be able to integrate third party systems via existing vendor protocols including, as a minimum, LonTalk, BACnet and MODBUS.
 - 3. System architecture shall provide secure Web access using any of the current versions of Microsoft Internet Explorer, Mozilla Firefox, or Google Chrome browsers from any computer on the owner's LAN.
 - 4. Only systems that utilize the Niagara 4 Framework shall satisfy the requirements of this section.
 - 5. **I**The N4 supervisor shall be a PC with minimum Intel Xeon CPU E5-2640 (or better) with 16 GB RAM 2 (256GB) SSD hard drives in a RAID 1 configuration. It shall include a minimum 32X CD-ROM drive and 4-USB 3.0 ports. A minimum 21", HDMI, DVI-D video interfaces, minimum 1024 x 768 resolution, 4x3 Widescreen, LED color monitor with a minimum 60 Hz refresh rate shall also be included.
The N4 supervisor operating system shall be Windows 10 PRO 64 bit for workstation grade hardware and Windows Server 2016 for server grade hardware as a minimum. Utilize latest OS compatible with latest release of Niagara N4. Remove all other OS entries. Workstation and Server grade must be identified by the manufacturer and not a designer designation.
 - a. With VM support
 - b. With the most recent service packs and system updates.
 - c. Selected based on availability and project requirements.
 - d. Acceptable Manufacturers are:
 - a) Dell
 - b) Lenovo
 - c) HP (Hewlett Packard)
 - e. Connection to the BAS LAN network shall be via an Ethernet network interface card, 1Gb LAN.
 - f. The N4 supervisor shall support all Network Control Units (NCU), OWSs, and

Lenoir Youth Development Center Retro-Commissioning

Building Management System

- 3rd party mechanical / electrical systems connected to the Facility Management Control / Building Automation System Local Area Network.
- g. N4 supervisor to include Niagara 4 license as required to accommodate all DDC controllers and control points provided for this project.
 - h. Include 5-year SMA (Software Maintenance Agreement). Labor for software maintenance is not included. NOTE: a 5 year SMA is required.
- 6. The JACE shall handle the communications and licenses and be provided by the contractor. A rack mounted supervisor and license will be purchased and installed by others. The integrator shall be responsible for the entire site integration.
 - 7. Owner shall receive all Administrator level login and passwords for engineering toolset at first training session. The Owner shall have full licensing and full access rights for all network management, operating system computer, engineering and programming software required for the ongoing maintenance and operation of the BMS.
 - 8. OPEN NIC STATEMENTS - All Niagara 4 software licenses shall have the following NiCS: "accept.station.in=*"; "accept.station.out=*" and "accept.wb.in=*" and "accept.wb.out=*". All open NIC statements shall follow Niagara Open NIC specifications.
 - 9. All NAC hardware licenses and certificates shall be stored on local MicroSD memory card employing encrypted "safe boot" technology.
 - 10. All NAC provided as part of this project shall be the appropriate JACE-8000 model licensed with all necessary drivers.
 - 11. All NAC's provided as part of this project shall be licensed to accommodate a minimum of 10% additional controllers and points.
 - 12. Access: The owner will be granted permanent full administrative access to the entire system with no limitations or expiring licenses or renewals required. This access level allows the ability to add and/or delete accounts.
 - 13. The components of the FAC LAN, used to implement smoke control strategies, shall be UUKL listed.
 - 14. Device Level Network (DLN): Network used to connect LCUs and TCUs.
 - a. The components of the DLN, used to implement smoke control strategies, shall be UUKL listed.
 - 15. The TCUs and LCUs, used to implement smoke control strategies, shall be UUKL listed.

1.4 SPECIFICATION NOMENCLATURE

- A. Acronyms used in this specification are as follows:
 - 1. Actuator: Control device that opens or closes valve or damper in response to control signal.
 - 2. AI: Analog Input.
 - 3. AO: Analog Output.
 - 4. Analog: Continuously variable state over stated range of values.
 - 5. BMS: Building Management System.
 - 6. DDC: Direct Digital Control.
 - 7. Discrete: Binary or digital state.
 - 8. DI: Discrete Input.
 - 9. DO: Discrete Output.
 - 10. FC: Fail Closed position of control device or actuator. Device moves to closed position on loss of control signal or energy source.
 - 11. FO: Fail open (position of control device or actuator). Device moves to open position on loss of control signal or energy source.
 - 12. GUI: Graphical User Interface.
 - 13. HVAC: Heating, Ventilating and Air Conditioning.

Lenoir Youth Development Center Retro-Commissioning

Building Management System

14. IDC: Interoperable Digital Controller.
15. ILC: Interoperable Lon Controller.
16. LAN: Local Area Network.
17. Modulating: Movement of a control device through an entire range of values, proportional to an infinitely variable input value.
18. Motorized: Control device with actuator.
19. NAC: Network Area Controller (JACE).
20. NC: Normally closed position of switch after control signal is removed or normally closed position of manually operated valves or dampers.
21. NO: Normally open position of switch after control signal is removed; or the open position of a controlled valve or damper after the control signal is removed; or the usual position of a manually operated valve.
22. OSC: Operating System Computer, host for system graphics, alarms, trends, etc.
23. Operator: Same as actuator.
24. PC: Personal Computer.
25. Peer-to-Peer: Mode of communication between controllers in which each device connected to network has equal status and each shares its database values with all other devices connected to network.
26. P: Proportional control; control mode with continuous linear relationship between observed input signal and final controlled output element.
27. PI: Proportional-Integral control, control mode with continuous proportional output plus additional change in output based on both amount and duration of change in controller variable (reset control).
28. PICS: BACnet Product Interoperability Compliance Statement.
29. PID: Proportional-Integral-Derivative control, control mode with continuous correction of final controller output element versus input signal based on proportional error, its time history (reset) and rate at which it's changing (derivative).
30. Point: Analog or discrete instrument with addressable database value.
31. SMA: Software Maintenance Agreement. Maintenance agreement that provides future releases of Niagara 4 software at no licensing cost to owner. Labor to implement software upgrades is not covered under the Software Maintenance Agreement.
32. WAN: Wide Area Network.
33. UUKL Listing: Underwriter's Laboratory UL 864 Listed, 9th Edition, UUKL Smoke Control System.

1.5 PRELIMINARY DESIGN REVIEW

- A. The BAS contractor shall submit a preliminary design document for review within 45 days of the NTP. This document shall contain the following information:
 1. Provide a description of the proposed system along with a system architecture diagram with the intention of showing the contractors solution to meet this specification and samples of graphics consistent with NCDPS latest design guidelines attached to and made part of this project.
 2. Provide product data sheets and a technical description of all direct digital controller hardware required to meet specifications listed herein.
 3. Provide an overview of the BAS contractor's local/branch organization, local staff, recent related project experience with references, and local service capabilities.
 4. Provide information on the BAS contractor's project team including project organization, project manager, project engineer, programmers, project team resumes, and location of staff.

Lenoir Youth Development Center Retro-Commissioning

Building Management System

- B. Coordinate a meeting with a control team project manager, programmer, design engineer, and owner to review sequences within that time. NCDPS Central Engineering Electronics Engineering Group shall receive notification and invitation to this meeting. Offer concerns or suggestions for improvement.

Agenda items for the meeting:

1. Sequences
2. Trends to be set up
3. Alarms and required delays/buffers to avoid nuisance alarms.
4. Review procedures for Bacnet equipment startup by manufacture and understanding interfacing for control and monitoring. Bacnet points numbers and names will be coordinated. Points to be viewed and how will be discussed. The mechanical contractor will be responsible for having an equipment control expert knowledgeable on the specific equipment at the meeting.

1.6 SUBMITTALS

- A. Submit under provisions of Division 1 specifications.
- B. Product Data: Manufacturer's data sheets on each product to be used, including:
1. Preparation instructions and recommendations.
 2. Storage and handling requirements and recommendations.
 3. Installation methods.
- C. Submit documentation of contractor qualifications, including those indicated in "Quality Assurance" if requested by the A-E.
- D. The control system submittal shall consist of shop drawings, manufacturers' catalog data sheets and installation instructions. Submit in electronic format. Samples of written Controller Checkout Sheets and Performance Verification Procedures for applications similar in scope shall be included for approval.
- E. As a minimum, shop drawings shall contain:
1. A table of contents.
 2. Equipment schedules.
 3. VAV box controller schedule. Schedule shall include box size, K-Factor, and flow setpoints.
 4. Schematic diagrams of all controlled equipment.
 5. Sequences of operation for all controlled equipment. To be written in a more programming style than engineer's narrative sequence. Do not cut and paste engineer's sequence.
 6. Controller wiring diagrams, including terminal number identification for all control wiring.
 7. Wiring details for all field devices.
 8. A network architecture diagram showing a high-level overview of the installed system.
 9. A detailed control system bus layout depicted on building floorplans. Indicate controller locations.
 10. Control panel layout diagrams depicting all panel mounted components.
 11. Any other details required to demonstrate that the system has been coordinated with other trades and will properly function as a system.
 12. Manufacturer's data sheets for all installed components.
- F. All system manuals available to the controls vendor shall be provided to the owner as submittals to permit full networking, installation, programming, graphic generation, and checkout of the installed system. As a minimum but not limited to the following. Failure to provide these manuals shall result in rejection of the submittal in toto:

Lenoir Youth Development Center Retro-Commissioning

Building Management System

1. Operator's Manuals
 2. Programming Manuals
 3. Graphic Creation and Integration Manuals
 4. Niagara Platform Manuals
 5. Module Installation, Diagnostic
- G. Upon completion of the work, provide 3 complete sets of 'as-built' drawings and other project-specific documentation in 3-ring hard-backed binders and one electronic copy.
- H. Any deviations from these specifications or the work indicated on the drawings shall be clearly identified in the Submittals.

1.7 QUALITY ASSURANCE

- A. The Control System Contractor shall have a full service DDC office within 150 miles of the job site. This office shall be staffed with applications engineers, software engineers and field technicians. The Control System Contractor shall be staffed with a minimum of ten (10) Niagara 4 certified software engineers and/or technicians. The Control System Contractor shall also be staffed with a minimum of ten (10) control system manufacturer certified software engineers and/or technicians. The Control System Contractor shall maintain parts inventory and shall have all testing and diagnostic equipment necessary to support this work, as well as staff trained in the use of this equipment.
- B. **Single Source Responsibility of Supplier:** The Control System Contractor shall be responsible for the complete installation and proper operation of the control system. The Control System Contractor shall exclusively be in the regular and customary business of design, installation and service of computerized building management systems similar in size and complexity to the system specified. The Control System Contractor shall be the manufacturer of the primary DDC system components or shall have been the authorized representative for the primary DDC components manufacturer for at least 3 years. All control panels shall be assembled by the Control System Contractor in a UL-Certified 508A panel shop. Control panels shall be assembled such that all necessary I/O points are pre-wired from DDC controllers to terminal blocks. Wire ducts shall be installed within the panel as needed to accommodate field wiring.
- C. **Equipment and Materials:** Equipment and materials shall be cataloged products of manufacturers regularly engaged in the production and installation of HVAC control systems. Products shall be manufacturer's latest standard design and have been tested and proven in actual use.
- D. The IAS components, used to implement smoke control strategies, shall be UUKL listed.
- E. **Preferred Brand Alternate:** Distech ECB Series.
- F. **Familiarity with working environment:** The DDC contractor and the wiring sub-contractor on retro-fit jobs must be acquainted with working in a prison environment. They must have proof of having experience or training and follow all requirements set by NCDPS.

1.8 SOFTWARE OWNERSHIP

- A. The Owner (NCDPS Central Engineering) shall have full ownership and full access rights for all network management, operating system computer, engineering and programming software required for the ongoing maintenance and operation of the BMS.

Lenoir Youth Development Center Retro-Commissioning**Building Management System**

- B. Contractor shall provide a complete backup of programs, graphics, and documentation, in an editable format without password restriction (other than what is inherently required by the controller or equipment. In that case, password shall be provided.)

1.9 DELIVERY, STORAGE AND HANDLING

- A. Maintain integrity of shipping cartons for each piece of equipment and control device through shipping, storage and handling as required to prevent equipment damage. Store equipment and materials inside and protected from weather.

1.10 JOB CONDITIONS

- A. Cooperation with Other Trades: Coordinate the Work of this section with that of other sections to insure that the Work will be carried out in an orderly fashion. It shall be this Contractor's responsibility to check the Contract Documents for possible conflicts between his Work and that of other crafts in equipment location, pipe, duct and conduit runs, electrical outlets and fixtures, air diffusers and structural and architectural features.

1.11 SEQUENCING

- A. Ensure that products of this section are supplied to affected trades in time to prevent interruption of construction progress.

PART 2 PRODUCTS**2.1 GENERAL**

- A. The Building Management System (BMS) shall be comprised of a network of interoperable, stand-alone digital controllers, a network area controller, graphics and programming and other control devices for a complete system as specified herein. An N4 supervisor is to be on site for graphic storage and trending data storage and located on a new rack mount by Central Engineering Staff as noted above. Graphics shall be of the type and quality for each piece of equipment as shown in Appendix A.
- B. The installed system shall provide secure strong password access to all features, functions and data contained in the overall BMS.
- C. Appendix A is provided to demonstrate the graphical formatting, name tagging, and the level of detail and content expected in the BMS Graphical User Interface and programming. Sequences of operation contained in Appendix A are not to be used and are only shown as examples. The sequence of operation to be used are on the drawings.
- D. OPEN, INTEROPERABLE, INTEGRATED ARCHITECTURE
- E. The intent of this specification is to provide a peer-to-peer networked, stand-alone, distributed control system utilizing Open protocols in one open, interoperable system.
- F. The supplied computer software shall employ object-oriented technology (OOT) for representation of all data and control devices within the system. Physical connection of any BACnet control equipment, such as chillers, shall be via Ethernet, IP, or MS/TP.
- G. All components and controllers supplied under this contract shall be true "peer-to-peer" communicating devices. Components or controllers requiring "polling" by a host to pass data shall not be acceptable.
- H. The supplied system shall incorporate the ability to access all data using HTML5 enabled

Lenoir Youth Development Center Retro-Commissioning

Building Management System

browsers without requiring proprietary operator interface and configuration programs or browser plug-ins. An Open Database Connectivity (ODBC) or Structured Query Language (SQL) compliant BMS computer database is required for all system database parameter storage. This data shall reside on the N4 supervisor located in the Facilities Office on the LAN. Systems requiring proprietary database and user interface programs shall not be acceptable.

- I. A hierarchical topology is required to assure reasonable system response times and to manage the flow and sharing of data without unduly burdening the customer's internal Intranet network. Systems employing a "flat" single tiered architecture shall not be acceptable.
 1. Maximum acceptable response time from any alarm occurrence (at the point of origin) to the point of annunciation shall not exceed 5 seconds for network connected user interfaces.
 2. Maximum acceptable response time from any alarm occurrence (at the point of origin) to the point of annunciation shall not exceed 60 seconds for remote or dial-up connected user interfaces.

2.2 NETWORK AREA CONTROLLER (NAC)

- A. Basis of design is the JACE- 8000. These controllers are designed to manage communications between the Advanced Application Controllers (B-AAC), Application Specific Controllers (B-ASC) and Advanced Unitary Controllers (AUC) which are connected to its communications trunks, manage communications between itself and other system network controllers (NAC) and with any operator workstations (OWS) that are part of the BAS, and perform control and operating strategies for the system based on information from any controller connected to the BAS.
- B. The JACE shall be an embedded controller and server platform for connecting multiple and diverse devices and subsystems, internet connectivity, webserving capability, integrated control, supervision, data logging, alarming, scheduling and network management. Data and graphical displays shall be streamed to a standard network browser via Ethernet or wireless LAN, or remotely over the internet. The operating system shall be EC-Net 4 web-based building management platform powered by the Niagara Framework.
- C. The controllers shall be fully programmable to meet the unique requirements of the facility it shall control.
- D. The controllers shall be capable of peer-to-peer communications with other NAC's and with any OWS connected to the BAS, whether the OWS is directly connected, connected via cellular modem or connected via the Internet.
- E. The communication protocols utilized for peer-to-peer communications between NAC's will be Niagara 4 Fox, BACnet TCP/IP and SNMP. Use of a proprietary communication protocol for peer-to-peer communications between NAC's is not allowed.
- F. The NAC shall employ a device count capacity license model that supports expansion capabilities.
- G. The NAC shall be enabled to support and shall be licensed with the following Open protocol drivers (client and server) by default:
 1. BACnet
 2. Lon
 3. MODBUS
 4. SNMP
 5. KNX

Lenoir Youth Development Center Retro-Commissioning

Building Management System

- H. The NAC shall be capable of executing application control programs to provide:
1. Calendar functions.
 2. Scheduling.
 3. Trending.
 4. Alarm monitoring and routing.
 5. Time synchronization.
 6. Integration of LonWorks, BACnet, and MODBUS controller data.
 7. Network management functions for all NAC, PEC and ASC based devices.
- I. The NAC shall provide the following hardware features as a minimum:
1. Two 10/100 Mbps Ethernet ports.
 2. Two Isolated RS-485 ports with biasing switches.
 3. 1 GB DDR3 SDRAM RAM
 4. 4 GB Flash Total Storage / 2 GB User Storage
 5. Wi-Fi (Client or WAP)
 6. USB Flash Drive
 7. High Speed Field Bus Expansion
 8. -20-60°C Ambient Operating Temperature
 9. Integrated 24 VAC/DC Global Power Supply
 10. MicroSD Memory Card Employing Encrypted Safe Boot Technology. Minimum 4GB flash and total storage/2GB user storage.
 11. Have a USB type A port for station backup and restore functions
 12. Backward compatibility to run an EC-Net station (minimum requirement is 3.8.111)
 13. Platform:
 - a. Processor TI AM3352 1000MHz ARM® Cortex™ -A8
 - b. Removable micro-SD card with 4GB flash total storage/2GB user storage
 - c. Real-time clock
 - d. Batteryless
 - e. Secure boot
 14. Operating System:
 - a. EC-Net 4 4.1 or later
 - b. EC-NetAX 3.8.111 or later
 - c. EC-Net Access 2.3.118 or later
 15. Communications: Wi-Fi Client or WAP
 16. Wi-Fi Communication Protocol:
 - a. IEEE802.11 a/b/g/n
 - b. IEEE802.11 n HT20 @ 2.4GHz
 - c. IEEE802.11n HT20/HT40@5GHz
 17. Client Authentication Method: WPAPSK/WPA2PSK support
- (2) Ethernet 10/100MB Ethernet ports
- BACnet Listing BTL, B-BC listed with version 4.4.93 or latest
- MTTF: 10 years+
- J. The NAC shall support standard Web browser access via the Intranet/Internet. It shall support a minimum of 16 simultaneous users.
- K. The NAC shall provide alarm recognition, storage, routing, management and analysis to supplement distributed capabilities of equipment or application specific controllers.
- L. The NAC shall be able to route any alarm condition to any defined user location whether connected to a local network or remote via cellular modem, or wide-area network.
1. Alarm generation shall be selectable for annunciation type and acknowledgement requirements including but not limited to:
 - a. Alarm.

Lenoir Youth Development Center Retro-Commissioning

Building Management System

- b. Return to normal.
 - c. To default.
 - 2. Alarms shall be annunciated in any of the following manners as defined by the user:
 - a. Screen message text.
 - b. Email of complete alarm message to multiple recipients.
 - c. Mobile device text message.
 - d. Pagers via paging services that initiate a page on receipt of email message.
 - e. Graphics with flashing alarm object(s).
 - 3. The following shall be recorded by the NAC for each alarm (at a minimum):
 - a. Time and date.
 - b. Equipment (air handler #, access way, etc.).
 - c. Acknowledge time, date, and user who issued acknowledgement.
- M. The NAC shall support the following security functions.
 - 1. Module code signing to verify the author of programming tool and confirm that the code has not been altered or corrupted.
 - 2. Role-Based Access Control (RBAC) for managing user roles and permissions.
 - 3. Require users to use strong credentials.
 - 4. Data in Motion and Sensitive Data at Rest be encrypted.
 - 5. LDAP and Kerberos integration of access management.
- N. The NAC shall support the following data modeling structures to utilize Search; Hierarchy; Template; and Permission functionality:
 - 1. Metadata: Descriptive tags to define the structure of properties.
 - 2. Tagging: Process to apply metadata to components
 - 3. Tag Dictionary
- O. The NAC shall employ template functionality. Templates are a containerized set of configured data tags, graphics, histories, alarms, etc. that are set to be deployed as a unit based upon manufacturer's controller and relationships. All lower level communicating controllers (PEC, AVAV, CVAV, VFD's, etc.) shall have an associated template file for reuse on future project additions.
- P. The NAC shall be provided with a Software Maintenance Agreement as indicated in Paragraph 1.3.

2.3 BUILDING AUTOMATION SYSTEM CONTROLLERS (DDC)

- A. HVAC control shall be accomplished using BACnet based devices where the application has a BTL Listed PICS defined. The controller platform shall provide options and advanced system functions, programmable and configurable using the Niagara 4 Framework or through manufacturer supplied software, that allow standard and customizable control solutions required in executing the "Sequence of Operation". For systems that do not provide the ability to program DDC controllers through the Niagara 4 Framework, provide (4) copies of controller engineering/programming software, including any necessary licenses required for use of software.
- B. While BACnet is the selected communications platform there may be cases where Lonworks will be utilized on system expansions or renovations. All DDC controllers shall incorporate a common hardware platform between the BACnet and Lonworks communication models. Model I/O options and termination layouts shall be identical regardless of communication option selected.
- C. All controllers shall include a network connection for local viewing of operation, AHU, FCU, UV, VAV for example.

Lenoir Youth Development Center Retro-Commissioning

Building Management System

- D. DDC controller manufacture shall offer both custom programmable controllers and plug-and-play pre-configured application specific controllers.
- E. DDC controllers shall utilize a graphical block oriented programming interface tool. This software tool shall license free and not require any reoccurring costs for continued operation.
- F. All controllers shall have sufficient input and output capability for the terminal system being controlled and monitored plus allow two spare inputs and outputs, VAV box controllers require one set. Plant controllers to have min of 10% spare capacity. Controller enclosure shall be size to accommodate a second controller of the same size.
 - 1. Advanced Application Controller (B-AAC) - a controller designed for more complex sequences of operations such as built up AHU's, central plant operations, electrical monitoring, and control and management for chillers, boilers and generators. The B-AAC's are to allow for the flexibility of custom control programming to meet the needed sequences of operation. B-AAC's shall be selected based upon I/O requirements. Additional I/O may be added via expansion modules.
 - a. All B-AAC's shall be application programmable and shall at all times maintain their certification. All control sequences within or programmed into the B-AAC shall be stored in non-volatile memory, which is not dependent upon the presence of a battery to be retained.
 - b. The B-AAC shall provide LED indication of communication and controller performance to the technician, without cover removal.
 - c. B-AAC's shall have mixture of I/O including dry contact digital inputs, universal inputs (configurable as of 4-20 mA, 0-10 VDC, thermistor and RTD in the range 0 to 350,000 ohm), universal outputs (4-20mA, 0-10 VDC, or digital), and digital outputs (24 VAC TRIAC).
 - 2. Configurable VAV Controller (CVAV) - the configurable VAV controller platform shall be designed specifically for room-level VAV control – pressure-independent air flow control, pressure dependent damper control, supply and exhaust pressurization/de-pressurization control; temperature, humidity, complex CO2, occupancy, and emergency control. Equipment includes: VAV terminal unit, VAV terminal unit with reheat, series fan powered terminal unit, parallel fan powered terminal unit, supply and exhaust air volume terminals, and constant volume dual-duct terminal unit.
 - a. The CVAV shall be application specific configuration and shall at all times maintain their certification. All control sequences within or programmed into the CVAV shall be stored in non-volatile memory, which is not dependent upon the presence of a battery to be retained.
 - b. The controller shall have an internal velocity pressure sensor.
 - c. The CVAV shall provide LED indication of communication and controller performance to the technician, without cover removal.
 - d. CVAV's shall have mixture of I/O including dry contact digital inputs, universal inputs (configurable as of 4-20 mA, 0-10 VDC, thermistor and RTD in the range 0 to 350,000 ohm), universal outputs (4-20mA, 0-10 VDC, or digital), and digital outputs (24 VAC TRIAC).
 - e. The controller shall provide an integrated actuator option.

2.4 DDC Sensors and Point Hardware

- A. Temperature Sensors
 - 1. Acceptable Manufacturers: Veris, Distech, Honeywell, ACI
 - 2. All temperature devices shall use precision thermistors accurate to +/- 1 degree F over a range of -30 to 230 degrees F. Space temperature sensors shall be accurate to +/- .5 degrees F over a range of 40 to 100 degrees F.

Lenoir Youth Development Center Retro-Commissioning

Building Management System

3. Room Sensor: Standard space sensors shall be available in an [off white] [black] enclosure made of high impact ABS plastic for mounting on a standard electrical box. Basis of Design: Veris TW Series
 - a. Where manual overrides are required, the sensor housing shall feature both an optional sliding mechanism for adjusting the space temperature setpoint, as well as a push button for selecting after hours operation.
 - b. Where a local display is specified, the sensor shall incorporate an LCD display for viewing the space temperature, setpoint and other operator selectable parameters. Using built in buttons, operators shall be able to adjust setpoints directly from the sensor.
 4. A pneumatic signal shall not be allowed for sensing temperature.
- B. Humidity Wall Transmitter
1. Acceptable Manufacturer: Veris, Distech, Vaisala, Hy-Cal, Honeywell
 2. Transmitters shall be accurate to +/- [1] [2] % at full scale.
 3. Transmitter shall have replaceable sensing element.
 4. Sensor type shall be thin-film capacitive.
 5. Sensor element shall contain multipoint calibration on-board in nonvolatile memory
 6. Operating range shall be 0 - 100% RH noncondensing, 50 to 95 F
 7. Output shall be field selectable 4-20 mA or 0-5/0-10 VDC.
 8. Transmitter shall accept 12-30 VDC or 24 VAC supply power.
 9. Transmitter shall be available in an [off white] [black] enclosure made of high impact ABS plastic for mounting on a standard electrical box.
 10. Transmitter shall have LCD display
 11. Transmitter shall be available with a certification of NIST calibration
 12. [Transmitter shall have integrated temperature sensor]
 13. Basis of Design: Veris HWL Series

2.5 OTHER CONTROL SYSTEM HARDWARE

- A. Temperature Control Panels: Furnish temperature control panels of code gauge steel with locking doors for mounting all devices as shown. All electrical devices within a control panel shall be factory wired. Control panel shall be assembled by the BMS in a UL-Certified 508A panel shop and constructed in accordance with the 2017 NEC Code, Section 409. A complete set of 'as-built' control drawings (relating to the controls within that panel) shall be furnished within each control panel.

Lenoir Youth Development Center Retro-Commissioning

Building Management System

- B. Fire Fighter's Smoke System and Control Panel (FSCS & FSCP): All smoke control shall be accomplished with a system in compliance with the 2018 Building Code including end to end UL864 certification and be in compliance with the 2020 Edition of NFPA 92 Section 6.4. Control panel shall be assembled in a UL-Certified 508A panel shop and constructed in accordance with the 2017 NEC Code, Section 409. The control panel shall:
1. Be in a NEMA 3R enclosure
 2. Be constructed of 16 gauge steel
 3. Be in a lockable enclosure to limit access to integral components and power supply
 4. Have dry contact inputs to receive signals from the Fire Alarm Control Panel
 5. Fans within the building including all fans that are part of the smoke control system (e.g. smoke exhaust and AHU fans) shall be shown on the panel with a clear indication of the direction of air flow and the relationship of the of components. Status indicators shall be provided for all smoke control equipment, annunciated by fan and zone, and by pilot-lamp-type indicators as follows:
 - a. Fan, dampers, and other operation equipment in their normal status-WHITE
 - b. Fans, dampers and other operation equipment in their off or closed status-RED
 - c. Fans, dampers and other operating equipment in their on or open status-GREEN
 - d. Fans, dampers, and other operating equipment in a fault status-YELLOW/AMBER
 6. Provide Auto and manual overrides to put compartments in pressurization or Evac Mode.
 7. For each smoke department, the control panel shall indicate the following status:
 - a. Evacuation
 - b. Pressurization
 - c. Auto
 - d. Off
 - e. Fault
 8. Have supply Fan control and monitoring (Fan status shown on panel face)
 9. Have smoke damper control and monitoring (Damper status shown on panel face)
 10. Provide signal to control speed of the variable speed drive(s) for the supply fan on variable volume air handling units.
 11. Have dedicated system enable for fire control panel interface
 12. Have dedicated input and relay output for Fireman's Smoke Control Panel
 13. Immediately after receiving an automatic signal from the Fire Alarm Control Panel or manual command shall initiate smoke control mode.
 14. Have a lamp test function to pilot lamps by means of one or more "LAMP TEST" momentary push buttons or other self-restoring means.
 15. Have audible and visual indicators and a key switch to silence audible alarms. The visual alarm shall remain on after the audible alarm is silenced until fault is cleared. If fault is not cleared within 24 hours, the audible alarm shall reactivate.
 16. Be constructed and located so that all input and output devices shall be within the same room as their connected controller and the wiring from those devices shall be inside conduit connected to the controllers enclosure. All transformers and their Class-2 24 VAC secondary voltage wiring shall be inside the same enclosure as the controller to which they supply power. All Class-1 supply voltage wiring to those transformers shall be inside conduit connected to the transformer's and controller's enclosure. Within the enclosure, the Class-1 supply voltage wiring shall be separate (by a minimum of 2 inches) from the power-limited Class-2 secondary voltage wiring and input/output device wiring.
 17. The controllers in the FSCP shall be maintained as a separate system from the non-dedicated BMS. It shall have the highest priority control over all smoke control

Lenoir Youth Development Center Retro-Commissioning

Building Management System

systems and components, isolating any component not listed for UL 864 from the smoke control bus, and annunciate at the FSCP any interruption to the ability to perform smoke control. Any interruption shall cause an audible and visual alarm even during normal (non-smoke control) operation. A monitoring program will determine within 75 seconds if the smoke control commands can be sent.

18. If power is lost the controllers clock will maintain time and date information for 72 hours.

- C. Relays: Start/stop relay model shall provide either momentary or maintained switching action as appropriate for the motor being started. All relays shall be plugged in, interchangeable, mounted on a sub base and wired to numbered terminals strips. Relays installed in panels shall all be DPDT with indicating lamp. Relays installed outside of controlled devices shall be enclosed in a NEMA enclosure suitable for the location. Relays shall be labeled with UR symbol. RIB-style relays are acceptable for remote enable/disable.
- D. Control Power Transformers: Provide step-down transformers for all DDC controllers and devices as required. Transformers shall be sized for the load, but shall be sized for 50 watts, minimum. Transformers shall be UL listed Class 2 type, for 120 VAC/24 VAC operation.
- E. Line voltage protection: All DDC system control panels that are powered by 120 VAC circuits shall be provided with surge protection. This protection is in addition to any internal protection provided by the manufacturer. The protection shall meet UL, ULC 1449, IEEE C62.41B. A grounding conductor, (minimum 12 AWG), shall be brought to each control panel.

2.6 N4 SUPERVISOR & WEB BROWSER GUI - SYSTEM OVERVIEW

- A. The BAS Contractor shall provide system software based on server/thin-client architecture, designed around the open standards of web technology. The N4 supervisor shall communicate using Ethernet and TCP. N4 supervisor shall be accessed using a web browser over Owner intranet and remotely over the Internet.
- B. The intent of the thin-client architecture is to provide the operator(s) complete access to the BAS system via a web browser. The thin-client web browser Graphical User Interface (GUI) shall be browser and operating system agnostic, meaning it will support HTML5 enabled browsers without requiring proprietary operator interface and configuration programs or browser plug-ins. Microsoft, Firefox, and Chrome browsers (current released versions), and Windows as well as non-Window operating systems.
- C. The N4 supervisor software shall support at least the following platforms (Windows 10 Pro 64bit and Windows Server 2016). The N4 supervisor software shall be developed and tested by the manufacturer of the system stand-alone controllers and network controllers/routers.
- D. The web browser GUI shall provide a completely interactive user interface and shall provide a HTML5 experience that supports the following features as a minimum:
 - 1. Trending.
 - 2. Scheduling.
 - 3. Electrical demand limiting.
 - 4. Duty Cycling.
 - 5. Downloading Memory to field devices.
 - 6. Real time 'live' Graphic Programs.
 - 7. Tree Navigation.

Lenoir Youth Development Center Retro-Commissioning

Building Management System

8. Parameter change of properties.
 9. Set point adjustments.
 10. Alarm / event information.
 11. Configuration of operators.
 12. Execution of global commands.
 13. Add, delete, and modify graphics and displayed data.
- E. Software Components: All software shall be the most current version. All software components of the BAS system software shall be provided and installed as part of this project. BAS software components shall include:
1. N4 supervisor Software, Database and Web Browser Graphical User Interface.
 2. Software Maintenance Agreement license as specified. Labor to implement future upgrades is not included.
 3. Embedded System Configuration Utilities for future modifications to the system and controllers.
 4. Embedded Graphical Programming Tools.
 5. Embedded Application Software.
- F. N4 supervisor Database: The N4 supervisor software shall utilize a Java Database Connectivity (JDBC) compatible database such as: MS SQL 8.0, Oracle 8i or IBM DB2. BAS systems written to Non -Standard and/or Proprietary databases are NOT acceptable.
- G. Thin Client - Web Browser Based: The GUI shall be thin client or browser based and shall meet the following criteria:
1. Web Browser's for PC's: Only the current released browser (Edge/Firefox/Chrome) will be required as the GUI and a valid connection to the server network. No installation of any custom software shall be required on the operator's GUI workstation/client. Connection shall be over an intranet or the Internet.
 2. Secure Socket Layers: Communication between the Web Browser GUI and N4 supervisor shall offer encryption using 128-bit encryption technology within Secure Socket Layers (SSL). Communication protocol shall be Hyper-Text Transfer Protocol (HTTP).

2.7 WEB BROWSER GRAPHICAL USER INTERFACE

- A. Web Browser Navigation: The Thin Client web browser GUI shall provide a comprehensive user interface. Using a collection of web pages, it shall be constructed to "feel" like a single application, and provide a complete and intuitive mouse/menu driven operator interface. It shall be possible to navigate through the system using a web browser to accomplish requirements of this specification. The Web Browser GUI shall (as a minimum) provide for navigation, and for display of animated graphics, schedules, alarms/events, live graphic programs, active graphic set point controls, configuration menus for operator access, reports and reporting actions for events.
- B. Login: On launching the web browser and selecting the appropriate domain name or IP address, the operator shall be presented with a login page that will require a login name and strong password. Navigation in the system shall be dependent on the operator's role-based application control privileges.
- C. Navigation: Navigation through the GUI shall be accomplished by clicking on the appropriate level of a navigation tree (consisting of an expandable and collapsible tree control like Microsoft's Explorer program) and/or by selecting dynamic links to other system graphics. Both the navigation tree and action pane shall be displayed simultaneously, enabling the operator to select a specific system or equipment and view the corresponding graphic. The navigation tree shall as a minimum provide the following views: Geographic,

Lenoir Youth Development Center Retro-Commissioning

Building Management System

Network, Groups and Configuration.

1. Geographic View shall display a logical geographic hierarchy of the system including: cities, sites, buildings, building systems, floors, equipment and objects.
 2. Groups View shall display Scheduled Groups and custom reports.
 3. Configuration View shall display all the configuration categories (Operators, Schedule, Event, Reporting and Roles).
- D. Action Pane: The Action Pane shall provide several functional views for each subsystem specified. A functional view shall be accessed by clicking on the corresponding button:
1. Graphics: Using graphical format suitable for display in a web browser, graphics shall include aerial building/campus views, color building floor-plans, equipment drawings, active graphic set point controls, web content and other valid HTML elements. The data on each graphic page shall automatically refresh.
 2. Dashboards: User customizable data using drag and drop HTML5 elements. Shall include Web Charts, Gauges, and other custom developed widgets for web browser. User shall have ability to save custom dashboards.
 3. Search: User shall have multiple options for searching data based upon Tags. Associated equipment, real time data, Properties, and Trends shall be available in result.
 4. Properties: Shall include graphic controls and text for the following: Locking or overriding objects, demand strategies, and any other valid data required for setup. Changes made to the properties pages shall require the operator to depress an 'accept/cancel' button.
 5. Schedules: Shall be used to create, modify/edit and view schedules based on the systems hierarchy (using the navigation tree).
 6. Alarms: Shall be used to view alarm information geographically (using the navigation tree), acknowledge alarms, sort alarms by category, actions and verify reporting actions.
 7. Charting: Shall be used to display associated trend and historical data, modify colors, date range, axis and scaling. User shall have ability to create HTML charts through web browser without utilizing chart builder. User shall be able to drag and drop single or multiple data points, including schedules, and apply status colors for analysis.
 8. Logic - Live Graphic Programs: Shall be used to display 'live' graphic programs of the control algorithm, (micro block programming) for the mechanical/electrical system selected in the navigation tree, including current parameter values.
 9. Other actions such as Print, Help, Command, and Logout shall be available via a drop-down window.
- E. High Resolution Color Graphics: The Web Browser GUI shall make extensive use of color in the graphic pane to communicate information related to set points and comfort. Animated .gifs, .png, or .jpg, vector scalable, active set point graphic controls shall be used to enhance usability. Graphics tools used to create Web Browser graphics shall be non-proprietary and conform to the following basic criteria:
1. Display Size: The GUI workstation software shall graphically display in a minimum of 1920 by 1200 pixels 32 bit True Color.
 2. General Graphic: General area maps shall show locations of controlled buildings in relation to local landmarks.
 3. Color Floor Plans: Floor plan graphics shall show heating and cooling zones throughout the buildings in a range of colors, as selected by Owner.
 4. Mechanical Components: Mechanical system graphics shall show the type of mechanical system components serving any zone through the use of a pictorial representation of components. Selected I/O points being controlled or monitored for each piece of equipment shall be displayed with the appropriate engineering units. Animation shall be used for rotation or moving mechanical components to enhance usability.

Lenoir Youth Development Center Retro-Commissioning

Building Management System

5. Minimum System Color Graphics: Color graphics shall be selected and displayed via a web browser for the following:
 - a. Each piece of equipment monitored or controlled including each terminal unit.
 - b. Each building.
 - c. Each floor and zone controlled.
 6. Color Coding for Piping:
 - a. Hot Water Supply: Red with orange letters and arrows
 - b. Hot Water Return: Red with baby blue letters and arrows
- F. Hierarchical Schedules: Utilizing the Navigation Tree displayed in the web browser GUI, an operator (with proper access credentials) shall be able to define a Normal, Holiday or Override schedule for an individual piece of equipment or room, or choose to apply a hierarchical schedule to the entire system, site or floor area. For example, Independence Day 'Holiday' for every level in the system would be created by clicking at the top of the geographic hierarchy defined in the Navigation Tree. No further operator intervention would be required and every control module in the system with would be automatically downloaded with the 'Independence Day' Holiday. All schedules that affect the system/area/equipment highlighted in the Navigation Tree shall be shown in a summary schedule table and graph.
1. Schedules: Schedules shall comply with the LonWorks and BACnet standards, (Schedule Object, Calendar Object, Weekly Schedule property and Exception Schedule property) and shall allow events to be scheduled based on:
 - a. Types of schedule shall be Normal, Holiday or Override.
 - b. A specific date.
 - c. A range of dates.
 - d. Any combination of Month of Year (1-12, any), Week of Month (1-5, last, any), Day of Week (M-Sun, Any).
 - e. Wildcard (example, allow combinations like second Tuesday of every month).
 2. Schedule Categories: The system shall allow operators to define and edit scheduling categories (different types of "things" to be scheduled; for example, lighting, HVAC occupancy, etc.). The categories shall include: name, description, icon (to display in the hierarchy tree when icon option is selected) and type of value to be scheduled.
 3. Schedule Groups: In addition to hierarchical scheduling, operators shall be able to define functional Schedule Groups, comprised of an arbitrary group of areas/rooms/equipment scattered throughout the facility and site. For example, the operator shall be able to define an 'individual tenant' group - who may occupy different areas within a building or buildings. Schedules applied to the 'tenant group' shall automatically be downloaded to control modules affecting spaces occupied by the 'tenant group'.
 4. Intelligent Scheduling: The control system shall be intelligent enough to automatically turn on any supporting equipment needed to control the environment in an occupied space. If the operator schedules an individual room in a VAV system for occupancy, for example, the control logic shall automatically turn on the VAV air handling unit, chiller, boiler and/or any other equipment required to maintain the specified comfort and environmental conditions within the room.
 5. Partial Day Exceptions: Schedule events shall be able to accommodate a time range specified by the operator (ex: board meeting from 6 pm to 9 pm overrides Normal schedule for conference room).
 6. Schedule Summary Graph: The schedule summary graph shall clearly show Normal versus Holiday versus Override Schedules and the net operating schedule that results from all contributing schedules. Note: In case of priority conflict between schedules at the different geographic hierarchy, the schedule for the more detailed geographic level shall apply.

Lenoir Youth Development Center Retro-Commissioning

Building Management System

- G. Alarms: Alarms associated with a specific system, area, or equipment selected in the Navigation Tree, shall be displayed in the Action Pane by selecting an ' Alarms' view. Alarms, and reporting actions shall have the following capabilities: Alarms are to be set up to not be a nuisance but be instructive and will require tuning based on feedback during the warranty period.
1. Alarms View: Each Alarm shall display an Alarms Category (using a different icon for each alarm category), date/time of occurrence, current status, alarm report and a bold URL link to the associated graphic for the selected system, area or equipment. The URL link shall indicate the system location, address and other pertinent information. An operator shall easily be able to sort events, edit event templates and categories, acknowledge or force a return to normal in the Events View as specified in this section.
 2. Alarm Categories: The operator shall be able to create, edit or delete alarm categories such as HVAC, Maintenance, Fire, or Generator. An icon shall be associated with each alarm category, enabling the operator to easily sort through multiple events displayed.
 3. Alarm Templates: Alarm template shall define different types of alarms and their associated properties. As a minimum, properties shall include a reference name, verbose description, severity of alarm, acknowledgement requirements, and high/low limit and out of range information.
 4. Alarm Areas: Alarm Areas enable an operator to assign specific Alarm Categories to specific Alarm Reporting Actions. For example, it shall be possible for an operator to assign all HVAC Maintenance Alarm on the 1st floor of a building to email the technician responsible for maintenance. The Navigation Tree shall be used to setup Alarm Areas in the Graphic Pane.
 5. Alarm Time/Date Stamp: All events shall be generated at the DDC control module level and comprise the Time/Date Stamp using the standalone control module time and date.
 6. Alarm Configuration: Operators shall be able to define the type of Alarm generated per object. A ' network' view of the Navigation Tree shall expose all objects and their respective Alarm Configuration. Configuration shall include assignment of Alarm, type of Acknowledgement and notification for return to normal or fault status.
 7. Alarm Summary Counter: The view of Alarm in the Graphic Pane shall provide a numeric counter, indicating how many Alarms are active (in alarm), require acknowledgement and total number of Alarms in the N4 supervisor database.
 8. Alarm Auto-Deletion: Alarms that are acknowledged and closed shall be auto-deleted from the database and archived to a text file after an operator defined period.
 9. Alarm Reporting Actions: Alarm Reporting Actions specified shall be automatically launched (under certain conditions) after an Alarm is received by the N4 supervisor software. Operators shall be able to easily define these Reporting Actions using the Navigation Tree and Graphic Pane through the web browser GUI. Reporting Actions shall be as follows:
 - a. Print: Alarm information shall be printed to the N4 supervisor's PC or a networked printer.
 - b. Email: Email shall be sent via any POP3-compatible e-mail server (most Internet Service Providers use POP3). Email messages may be copied to several email accounts. Note: Email reporting action shall also be used to support alphanumeric paging services, where email servers support pagers.
 - c. File Write: The ASCII File write reporting action shall enable the operator to append operator defined alarm information to any alarm through a text file. The alarm information that is written to the file shall be completely definable by the operator. The operator may enter text or attach other data point information (such as AHU discharge temperature and fan condition upon a high room temperature alarm).

Lenoir Youth Development Center Retro-Commissioning

Building Management System

- d. Write Property: The write property reporting action updates a property value in a hardware module.
 - e. SNMP: The Simple Network Management Protocol (SNMP) reporting action sends an SNMP trap to a network in response to receiving an alarm.
 - f. Run External Program: The Run External Program reporting action launches specified program in response to an event.
- H. Trends: As system is engineered, all hard-wired points shall be enabled to trend. Trends shall both be displayed and user configurable through the Web Browser GUI. Trends shall comprise analog, digital or calculated points simultaneously. A trend log's properties shall be editable using the Navigation Tree and Graphic Pane.
- 1. Viewing Trends: The operator shall have the ability to view trends by using the Navigation Tree and selecting a Trends button in the Graphic Pane. The system shall allow y- and x-axis maximum ranges to be specified and shall be able to simultaneously graphically display multiple trends per graph.
 - 2. Local Trends: Trend data shall be collected locally by Multi-Equipment/Single Equipment general-purpose controllers, and periodically uploaded to the N4 supervisor if historical trending is enabled for the object. Trend data, including run time hours and start time date shall be retained in non-volatile module memory. Systems that rely on a gateway/router to run trends are NOT acceptable.
 - 3. Resolution. Sample intervals shall be as small as one second. Each trended point will have the ability to be trended at a different trend interval. When multiple points are selected for displays that have different trend intervals, the system will automatically scale the axis.
 - 4. Dynamic Update. Trends shall be able to dynamically update at operator-defined intervals.
 - 5. Zoom/Pan. It shall be possible to zoom-in on a particular section of a trend for more detailed examination and 'pan through' historical data by simply scrolling the mouse.
 - 6. Numeric Value Display. It shall be possible to pick any sample on a trend and have the numerical value displayed.
 - 7. Copy/Paste. The operator shall have the ability to pan through a historical trend and copy the data viewed to the clipboard using standard keystrokes (i.e. CTRL+C, CTRL+V).
 - 8. Access: The owner will granted permanent full Administrative access to the entire system with no limitations or expiring licenses or renewals required. This access level allows the ability to add and/or delete accounts.
- I. Security Access: Systems that Security access from the web browser GUI to N4 supervisor shall require a Login Name and Strong Password. Access to different areas of the BAS system shall be defined in terms of Role-Based Access Control privileges as specified:
- 1. Roles: Roles shall reflect the actual roles of different types of operators. Each role shall comprise a set of 'easily understood English language' privileges. Roles shall be defined in terms of View, Edit and Function Privileges.
 - a. View Privileges shall comprise: Navigation, Network, and Configuration Trees, Operators, Roles and Privileges, Alarm/Event Template and Reporting Action.
 - b. Edit Privileges shall comprise: Set point, Tuning and Logic, Manual Override, and Point Assignment Parameters.
 - c. Function Privileges shall comprise: Alarm/Event Acknowledgement, Control Module Memory Download, Upload, Schedules, Schedule Groups, Manual Commands, Print and Alarm/Event Maintenance.
 - 2. Geographic Assignment of Roles: Roles shall be geographically assigned using a similar expandable/collapsible navigation tree. For example, it shall be possible to assign two HVAC Technicians with similar competencies (and the same operator defined HVAC Role) to different areas of the system.

2.8 GRAPHICAL PROGRAMMING

- A. The system software shall include a Graphic Programming Language (GPL) for all DDC control algorithms resident in all control modules. Any system that does not use a drag and drop method of graphical icon programming shall not be accepted. All systems shall use a GPL method used to create a sequence of operations by assembling graphic microblocks that represent each of the commands or functions necessary to complete a control sequence. Microblocks represent common logical control devices used in conventional control systems, such as relays, switches, high signal selectors etc., in addition to the more complex DDC and energy management strategies such as PID loops and optimum start. Each microblock shall be interactive and contain the programming necessary to execute the function of the device it represents.
- B. Graphic programming shall be performed while on screen and using a mouse; each microblock shall be selected from a microblock library and assembled with other microblocks necessary to complete the specified sequence. Microblocks are then interconnected on screen using graphic "wires," each forming a logical connection. Once assembled, each logical grouping of microblocks and their interconnecting wires then forms a graphic function block which may be used to control any piece of equipment with a similar point configuration and sequence of operation.
- C. Graphic Sequence: The clarity of the graphic sequence shall be such that the operator has the ability to verify that system programming meets the specifications, without having to learn or interpret a manufacturer's unique programming language. The graphic programming shall be self-documenting and provide the operator with an understandable and exact representation of each sequence of operation.
- D. GPL Capabilities: The following is a minimum definition of the capabilities of the Graphic Programming software:
 - 1. Function Block (FB): Shall be a collection of points, microblocks and wires which have been connected together for the specific purpose of controlling a piece of HVAC equipment or a single mechanical system.
 - 2. Logical I/O: Input/Output points shall interface with the control modules in order to read various signals and/or values or to transmit signal or values to controlled devices.
 - 3. Microblocks: Shall be software devices that are represented graphically and may be connected together to perform a specified sequence. A library of microblocks shall be submitted with the control contractors bid.
 - 4. Wires: Shall be Graphical elements used to form logical connections between microblocks and between logical I/O.
 - 5. Reference Labels: Labels shall be similar to wires in that they are used to form logical connections between two points. Labels shall form a connection by reference instead of a visual connection, i.e. two points labeled 'A' on a drawing are logically connected even though there is no wire between them.
 - 6. Parameter: A parameter shall be a value that may be tied to the input of a microblock.
 - 7. Properties: Dialog boxes shall appear after a microblock has been inserted which has editable parameters associated with it. Default parameter dialog boxes shall contain various editable and non-editable fields, and shall contain 'push buttons' for the purpose of selecting default parameter settings.
 - 8. Icon: An icon shall be graphic representation of a software program. Each graphic microblock has an icon associated with it that graphically describes its function.
 - 9. Menu-bar Icon: Shall be an icon that is displayed on the menu bar on the GPL screen, which represents its associated graphic microblock.
 - 10. Live Graphical Programs: The Graphic Programming software shall support a 'live' mode, where all input/output data, calculated data and set points shall be displayed in

Lenoir Youth Development Center Retro-Commissioning

Building Management System

a 'live' real-time mode.

2.9 BACNET NETWORK MANAGEMENT

- A. Systems requiring the use of third-party BACnet network management tools shall not be accepted.
- B. Network management shall include the following services: device identification, device installation, device configuration, device diagnostics, device maintenance and network variable binding.
- C. The Network configuration tool shall also provide diagnostics to identify devices on the network, to reset devices and to view health and status counters within devices.
- D. These tools shall provide the ability to "learn" an existing BACnet network, regardless of what network management tool(s) were used to install the existing network, so that existing BACnet devices and newly added devices are part of a single network management database.
- E. The network management database shall be resident in the Network Area Controller (NAC), ensuring that anyone with proper authorization has access to the network management database at all times. Systems employing network management databases that are not resident, at all times and within the control system shall not be accepted.

PART 3 EXECUTION

3.1 WORK INCLUDED

- A. Install the system as specified above and herein, and, along with the other supporting documents attached to and made part of this specification. This includes:
 - 1. The Graphical Interface Package and addenda to this package including:
 - a. Additions to the navigation menus.
 - b. Control status section for each equipment system graphic.
 - c. Standard trends
 - 2. Input/Output points listings
 - 3. Sequence of Operations
 - 4. Alarms and Analytics
- B. Graphics: All local graphics and system access shall be integrated into the existing state rack mounted station located at NCCIW. Operators to this site will have full access, control, programming, graphic capabilities, etc. to modify the system in its entirety from this access.
- C. System Graphics: The look, layout and feel of the work station graphics shall to the best degree possible mimic what is provided in the attached Graphics package and therefore part of this specification. This includes the menu and submenu structures reflected therein. However, this is intended as a guideline and not an exact representation of what is needed on each screen. As a minimum:
 - 1. The workstation/graphics shall provide full access via the Niagara platform to all underlying system modules, data, parameters, programming, etc.
 - a. The Site Graphic shall consist, as a minimum, of the menu format indicated on both the vertical and horizontal plane. If additional information is available, provide under the appropriate menu selection.
 - b. Provide links to the O&M manuals, specifications and drawings as indicated in the graphics package.
 - c. All O&M manuals shall be electronically archived, and bookmarked by section and product. Owner shall have the chance to review and request the contractor

Lenoir Youth Development Center Retro-Commissioning

Building Management System

- make final changes to the bookmarks, bookmark structure, and, bookmark names.
2. The system graphics (AHUs, zones, Boiler Plant, etc.) are representative in nature and need to be modified specific to this system.
 3. The representative Properties pages and information are a minimum that is to be provided with the ability to manipulate setpoints, limits, calibration, etc. as a minimum.
 4. Any and all other data points are to be modifiable from the block programming pages.
 5. The contractor is to coordinate with the customer (Electronics Controls Group-ECG) for access privileges. This group and Energy Management (EM) are to be provided the highest level access. There shall be no proprietary data. As a minimum:
 - a. Level 10 (highest/Administrator)
 - a) Test and balance parameters
 - b) Hysteresis
 - c) Minimum start and stops
 - d) Ramp up and ramp downs
 - b. Sequencing enables shall be at the next highest level.
 - c. Provide the owner (ECG & EM) Administrator passwords at the initial sit down to discuss the submittals and proposed graphics.
- D. Point Names and Name Tagging: Shall be provided as identified in the Input and Output points listed attached to and therefore made part of this specification. All nametagging shall comply with the Haystack protocol. See Appendix A for project Haystack nametagging details.
- E. Function Block programming standards:
1. Only Function Block programming is permissible for programming.
 2. Each "line" of block programming will be numbered to allow easy means of tracking of the logic (like a ladder diagram).
 - a. The block programming shall be divided into submodules such as:
 - a) Occupancy
 - b) Fan Control
 - c) Cooling Control
 - d) Heating Control
 - e) Damper Control
 - f) Alarm & Safety
 - g) Outside dependencies such as heating and cooling requests
 - b. Each submodule shall be clearly identified as to function and the sequence of operation provided as text to simplify referencing between the code and sequence of operation required.
 3. Connectors & Tags
 - a. Connectors shall have reference "tags" to allow that line of logic/data to support submodule programming as needed. These tags will be referenced by the ladder line number for easy tracking.
 4. PID Loop Control: Control Loops shall be PID loop controls with appropriate PID parameters to reach and maintain setpoint with minimal offset/error.
 5. Hysteresis: All thresholds/setpoints shall have hysteresis or dead band values to prevent constant resetting of setpoints up or down.
 6. Setpoint Ramp Ups/Downs: All significant changes in setpoint adjustments shall be ramped up/down to prevent wild swings in PID loop controls
- F. Trending:
1. "Standing" trends shall be provided as identified in the Graphics Package. These shall be set up "permanently" so the user does not have to create their own trends on the fly.
 2. Provide the ability to enter custom dates to access historic data and provide trends

Lenoir Youth Development Center Retro-Commissioning

Building Management System

- accordingly.
3. If available, provide a sliding bar that allows the user to simply slide the bar like a fast forward or fast reverse to access historic or current trend data.
 4. On they fly trend capability shall also be provided. The owner shall be capable of saving these custom trends for future use and not have to reenter point and other relevant information.
- G. Alarms: Alarms shall be set up as defined in the Alarms, Analysis and Energy Diagnostics tables shown in Appendix A. All alarm messages are to be populated as identified in these tables as applicable to the equipment and systems described in these documents.
- H. Initial Meeting:
- a. Provide the owner the Administrative passwords and demonstrate the owner has full access to all aspects of the system. (The Owner's Representative in this case will be NC Department of Public Safety Central Engineering representatives intimately familiar with the design guidelines and standards, and, BMS operations. As a minimum this will be either an individual from the Electronics Controls Group Team, Energy Management or both):
 - b. Describe to the satisfaction of the Owner's Representative the following
 - a) The owner has full rights and privileges to programming, graphic development, data access, etc.
 - b) Representative graphics and similarity to the graphics provided as part of this package.
 - c) Representative graphic programs documented as required above.
 - d) How the algorithm for Optimal Start and Stop will successfully be accomplished.
 - e) Representative standard trends as required by the attached graphics package, and how integrated into graphic displays.
 - f) Point-by-Point test sheets that will be used for each system type.
 - g) Training to be provided by the contractor and as outlined herein.
- I. Mid Meeting: The contractor shall meet with ECG and/or EM as integration begins to ensure the above standards continue to be met.
- J. Seasonal Changes: The night setback temperatures and Optimal Start Stop parameters will be reviewed by the contractor during the cooling, and, during the heating season to ensure the HVAC systems can recover in time for Scheduled Occupancy and energy savings can be attained. This will be demonstrated via the Standard Trends. Particular care will be paid to setbacks for the weekend conditions since the HVAC systems could be off for extended periods of time. The contractor is to discuss these changes with ECG or EM before proceeding with the review, and, before making the changes.
- K. Weather Conditions: Provide local weather conditions shall be obtained from the most local weather stations including Temperature, Humidity, Dewpoint, and rainfall.
- L. Zones shall have their own unitary control module as identified within this document.
- M. BACnet Cards: All data from equipment including but not limited to chillers, boilers, variable speed drives, and package units shall have BACnet cards installed. All data from the BACnet module shall be accessible to the customer from the graphical interface. The contractor is to coordinate with ECG or EM to discuss how the presentation of this information via the graphical interface.
- N. Analytics: In addition to the control sequences in the design documents, provide analytics for the systems and equipment in the project documents similar to those in Appendix A with

Lenoir Youth Development Center Retro-CommissioningBuilding Management System

the available existing and new sensors, meters shown in these documents to the extent possible.

3.2 Balance

- A. The VAV TCU shall also provide an air flow balancing tool.
- B. This tool shall allow the air balancer to manually control the action of the actuator including the following function: open VAV damper, close VAV damper, open all VAV dampers, and close all VAV dampers.
- C. Systems not able to provide a web based air balance tool or a portable air flow balancing interface or an Intelligent Space Sensor (ISS) capable of balancing air flow as part of the VAV TCU controller shall provide an individual full time technician during the air flow balancing process to assure full balance compliance.

3.3 Control contractor shall provide a local computer to record trends and store graphics not stored on the Jace. Contractor to run Ethernet cable in conduit to location of owner's internet access for final termination by owner.

3.4 PREPARATION

- A. Clean surfaces thoroughly prior to installation.
- B. Prepare surfaces using the methods recommended by the manufacturer for achieving the best result for the substrate under the project conditions.

3.5 GENERAL

- A. Install system and materials in accordance with manufacturer's instructions, and as detailed on the project drawing set.
- B. Line and low voltage electrical connections to control equipment shown specified or shown on the control diagrams shall be furnished and installed by the Control System Contractor in accordance with these specifications.
- C. Equipment furnished by the Mechanical Contractor that is normally wired before installation shall be furnished completely wired. Control wiring normally performed in the field will be furnished and installed by the Control System Contractor.
- D. All control devices mounted on the face of control panels shall be clearly identified as to function and system served with permanently engraved phenolic labels.
- E. Location of controllers to be approved by Owner prior to installation.

3.6 WIRING

- A. All control wiring to the control panels shall be the responsibility of the Control System Contractor. 120 VAC wiring to control panels shall be provided by Control Contractor from nearest panel with spare capacity unless otherwise noted to be by Electrical Contractor. 120 VAC surge protector to be provided and installed by Control System Contractor.
- B. All wiring shall be in accordance the National Electrical Code and any applicable local codes. All control wiring shall be installed EMT with rigid couplings. All conduit installed by controls contractor shall be blue.
- C. Excess wire shall not be looped or coiled in the controller cabinet.

Lenoir Youth Development Center Retro-Commissioning**Building Management System**

- D. All wires shall be labeled on each end with professional labeling system using label printer Brady Model BMP41 or equivalent using labels designed for wire marking. Labels shall indicate connection point on each end of wire.
- E. Incorporate electrical noise suppression techniques in relay control circuits.
- F. There shall be no drilling on the controller cabinet after the controls are mounted inside.
- G. Careful stripping of wire while inside the cabinet is required to ensure that no wire strand fragments land on circuit boards.
- H. Use manufacturer-specified wire for all network connections. LON network cable jacket shall be blue. Network cable for integration of RS-485 BACnet or Modbus devices shall have an orange jacket.
- I. All Input/Output cable shall have a yellow jacket. All output wiring shall be 18 gauge, minimum. All input wiring shall be 22 gauge minimum.
- J. Use approved optical isolation, fiber optic converters, and lightning protection when penetrating building envelope.
- K. Read installation instructions carefully. Any unavoidable deviations shall be approved by owner's rep prior to installation.

3.7 ACCEPTANCE TESTING

- A. Upon completion of the installation, the Control System Contractor shall load all system software and start-up the system. The Control System Contractor shall perform all necessary calibration, testing and de-bugging and perform all required operational checks to insure that the system is functioning in full accordance with these specifications.
- B. The Control System Contractor shall perform tests to verify proper performance of components, routines and points. Repeat tests until proper performance results are achieved. This testing shall include a point-by-point log to validate 100% of the input and output points of the DDC system operation. Sample Point-by-point test sheets to be provided at the 45 day meeting. Completed pages shall be sent to the owner as they are completed. Specifically:
 - 1. Provide a point by point test. That ensures the following occurs. Means and methods will be by the contractor for confirmation of the following:
 - a. Disconnect or short sensor as appropriate. Observe failure. Document alarm condition. Document reading on HVAC System Graphic, and, Properties page. Confirm failure mode. Upon sensor reaching status, calibrate.
 - 2. Logic testing: Describe the logic to be tested and the desired outcome. Confirm operation.
- C. System Acceptance: Satisfactory completion is when the Control System Contractor has performed successfully all the required testing to show performance compliance with the requirements of the Contract Documents to the satisfaction of the Owner's Representative. System acceptance shall be contingent upon completion and review of all corrected deficiencies.
- D. Perform commissioning test where required.

3.8 OPERATOR TRAINING

- A. During system commissioning and at such time acceptable performance of the Control

Lenoir Youth Development Center Retro-Commissioning

Building Management System

System hardware and software has been established, the Control System Contractor shall provide on-site operator instruction to the owner's operating personnel. Operator instruction shall be done during normal working hours and shall be performed by a competent representative familiar with the system hardware, software and accessories.

- B. The Control System Contractor shall provide 8 total hours of training in two 4-hour sessions for system orientation, product maintenance and troubleshooting, programming and engineering. These classes are to be spread out during the 1st year warranty period. The first class starting after final commissioning and the second class is to be in the last month of 1-year warranty period.
- C. Training shall be hands on and not the operator sitting in front of the computer while the trainee observes from behind. As a minimum:
 - 1. Trainee shall successfully and independently perform a point by point testing for at least two (2) of each type of points in the system.
 - 2. Trainee shall successfully demonstrate the ability to enter a schedule for a zone, and a group of zones at least three times.
 - 3. Trainee shall successfully be able to discuss how optimal start/stop works, night setback, hot and chilled water reset. They will also demonstrate an understanding of how the building envelope and its dynamics will impact optimal start/stop, and night setback limits.
 - 4. Contractor will create at least four scenarios where the HVAC system fails to work properly, and the trainee successfully tracks down the issue. As a minimum include:
 - a. A Valve or control point locked on.
 - b. A failed sensor.
 - c. Heating system failure
 - d. Cooling system failure.
- D. Control System Contractor shall select the DDC controller platform currently used by NCDPS and with NCDPS Central Engineering Electronics Group having technical personnel certified on the selected platform. Control System Contractor will be required to provide manufacturer certified training to 4 NCDPS employees if no employees are currently certified on the selected platform for this job.

3.9 WARRANTY PERIOD SERVICES

- A. Equipment, materials and workmanship incorporated into the work shall be warranted for a period of two years from the time of system acceptance (not startup).
- B. Within this period, upon notice by the Owner, any defects in the BMS due to faulty materials, methods of installation or workmanship shall be promptly repaired or replaced by the Control System Contractor at no expense to the Owner.
- C. Maintenance of Computer Software Programs: The Control System Contractor shall maintain all software during the standard first year warranty period. In addition, all factory or sub-vendor upgrades to software during the first year warranty period shall be added to the systems, when they become available, at no additional cost. In addition to first year standard warranty, software provided by Control System Contractor shall come with a Software Maintenance Agreement as defined in section 1.3. All NAC and N4 supervisors are included in this coverage.
- D. Maintenance of Control Hardware: The Control System Contractor shall inspect, repair, replace, adjust, and calibrate, as required, the controllers, control devices and associated peripheral units during the warranty period. The Control System Contractor shall then furnish a report describing the status of the equipment, problem areas (if any) noticed during

Lenoir Youth Development Center Retro-Commissioning**Building Management System**

service work, and description of the corrective actions taken. The report shall clearly certify that all hardware is functioning correctly.

- E. Service Period: Calls for service by the Owner shall be honored within 24 hours and are not to be considered as part of routine maintenance.
- F. Service Documentation: A copy of the service report associated with each owner-initiated service call shall be provided to the owner.

3.10 WARRANTY ACCESS

- A. The Owner shall grant to the Control System Contractor reasonable access to the BMS during the warranty period. Remote access to the BMS (for the purpose of diagnostics and troubleshooting, via the Internet, during the warranty period) will be allowed.

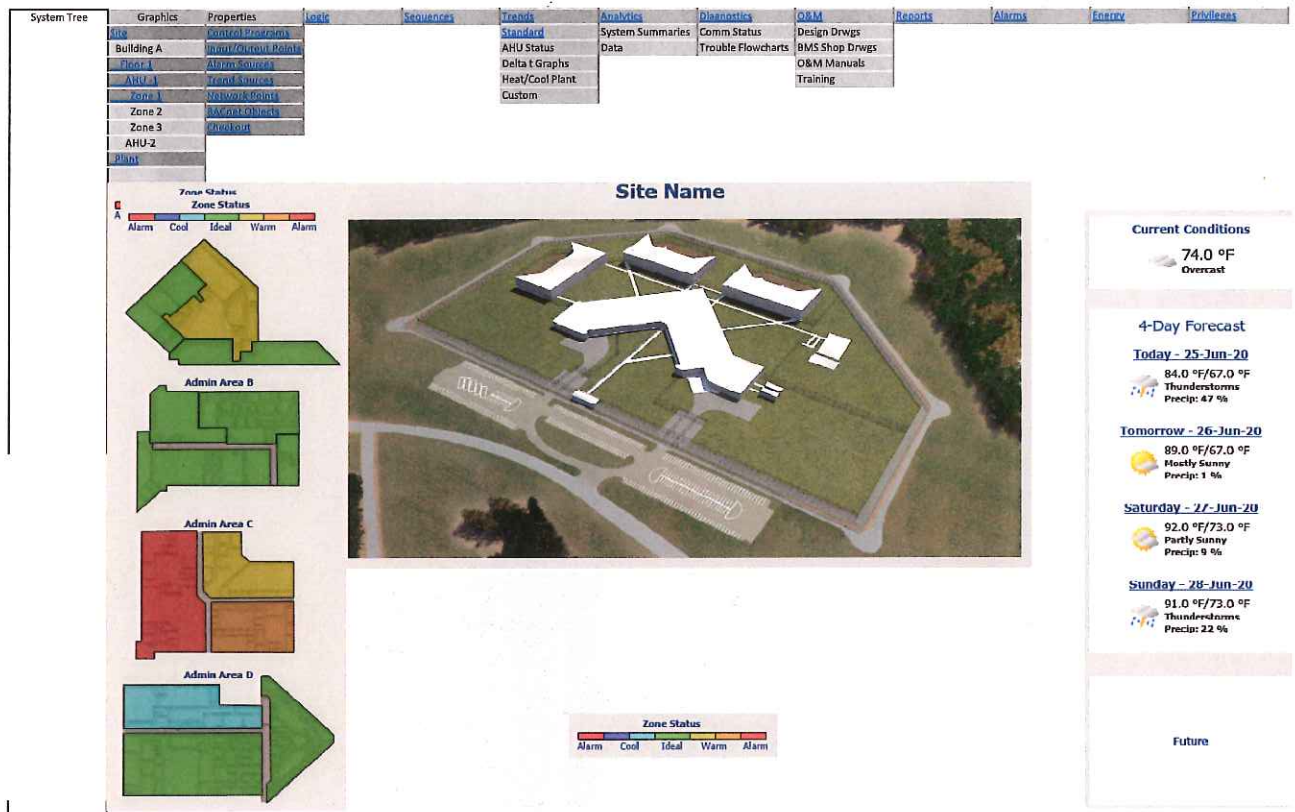
3.11 OPERATION & MAINTENANCE MANUALS

- A. See Division 1 for requirements. O&M manuals shall include the following elements, as a minimum and include all requirements as identified in Section 1.6 Submittals:
- B. As a minimum, shop drawings shall contain:
 - 1. A table of contents.
 - 2. Equipment schedules.
 - 3. Valve and damper schedules when applicable. Valve schedules shall include GPM, valve size, calculated Cv, valve Cv, pressure drop, close-off pressure, configuration (2-way or 3-way), and valve actuator data.
 - 4. VAV box schedule. VAV box schedule shall include box size, K-Factor, and flow setpoints.
 - 5. As-built schematic diagrams of all controlled equipment.
 - 6. Final sequences of operation for all controlled equipment.
 - 7. As-built controller wiring diagrams, including terminal number identification for all control wiring.
 - 8. As-built wiring details for all field devices.
 - 9. As-built network architecture diagram showing a high-level overview of the installed system.
 - 10. As-built control system bus layout depicted on building floorplans.
 - 11. As-built control panel layout diagrams depicting all panel mounted components.
 - 12. Completed Performance Verification sheets.
 - 13. Completed Controller Checkout/Calibration Sheets.
 - 14. Manufacturer's data sheets for all installed components.

3.12 PROTECTION

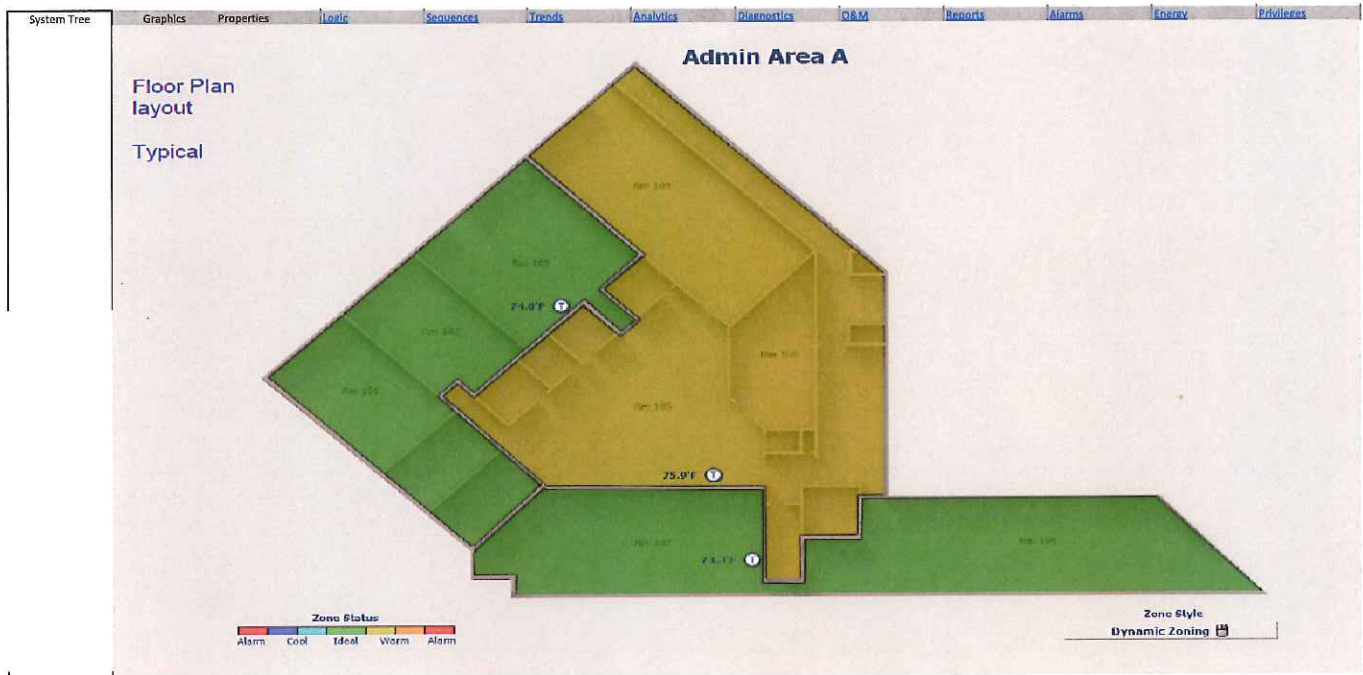
- A. Protect installed products until completion of project.
- B. Touch-up, repair or replace damaged products before Substantial Completion.

END OF SECTION 230900

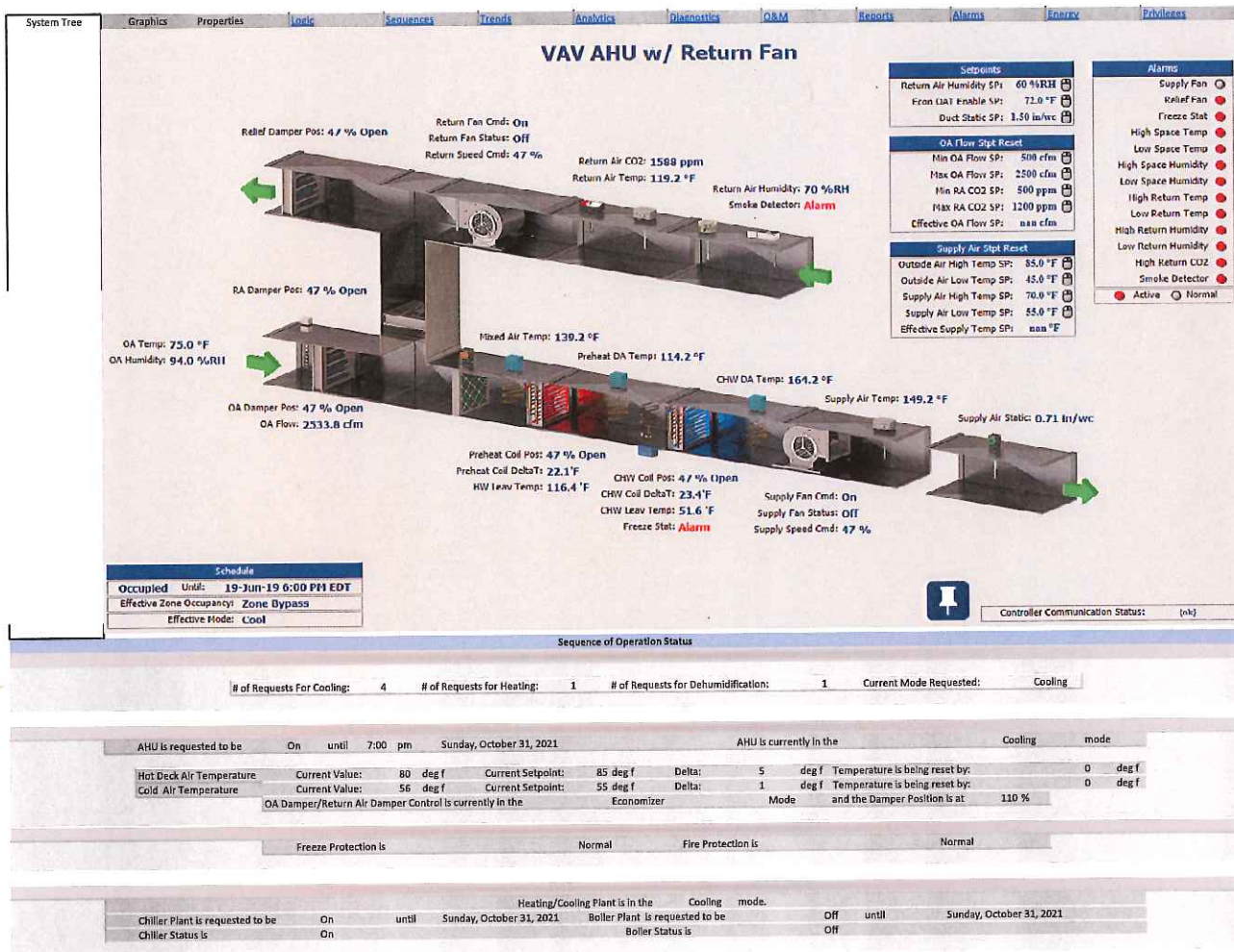


Notes: All data and graphics are representative in nature.

All zones are to be displayed with dynamic temperatures on this page. Surround the site graphic: If needed while leaving the weather data to the right intact. If necessary shrink the site graphic to accommodate the zones. Then, shrink the zones



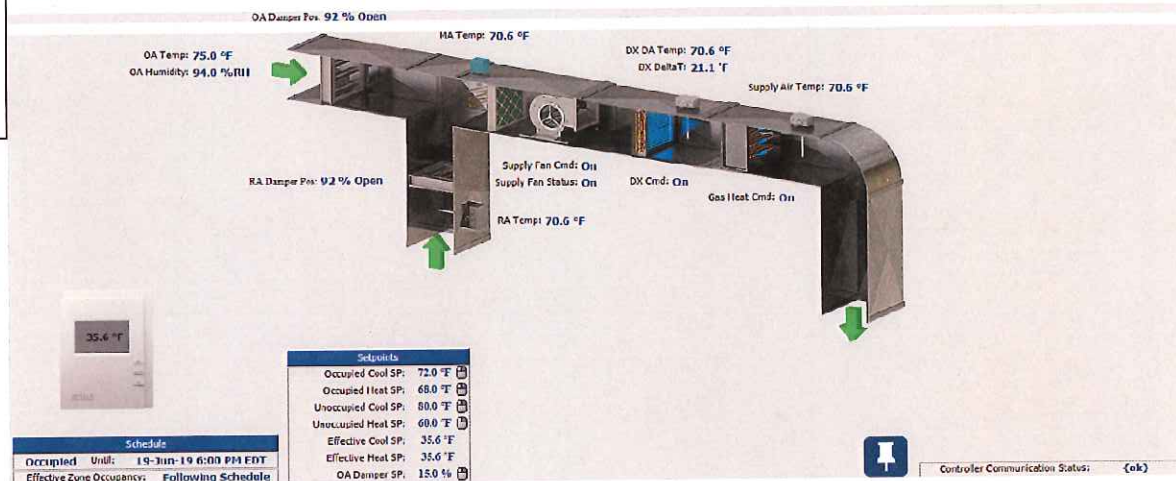
All data is representative in nature. As an example the AHU shown is a VAV AHU with return fan. The data reflects a multizone system. Modify as appropriate to accurately reflect the operating status of the system. The table data currently shown on the graphic is to be moved under the Sequence of Operation Status and appropriately formatted similarly to above. Do not duplicate data. This graphic will be corrected in future versions



All data is representative in nature. As an example the AHU shown is a VAV AHU with return fan. The data reflects a multizone system. Modify as appropriate to accurately reflect the operating status of the system. The table data currently shown on the graphic is to be moved under the Sequence of Operation Status and appropriately formatted similarly to above. Do not duplicate data. This graphic will be corrected in future versions

RTU Gas Pack

Alarms	
Supply Fan	<input type="radio"/>
High Space Temp	<input type="radio"/>
Low Space Temp	<input type="radio"/>
<input checked="" type="radio"/> Active	<input type="radio"/> Normal



Sequence of Operation Status

Zone is currently in Zone Comfort is currently in the		Occupied Cooling	Mode Mode	until 7:00 pm	Sunday, October 31, 2021	
Current Zone Heating Temperature Setpoint is Delta:	71 deg f 1 deg f	Actual Temperature: 76 deg f	Current Zone Cooling Temperature Setpoint is Delta:	75 deg f 1 deg f	Actual Temperature: 76 deg f	
Adjustments to Cooling Setpoint:	-1 deg f by Occupant Reset	1 deg f by Low Occupancy	1 deg f by Demand Limiting	0 deg f by Night Setback	Total Adjustment	1 deg f
Adjustments to Heating Setpoint:	1 deg f by Occupant Reset	1 deg f by Low Occupancy	1 deg f by Demand Limiting	0 deg f by Night Setback	Total Adjustment	1 deg f
Zone Temperature Controlled by:	Zone Space Sensor	Zone Humidity Controlled by:	Zone Space Sensor	Zone CO ₂ Controlled by:	Zone Space Sensor	
AHU is requested to be	On	until 7:00 pm	Sunday, October 31, 2021		AHU is currently in the	Cooling mode
Supply Air Temperature	Current Value: OA Damper/Return Air Damper Control is currently in the	56 deg f	Current Setpoint: Economizer	55 deg f	Delta: Mode	1 deg f and the Damper Position is at
						0 deg f 110 %
	Freeze Protection is	Normal	Fire Protection is	Normal		

All data is representative in nature. Modify as appropriate to accurately reflect the operating status of the system. The table data currently shown on the graphic is to be moved under the Sequence of Operation Status and appropriately formatted similarly to above. Do not duplicate data. This graphic will be corrected in future versions

System Tree

Graphics
Properties
Logic
Sequences
Trends
Analysis
Diagnostics
O&M
Reports
Alarms
Security
Privacy

Zone Temperature Control

Enable Return Air Temperature in lieu of Space Temperature for Zone Setpoint Control once Occupied Schedule is active (recommended):
Yes

Enable Return Air Humidity in lieu of Space Humidity for Zone Setpoint Control once Occupied Schedule is active (recommended):
Yes

Enable Return Air CO₂ in lieu of Space CO₂ for Zone Setpoint Control once Occupied Schedule is active (recommended):
Yes

PW Le Notes

Zone Color Band

65

66

67

68

69

70

74

75

76

77

78

79

80

81

Temperature Setpoints

Heating Setpoint:
70 deg f

Deadband:
4 deg f

Cooling Setpoint:
70 deg f

Setpoint Adjustment +/-:
2 deg f

Unoccupied Heating Setpoint:
65 deg f

Unoccupied Cooling Setpoint:
82 deg f

Zone Modes

Morning Warmup Mode Enable:
Yes

Morning Cooldown Mode Enable:
Yes

Low Occupancy Mode Enable:
Yes

Adjust Cooling Setpoint by +/-:
1 deg f when in low occupancy mode

Adjust Heating Setpoint by +/-:
1 deg f when in low occupancy mode

CO₂ Control Enable:
Yes

Setpoint:
1000 ppm

Filter Check Enable:
Yes

Send message to check filter status once operational hours exceed:
1000 hrs

Reset:

Dehumidification Control

Enable Dehumidification Mode:
Yes

Enter Dehumidification Mode whenever the Return Air or Room Air Humidity exceeds:
57 % rh

Demand Limiting

Demand Level 1:
Expand Setpoints +/-:
1 deg f on Demand Level 1.

Demand Level 2:
Expand Setpoints +/-:
1 deg f on Demand Level 2.

Demand Level 3:
Expand Setpoints +/-:
1 deg f on Demand Level 3

Outside Air Lockout and Hot Water Supply Reset

Enable Outside Air Lockout for Heating (not recommended):
No

When OAT is >
60 deg f

Enable Initial HWS Setpoint Based on OAT:
Yes

Reset Schedule

OAT
HWS

60
140

30
180

Supply Air Temperature Reset

Adjust Supply Air Temperature Setpoint down
1.5 deg f for every
1 Cooling Requests received
and up
1 deg f when
0
Cooling Requests received.

Adjust Supply Air Temperature Setpoint up
2.5 deg f for every
1 Heating Requests received
and down
1 deg f when
0
Heating Requests received.

Chilled Water Supply Temperature Reset

Adjust Chilled Water Temperature Setpoint down
1 deg f for every
1 Cooling Requests received
and up
0.5 deg f when
0
Cooling Requests received.

Hot Water Supply Temperature Reset

Adjust Hot Water Supply Temperature Setpoint down
1.5 deg f for every
1 Cooling Requests received
and up
1 deg f when
0
Cooling Requests received.

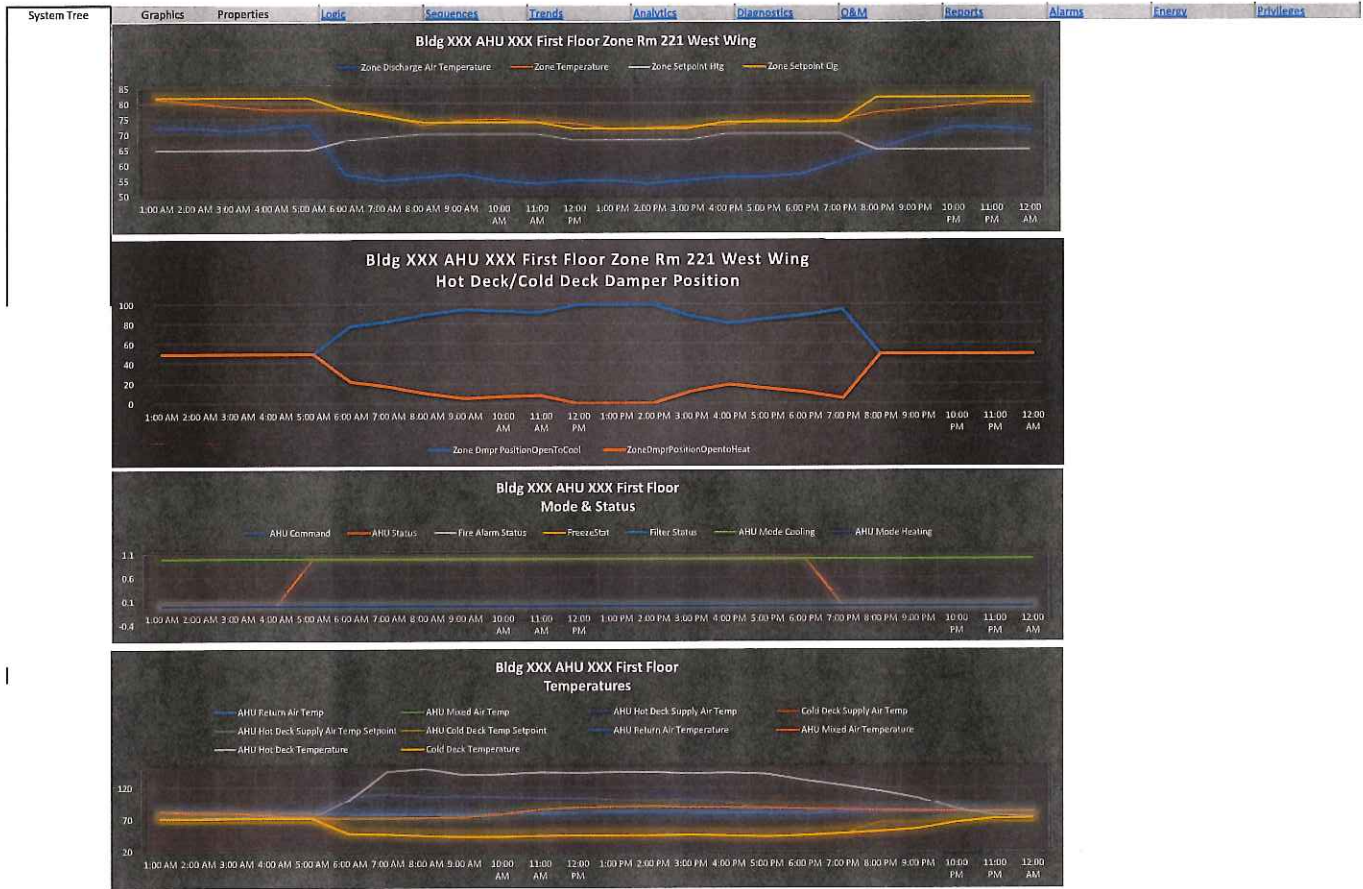
Minimum Setpoint

55 deg f
65 deg f
45 deg f
140 deg f

Maximum Setpoint

65 deg f
55 deg f
52 deg f
180 deg f

All data is representative in nature. As an example the properties data above is for a multizone control. Ensure all properties are listed. Ensure proper access levels are assigned as outlined in the specifications.



All data is representative in nature. The Controls Engineer needs to determine relevant points to permanently trend.

HAYSTACK NAME TAGGING

Login Disabled

[Home](#)
[Docs](#)
[Examples](#)
[Downloads](#)
[About](#)
[Marketing →](#)
[Index](#) » [tags](#)

All tag terms listed alphabetically

absorption	Cooling process using energy from heat source such as hot water
ac	Relating to alternating current electricity
accumulate	Accumulate the tag's value during inheritance and defx
active	Working, operative, effective
actuator	Equipment to move or control a mechanism
ahu	Air Handling Unit
ahuZoneDelivery	AHU delivery method of conditioned air to the zone
ahuZoneDeliveryType	AHU delivery method of conditioned air to the zone
air	The mixture of gases which surrounds the earth
airCooling	Cooling by dissipating heat into the surrounding air
airHandlingEquip	HVAC equipment that conditions and delivers air via one or more fans
airQuality	Measurement of contaminants in the air
airRef	Air flows from the the referent to this entity
airTerminalUnit	Equipment in air distribution systems which terminate at the space
airVolumeAdjustability	Ability of air handling equip to adjust volume of air flow
airVolumeAdjustabilityType	Ability of air handling equip to adjust volume of air flow
angle	Measurement of the relative difference in direction between two vectors or phasors
apparent	Perceived quantity
area	Area of a shape or floor space
association	Associations model ontological relationships between definitions
atmospheric	Related to the atmosphere of the earth
avg	Average
bacnet	ASHRAE building automation and control protocol
barometric	Relating atmospheric pressure
baseUri	Base URI for normalizing relative URIs
battery	Equipment used to store electric energy
blowdown	Removal from container or pipe
blowdownWaterRef	Blowdown water flows from the the referent to this entity
bluetooth	Short range wireless communication protocol
boiler	Equipment to generate hot water or steam for heating
bool	Boolean value <code>true</code> or <code>false</code>
bypass	Pipe used to bypass an equipment

cav	Constant air volume terminal unit
centrifugal	Compression via a continuous flow of fluid through an impeller
children	List of prototypes contained by this entity
childrenFlatten	List of aspects to flatten into children prototypes
chilled	Substance is cooled using cooling process
chilledBeam	Conditions a space using a heat exchanger integrated into the ceiling
chilledBeamZone	AHU supplies air to chilled beam terminal units
chilledWaterCooling	Cooling using transfer of heat to chilled water
chilledWaterRef	Chilled water flows from the the referent to this entity
chiller	Equipment to remove heat from a liquid
chillerMechanism	Primary mechanism of chiller
chillerMechanismType	Primary mechanism of chiller
choice	Choice specifies an exclusive marker selection
circ	Pipe used to circulate fluid through an equipment or system
cloudage	Percentage of sky obscured by clouds
cmd	Point is a command, actuator, AO/BO
co	Carbon monoxide level
co2	Carbon dioxide level
coap	Constrained Application Protocol
coil	Heat exchanger used to heat or cool air
coldDeck	Duct carries air for cooling
computed	Indicates a definition which is computed
condensate	Liquid phase produced by the condensation of steam or other gas
condensateRef	Condensate flows from the the referent to this entity
condenser	Device or related to process of condensation
condenserClosedLoop	Working fluid is kept separate from fluid used for heat transfer into the atmosphere
condenserCooling	Removal of heat through the process of water condensation
condenserLoop	Open or closed loop for condenser working fluid
condenserLoopType	Open or closed loop for condenser working fluid
condenserOpenLoop	Uses working fluid itself for evaporation into the atmosphere
condenserWaterRef	Condenser water flows from the the referent to this entity
conduit	Duct, pipe, or cable to convey a substance or phenomenon
constantAirVolume	Delivers a constant volume of air flow
containedBy	The entity is logically contained by the referent
contains	Entities logically contained by this entity
controller	Microprocessor based device used in a control system
controls	Associated with the control system for an industrial process
conveys	Equipment conveys a substance or phenomenon
cool	Point used to command equipment cooling
cooling	Cooling mode or process

coolingCapacity	Measurement of a chiller ability to remove heat measured
coolingCoil	Coil used to cool air
coolingOnly	Device without heating
coolingProcess	Processed used to cool a substance
coolingProcessType	Processed used to cool a substance
coolingTower	Equipment to transfer waste heat into the atmosphere
cools	Equipment removes heat from a substance
coord	Geographic coordinate in latitude/longitude in decimal degrees
crac	Computer Room Air Conditioner
cur	Supports current value
curErr	Error description when curStatus indicates error condition
curStatus	Status of point's current value reading
curVal	Current value of a point
current	Movement of fluid or electricity
dali	Digital Addressable Lighting Interface protocol for lighting
damper	Damper equipment or control point
dataCenter	Space used to house computer and networking gear
date	ISO 8601 date as year, month, day
dateTime	ISO 8601 timestamp followed by timezone identifier
daytime	Time between sunrise and sunset
dc	Relating to direct current electricity
def	Create a new definition bound to the given symbol
defx	Extends the given definition with additional meta tags
dehumidifies	Equipment removes moisture from air to decrease humidity
delta	Differential of fluid between entering and leaving sensors
demand	Rate required for a process
depends	List of this library's dependencies
dessicantDehumidifier	Decreases humidity from air using a substance which absorbs moisture
device	Microprocessor based hardware device
dewPoint	Dew point temperature at which water vapor will form dew
dict	Map of name/value tag pairs
directZone	AHU supplies air directly to the zone
direction	Compass direction measured in degrees
dis	Display name for an entity
discharge	Duct for air leaving an equipment
diverting	Three way valve which inputs one pipe and diverts between two output pipes
doas	Dedicated Outside Air System
doc	Documentation in simplified flavor of markdown
docSection	This tag is documented with its own section
docTaxonomy	Generate a taxonomy tree for this term in the documentation index

domestic	For human use
domesticWaterRef	Domestic water flows from the the referent to this entity
drive	Related to the drive control of a motor
dualDuct	Two ducts
duct	Conduit used to convey air for HVAC
ductArea	Config point on a vav for duct area measured in ft ² or m ²
ductConfig	Ductwork configuration
ductConfigType	Ductwork configuration
ductDeck	Cold, hot, or neutral deck
ductDeckType	Cold, hot, or neutral deck
ductSection	Equipment section of ductwork
ductSectionType	Equipment section of ductwork
duration	Number with a unit of time
dxCooling	Cooling using direct expansion of a refrigerant vapor
dxHeating	Heating using direct expansion of a refrigerant vapor
economizer	Duct to access fresh outside air only for economizing, not ventilation
economizing	Energy reduction mode which augments heating/cooling with outside air
effective	Current control setpoint in effect taking into account other factors
efficiency	Efficiency point of a chiller measured in "COP" or "kW/ton"
elec	Associated with electricity, electric charge
elecHeating	Heating by the conversion of electrical energy
elecRef	Electricity flows from the the referent to this entity
elevator	Enclosure used to move people between floors
enable	Secondary on/off point of an equip especially used with a vfd
energy	Measure of ability to do work
entering	Pipe conveys fluid into an equipment
entity	Top-level dicts with a unique identifier
enum	Defines an enumeration of string key names
equip	Equipment asset
equipFunction	Models one of the primary functions of an equipment type
equipRef	Reference to equip which contains this entity
escalator	Moving staircase used to move people between floors
evaporator	Mechanism used to convert a refrigerant from its liquid to gaseous state
exhaust	Duct used to expel air back outside
export	Supplied out of a system
faceBypass	Point of an ahu indicating air flow is by-passing the heating/cooling coils
fan	Fan equipment or control point
fanPowered	Device with a fan
fcu	Fan Coil Unit
feature	Feature namespace of definitions formatted as <code>feature:name</code>

feelsLike	Apparent temperature perceived when considering humidity, wind chill, and heat index
fileExt	Filename extension such as "csv"
filetype	File format type definition
filter	Related to an air or fluid filter
filterStr	Haystack filter string
floor	Storey of a building
floorNum	Unitless integer indicating the floor's distance from ground level
flow	Measure of volumetric flow of fluid
flue	Duct for exhausting combustion
fluid	Liquid or gas
flux	Measurement through a given surface
freezeStat	A boolean point of an ahu indicating a freezing condition
freq	Occurrences per unit time
ftp	File Transfer Protocol
fuelOil	Petroleum based oil burned for energy
fuelOilHeating	Heating by the combustion of fuel oil
fuelOilRef	Fuel oil flows from the the referent to this entity
fumeHood	Ventilation equipment to limit exposure to hazardous fumes
gas	Substance with neither definite volume nor shape
gasoline	Petroleum derived liquid used as a fuel source
gasolineRef	Gasoline flows from the the referent to this entity
geoAddr	Free form street address
geoCity	Geographic city or locality name
geoCoord	Geographic coordinate as C(latitude,longitude)
geoCountry	Geographic country as ISO 3166-1 two letter code
geoCounty	Geographic subdivision of US state
geoElevation	Elevation above sea-level of the location
geoPlace	Geographic place
geoPostalCode	Geographic postal code
geoState	State or province name
geoStreet	Geographic street address and name
grid	Two dimension table of columns and rows
ground	Related to the surface of the earth
haystack	Haystack HTTP protocol for exchanging tagged data
header	Pipe used as central connection or manifold for other piping runs
heat	Point used to command equipment heating
heatExchanger	Equipment to transfer heat between two working fluids
heatPump	Heat pump
heatWheel	Boolean point indicating command state of AHU's heat wheel
heating	Heating mode or process

heatingCoil	Coil used to heat air
heatingProcess	Processed used to heat a substance
heatingProcessType	Processed used to heat a substance
heats	Equipment heats a substance
his	Supports historization of data
hisErr	Error description when hisStatus indicates error condition
hisMode	Indicates the way that history data is collected for a point
hisStatus	Status of point's history collection or synchronization
hisTotalized	Indicates values which are a continuous stream of totalization
hot	Having high degree of heat
hotDeck	Duct carries air for heating
hotWaterHeating	Heating using energy of hot water
hotWaterRef	Hot water flows from the the referent to this entity
http	Hypertext Transfer Protocol which is foundation of the web
humidifier	Adding moisture to air
humidifies	Equipment adds moisture to air to increase humidity
humidity	Percent relative humidity
hvac	Heating, ventilation, and air conditioning
hvacZonePoints	Entity with logical grouping of zone HVAC air points
ice	Water in its solid form
id	Defines the unique identifier of an entity in system using a Ref value type
illuminance	Luminous flux hitting the inside of the sphere at a specific point
imap	Internet Message Access Protocol for retrieving email
imbalance	Lacking balance
import	Received into a system
inlet	Duct with air entering an equipment
input	Entity inputs a substance which flows from another entity
inputs	The entity inputs a substance from the referent
int	Unitless integer number
intensity	Measure of an electromagnetic field
irradiance	Energy received at a surface by area
is	Defines one or more supertypes of a subtyping relationship
isolation	Actuator used to isolate an equipment from a pipe or ductwork system
kind	Kind name used before Haystack 4.0 to identity data types
knx	KNX protocol commonly used for lighting systems
leaving	Pipe conveys fluid out of an equipment
level	Range from 0% to 100%
lib	Library module of symbolic definitions
light	Electromagnetic radiation in the visible spectrum
lighting	Systems associated with illumination in the built environment

lightingZonePoints	Entity with logical grouping lighting points
liquid	Substance with definite volume but takes the shape of its container
list	Ordered list of zero or more values
load	Chiller point to command or measure the chiller's load as a percentage from "0%" to "100%"
luminaire	Light fixture using electricity to provide illumination
luminance	Energy of light in a given direction
luminous	Relating to light as perceived by the eye
magnitude	Size or extent
makeup	Restore soemthing missed or lost
makeupWaterRef	Makeup water flows from the the referent to this entity
mandatory	Requires that the marker be applied to dicts which use the marker's subtypes
marker	Marker labels a dict with typing information
mau	Makeup Air Unit
maxVal	Inclusive maximum for a numeric value
meter	Equipment to meter a substance or phenomenon
meterScope	Classifies a meter as a main site meter or submeter
meterScopeType	Classifies a meter as a main site meter or submeter
mime	Mime type formatted as type/subtype
minVal	Inclusive minimum for a numeric value
mixed	Duct where fresh outside air and return air is mixed together
mixing	Three way valve which inputs two pipes and outputs a mixture between the two to a single output pipe
mobile	Relating to mobile phones, handheld computers, and similar technology
modbus	Register based communication protocol used with industrial devices
motor	Equipment that converts electrical energy into mechanical energy
moves	Equipment moves a substance
movingWalkway	Conveyor to move people across a horizontal or inclined plane
mqtt	Message Queuing Telemetry Transport publish/subscribe protocol
multiZone	AHU discharge air is split into a duct per zone
na	Not available used to indicate invalid or missing data
naturalGas	Fossil fuel energy source consisting largely of methane and other hydrocarbons
naturalGasHeating	Heating by the combustion of natural gas
naturalGasRef	Natural gas flows from the the referent to this entity
net	Difference between import and export
network	Logical communications network between two or more devices
networking	Related to data communication networks
neutralDeck	Duct carries air which by-passes both heating and cooling coils
notInherited	Marker applied to a def to indicate that is not inherited into subtype definitions
number	Integer or floating point numbers annotated with an optional unit
obix	XML based Open Building Information eXchange protocol

occ	Occupied mode of a space
occupancy	Number of occupants in a space
occupants	People who use the built environment
occupied	Setpoint or sensor indicating occupancy of a space
of	Expected value type of a collection, reference, or choice
openEnum	Apply to str enum tags where the enumeration range is open ended
output	Entity outputs a substance with flows to other entities
outputs	The entity outputs a substance to the referent
outside	Duct to access fresh outside air for both ventilation and economizer
panel	Enclosure for electrical and control equipment
parallel	Circuit with multiple paths of flow
perimeterHeat	Auxiliary heating points associated with a vav
pf	Electrical power factor
phase	Phase measurement in a three-phase electrical system
phenomenon	Aspect of scientific interest with measurable quantities
phone	Telephone used for voice telecommunication
pipe	Conduit used to convey a fluid
pipeSection	Equipment section of piping
pipeSectionType	Equipment section of piping
plant	Central plant used to generate a substance for a process
plantLoop	Plant piping loop
plantLoopType	Plant piping loop
plantPrimaryLoop	Pipework which circulates within the central plant
plantSecondaryLoop	Pipework which circulates between the central plant and building
plantTertiaryLoop	Pipework which circulates within the building
pm10	Particulate Matter 10
pm25	Particulate Matter 2.5
point	Data point such as a sensor or actuator
pointFunction	Classifies the point as a sensor, command, or setpoint
pointFunctionType	Classifies the point as a sensor, command, or setpoint
pointGroup	Grouping of children points used by spaces and equipment
pointQuantity	Quantity the point senses or controls
pointSubject	What the point senses or controls
pop3	Post Office Protocol version 3 for retrieving email
power	Energy consumed per unit time
precipitation	Amount of atmospheric water vapor fallen including rain, sleet, snow, and hail
prefUnit	Defines a preferred unit to be used with a quantity
pressure	Measure of force applied
pressureDependent	VAV damper modulates to control space temp
pressureIndependent	VAV damper or a control valve that modulates to maintain desired flow setpoint

primaryFunction	Primary function of building as US Energy Star key
process	Industrial or HVAC process
produces	Equipment produces a substance or phenomenon
protocol	Communication protocol used for devices on a network
pump	Pump equipment or control point
quality	Quantity measured against standard metric
quantities	Quantities used to measure this phenomenon
quantity	Measurable property of a substance or phenomenon
quantityOf	Associates quantity as measurement of a phenomenon
rack	Enclosure or chassis used to mount computer and networking gear
radiantEquip	HVAC equipment that conditions a space without forced air
radiantFloor	Heats a space using pipes or cables embedded beneath floor
radiator	Heats a space using exposed pipes or coils
reactive	Relating to reactance
reciprocal	Piston compressor driven by a crankshaft
reciprocalOf	Specifies the inverse of an association or relationships
ref	Reference to an entity
refrig	Fluid used in refrigeration and heat exchange
refrigRef	Refrigerant flows from the the referent to this entity
regulates	Equipment regulates the flow of substance or phenomenon
reheat	Command point for reheats process
reheats	Equipment heats a substance previously cooled or heated
relationship	Ref tags used to model entity-to-entity relationships
remove	Singleton for remove operation
return	Duct returning air back to equipment
roof	Envelope covering the top of a building
room	Enclosed room of a building
rotaryScrew	Rotary screw compression
router	Device used to route data packets
rtu	Roof Top Unit
run	Primary on/off point of an equip especially used with a vfd
scalar	Scalar is an atomic value kind
sensor	Point is a sensor, input, AI/BI
series	Circuit with single path of flow
server	General purpose computer
singleDuct	One single duct
site	Site is a geographic location of the built environment
siteMeter	Main meter for the associated site
siteRef	Reference to site which contains the entity
smtp	Simple Mail Transfer Protocol for sending email

snmp	Simple Network Management Protocol for managing IP devices
solar	Relating to energy from the sun
solid	Substance with definite shape and volume
sox	Sedona Framework UDP based communication protocol
sp	Point is a setpoint, soft point, internal control variable, schedule
space	Space is a three-dimensional volume in the built environment
spaceRef	Reference to space which contains this entity
speed	Distance per unit time
stage	Stage number of staged equipment operation such as coil or pump
standby	Readiness mode of a space
state	Software, hardware, or process control status
stateQuantity	What is sensed or controlled of software, hardware, or process state
steam	Water in its gas form
steamHeating	Heating using energy of steam
steamRef	Steam flows from the the referent to this entity
stores	Equipment stores a substance or phenomenon
str	Unicode string of characters
submeter	Submeters measure usage of a sub-system or equipment within a site
submeterOf	Reference to parent meter which is immediately upstream of this meter
substance	Matter in one the three states solid, liquid, or gas
subterranean	Below the surface of the earth
switch	Device for toggling state or routing data
symbol	Symbol to a def
tablet	Mobile device with touch screen for user input
tagOn	This tag is used on the given entity
tags	Tags used with this entity
tank	Tank used to store a substance for temporary holding
temp	Temperature - measure of hot and cold
thd	Total harmonic distortion
thermal	Related to energy of heat
thermostat	Senses and controls temperature of space in HVAC system
thread	Low power wireless IoT protocol
time	ISO 8601 time as hour, minute, seconds
total	Complete or absolute
transient	Indicates a value tag which should not be persisted
transitive	This marker is applied to a relationship to indicate it is transitive
tripleDuct	Three ducts
tvoc	Total volatile organic compound (TVOC)
tz	Timezone identifier from standard timezone database
unit	Unit identifier from standard unit database

unitVent	Unit Ventilator
unocc	Unoccupied mode of a space
uri	Unverisal resource identifier
val	Data value type
valve	Valve equipment or control point
variableAirVolume	Delivers a variable volume of air flow
vav	Variable air volume terminal unit
vavAirCircuit	How does the VAV pull in air
vavAirCircuitType	How does the VAV pull in air
vavMode	Standardized vav operational mode enumeration
vavModulation	How does VAV modulate the temp based on duct pressure
vavModulationType	How does VAV modulate the temp based on duct pressure
vavZone	AHU supplies air to VAV terminal units
ventilates	Equipment brings fresh outside air into a space
ventilation	Duct to access fresh outside air only for ventilation, not economizing
version	Version string formatted as decimal integers separated by a dot
verticalTransport	Equipment to move humans and materials
vfd	Motor with variable frequency drive
visibility	Distance at which light can be clearly discerned
volt	Electrical voltage, potential difference
volume	Three dimensional space occupied by a substance
water	Water in its liquid form
waterCooling	Cooling using transfer of heat to water which is not explicitly chilled
weather	Associated with atmospheric air or phenomenon
weatherCond	Enumeration of weather conditions
weatherRef	Reference to weather station for to use this entity
weatherStation	Logical weather station and its measurement points
wetBulb	Wet bulb air temperature
wikipedia	Hyperlink to the subject's page on Wikipedia
wind	Flow of air on surface of the Earth
wire	Cabling used to convey electricity or data
writable	Supports writing data
writeErr	Error description when writeStatus indicates error condition
writeLevel	Current priority level for writeVal as number between 1 and 17
writeStatus	Current status of a writable point output
writeVal	Current desired value to write to output
xstr	Extended string - type name and string value encoding
yearBuilt	Original year of construction as four digit year such as 1980
zigbee	Low power wireless communication protocol for home automation
zone	Related to spaces from a system perspective



[Home](#) [Docs](#) [Downloads](#) [About](#)

All content licensed under the [AFL 3.0](#)

[Login](#) • [Signup](#)[HOME](#) [DOCS](#) [TAGS](#) [FORUM](#) [WG](#) [DOWNLOADS](#) [MARKETING](#) [HAYSTACK4](#)

TOC

- 1 [Intro](#)
- 2 [TagModel](#)
- 3 [Structure](#)
- 4 [TimeZones](#)
- 5 [Units](#)
- 6 [Grids](#)
- 7 [Filters](#)
- 8 [Zinc](#)
- 9 [Json](#)
- 10 [Trio](#)
- 11 [Csv](#)
- 12 [Rest](#)
- 13 [Ops](#)
- 14 [Auth](#)
- 15 [VFDs](#)
- 16 [Networks](#)
- 17 [Energy](#)
- 18 [Zones](#)
- 19 [AHUs](#)
- 20 [VAVs](#)
- 21 [UnitaryEquips](#)
- 22 [Chillers](#)
- 23 [Boilers](#)
- 24 [Tanks](#)
- 25 **[ElecPanels](#)**
 - 25.1 [Overview](#)
 - 25.2 [Elec Panel](#)
 - 25.3 [Circuit](#)
- 26 [Lighting](#)
- 27 [Builds](#)
- 28 [Bacnet](#)
- 29 [ChangeLog](#)
- 30 [License](#)

[TOC](#)

- 1 [Intro](#)
- 2 [TagModel](#)
- 3 [Structure](#)
- 4 [TimeZones](#)
- 5 [Units](#)
- 6 [Grids](#)
- 7 [Filters](#)
- 8 [Zinc](#)
- 9 [Json](#)
- 10 [Trio](#)
- 11 [Csv](#)
- 12 [Rest](#)
- 13 [Ops](#)
- 14 [Auth](#)
- 15 [VFDs](#)
- 16 [Networks](#)
- 17 [Energy](#)
- 18 [Zones](#)
- 19 [AHUs](#)
- 20 [VAVs](#)
- 21 [UnitaryEquips](#)
- 22 [Chillers](#)
- 23 [Boilers](#)
 - 23.1 [Overview](#)
 - 23.2 [Hot Water Plants](#)
 - 23.3 [Steam Plants](#)
 - 23.4 [Boilers](#)
 - 23.5 [Heat Exchangers](#)
- 24 [Tanks](#)
- 25 [ElecPanels](#)
- 26 [Lighting](#)
- 27 [Builds](#)
- 28 [Bacnet](#)
- 29 [ChangeLog](#)
- 30 [License](#)

[◀ Chillers](#)[Tanks ▶](#)

23 Boilers

23.1 Overview

We model heating plants based on their output:

- [Hot Water Plants](#)
- [Steam Plants](#)

Within a plant is its system of equipment:

- [Boilers](#)
- [Heat exchangers](#)
- [Storage tanks](#)

Heating plants share the following terminology with chilled water plants:

- [primaryLoop](#): pipework within the plant
- [secondaryLoop](#): pipework from the plant to the building

23.2 Hot Water Plants

The [hotWaterPlant](#) tag is used to model the plant and its system of equipment to generate hot water.

Plant level points:

- [hot water leaving temp sensor](#)
- [hot water leaving temp sp](#)
- [hot water entering temp sensor](#)
- [hot water leaving flow sensor](#)
- [hot water leaving pressure sensor](#)
- [hot water entering flow sensor](#)
- [hot water entering pressure sensor](#)
- [hot water delta pressure sensor](#)
- [hot water delta flow sensor](#)
- [hot water delta temp sensor](#)
- [hot water bypass valve cmd](#)
- [hot water mixing valve cmd](#)
- [makeup water flow sensor](#)
- [outside air damper cmd](#)

- [flue temp sensor](#)

23.3 Steam Plants

The [steamPlant](#) tag is used to model the plant and its system of equipment to generate steam.

- [steam leaving temp sensor](#)
- [steam leaving temp sp](#)
- [steam leaving flow sensor](#)
- [steam leaving pressure sensor](#)
- [steam entering flow sensor](#)
- [steam entering pressure sensor](#)
- [steam delta pressure sensor](#)
- [steam delta flow sensor](#)
- [steam delta temp sensor](#)
- [steam bypass valve cmd](#)
- [steam mixing valve cmd](#)
- [steam header pressure sensor](#)
- [condensate entering temp sensor](#)
- [makeup water flow sensor](#)
- [outside air damper cmd](#)
- [flue temp sensor](#)

23.4 Boilers

The [boiler](#) tag is used model boiler assets as an [equip](#).

Equip level tags:

- [equipRef](#) must reference parent plant if associated with a plant
- [hot water](#) or [steam](#)
- [oil](#) or [gas](#)

Points associated with the boiler equip:

- [run cmd](#)
- [run sensor](#)
- [enable cmd](#)
- [circ pump cmd](#)
- [circ pump sensor](#)
- [condensate pump cmd](#)
- [condensate pump sensor](#)

23.5 Heat Exchangers

Heat exchangers are tagged with [heatExchanger](#). Equip level tags:

- [equipRef](#) must reference parent hot water or steam plant

The points for a heat exchanger will be based on the fluids between the two loops. In general we use [primaryLoop](#) and [secondaryLoop](#) to quality the points.

◀ [Chillers](#)

[Tanks](#) ▶



TOC

- 1 [Intro](#)
- 2 [TagModel](#)
- 3 [Structure](#)
- 4 [TimeZones](#)
- 5 [Units](#)
- 6 [Grids](#)
- 7 [Filters](#)
- 8 [Zinc](#)
- 9 [Json](#)
- 10 [Trio](#)
- 11 [Csv](#)
- 12 [Rest](#)
- 13 [Ops](#)
- 14 [Auth](#)
- 15 [VFDs](#)
- 16 [Networks](#)
- 17 [Energy](#)
- 18 [Zones](#)
- 19 [AHUs](#)
- 20 [VAVs](#)
- 21 [UnitaryEquips](#)
- 22 **Chillers**
 - 22.1 [Overview](#)
 - 22.2 [Chilled Water Plants](#)
 - 22.3 [Chillers](#)
 - 22.4 [Cooling Towers](#)
 - 22.5 [Heat Exchangers](#)
- 23 [Boilers](#)
- 24 [Tanks](#)
- 25 [ElecPanels](#)
- 26 [Lighting](#)
- 27 [Builds](#)
- 28 [Bacnet](#)
- 29 [ChangeLog](#)
- 30 [License](#)

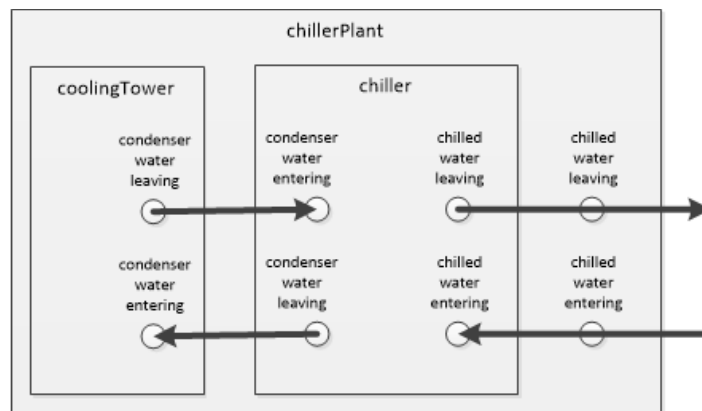
[◀ UnitaryEquips](#)[Boilers ▶](#)

22 Chillers

22.1 Overview

A chilled water plant is composed of multiple pieces of equipment used to generate [chilled water](#). The entire plant is modeled as an [equip](#) with its own plant-level points. Sub-equipment such as chillers and cooling towers are also modeled as [equip](#) contained by the plant via the [equipRef](#) tag.

The follow diagram shows the terminology used for logical flow of water through a plant:



Note that the terminology for sensors/setpoints are based on the perspective of the equipment. The condenser water *leaving* the chiller, is the condenser water *entering* the cooling tower.

22.2 Chilled Water Plants

We model the entire plant using the [chilledWaterPlant](#) tag. The plant is modeled as an [equip](#) and it will define its own plant level points:

Chilled water to/from AHUs

- [chilled water leaving temp sensor](#)
- [chilled water leaving temp sp](#)
- [chilled water leaving flow sensor](#)
- [chilled water leaving pressure sensor](#)
- [chilled water entering temp sensor](#)

- chilled water entering flow sensor
- chilled water entering pressure sensor
- chilled water delta temp sensor
- chilled water delta flow sensor
- chilled water delta pressure sensor
- chilled water delta pressure sp
- chilled water bypass valve cmd

Condenser water between Chillers/Cooling Towers

- condenser water delta pressure sensor
- condenser water bypass valve cmd

Note: not every combination of sp is listed, just most common setpoints.

We also define the following tags for pipework and its associated equip and points:

- primaryLoop: pipework within the plant
- secondaryLoop: pipework from the plant to the building

22.3 Chillers

Chiller equips are marked with the chiller tag. Equip level tags:

- equipRef must reference parent chilledWaterPlant if associated with a plant
- waterCooled or airCooled
- absorption or if vapor compression: reciprocal, screw, or centrifugal
- coolingCapacity

Points associated with chiller equip:

Run/Status

- run cmd
- run sensor
- enable cmd
- load cmd
- load sensor
- efficiency sensor
- power sensor
- energy sensor

Chilled water to/from AHUs

- chilled water leaving temp sensor
- chilled water leaving temp sp
- chilled water leaving flow sensor
- chilled water leaving pressure sensor
- chilled water entering temp sensor
- chilled water entering flow sensor
- chilled water entering pressure sensor
- chilled water delta temp sensor
- chilled water delta flow sensor
- chilled water delta pressure sensor
- chilled water valve isolation cmd

Condenser water to/from cooling towers

- condenser water leaving temp sensor

- [condenser water leaving flow sensor](#)
- [condenser water leaving pressure sensor](#)
- [condenser water entering temp sensor](#)
- [condenser water entering pressure sensor](#)
- [condenser water entering flow sensor](#)
- [condenser water valve isolation cmd](#)

Misc Internal

- [condenser cmd](#)
- [condenser refrig temp sensor](#)
- [condenser refrig pressure sensor](#)
- [evaporator refrig temp sensor](#)
- [evaporator refrig pressure sensor](#)

Note: not every combination of [sp](#) is listed, just most common setpoints. Chillers share the same point modeling conventions as [VFDs](#). Chillers which measure energy should model their points using the same conventions as [elec meters](#) or [thermal meters](#).

22.4 Cooling Towers

Cooling towers equips are marked with the [coolingTower](#) tag. Equip level tags:

- [equipRef](#) must reference parent [chilledWaterPlant](#) if associated with a plant
- [openLoop](#) or [closedLoop](#)

Points associated with cooling tower equip:

- [condenser water leaving temp sensor](#)
- [condenser water leaving temp sp](#)
- [condenser water leaving flow sensor](#)
- [condenser water leaving pressure sensor](#)
- [condenser water entering temp sensor](#)
- [condenser water entering pressure sensor](#)
- [condenser water entering flow sensor](#)
- [fan cmd](#)
- [fan sensor](#)

22.5 Heat Exchangers

Heat exchangers are tagged with [heatExchanger](#). Equip level tags:

- [equipRef](#) must reference parent [chilledWaterPlant](#) if associated with a plant

Points associated with heat exchanger equip:

- [chilled water leaving temp sensor](#)
- [chilled water entering temp sensor](#)
- [condenser water leaving temp sensor](#)
- [condenser water entering flow sensor](#)

◀ [UnitaryEquips](#)

[Boilers](#) ▶

[TOC](#)

- 1 [Intro](#)
- 2 [TagModel](#)
- 3 [Structure](#)
- 4 [TimeZones](#)
- 5 [Units](#)
- 6 [Grids](#)
- 7 [Filters](#)
- 8 [Zinc](#)
- 9 [Json](#)
- 10 [Trio](#)
- 11 [Csv](#)
- 12 [Rest](#)
- 13 [Ops](#)
- 14 [Auth](#)
- 15 [VFDs](#)
- 16 [Networks](#)
- 17 [Energy](#)
- 18 [Zones](#)
- 19 [AHUs](#)
- 20 [VAVs](#)
- 21 [UnitaryEquips](#)
- 22 [Chillers](#)
- 23 [Boilers](#)
- 24 [Tanks](#)
 - 24.1 [Overview](#)
 - 24.2 [Tags](#)
 - 24.3 [Points](#)
- 25 [ElecPanels](#)
- 26 [Lighting](#)
- 27 [Builds](#)
- 28 [Bacnet](#)
- 29 [ChangeLog](#)
- 30 [License](#)

[Home](#) • [About](#) • [Docs](#) • [Tags](#) • [Blog](#) • [Forum](#) • [Downloads](#)[◀ Boilers](#)[ElecPanels ▶](#)

24 Tanks

24.1 Overview

The [tank](#) tag models a storage tank. It is always paired with the [equip](#) tag.

24.2 Tags

The following tags should be used to define what the tank stores:

- [hot water](#)
- [domestic water](#)
- [condensate water](#)
- [gas](#)
- [oil](#)

24.3 Points

Points associated with the storage tank:

- [temp sensor](#)
- [pressure sensor](#)
- [level sensor](#)

[◀ Boilers](#)[ElecPanels ▶](#)All content licensed under the [AFL 3.0](#)



TOC

[Zones](#)[VAVs](#) ►

1	Intro
2	TagModel
3	Structure
4	TimeZones
5	Units
6	Grids
7	Filters
8	Zinc
9	Json
10	Trio
11	Csv
12	Rest
13	Ops
14	Auth
15	VFDs
16	Networks
17	Energy
18	Zones
19	AHUs
19.1	Overview
19.2	Tags
19.2.1	Heating and Cooling Method
19.2.2	Constant vs Variable Volume
19.2.3	Zone Delivery
19.2.4	Ductwork
19.3	Sections
19.4	Points
20	VAVs
21	UnitaryEquips
22	Chillers
23	Boilers
24	Tanks
25	ElecPanels
26	Lighting
27	Builds
28	Bacnet

19 AHUs

19.1 Overview

The [ahu](#) tag is used model air handling equipment designed to heat or cool air. In Project Haystack, packaged rooftop units are considered a special class of AHU. Packaged units use the [ahu](#) tag, but should also specify the [rooftop](#) tag:

```

ahu                                // any type of air handler unit (built-up or RTU)
ahu and rooftop                    // only packaged rooftop units (RTUs)
ahu and not rooftop                // only built-up custom AHUs

```

19.2 Tags

AHUs should always be marked as [ahu](#) and [equip](#). The following tags are also used:

- [hvac](#): always specified to mark as an HVAC asset
- [rooftop](#): if the AHU is a packaged rooftop unit (RTU)
- [mau](#): if the AHU is a makeup air unit
- [chilledWaterPlantRef](#): reference plant supplying chilled water
- [hotWaterPlantRef](#): reference plant supplying hot water
- [steamPlantRef](#): reference plant supplying steam

19.2.1 Heating and Cooling Method

AHUs should define their heating method using one of the following tags:

- [elecHeat](#)
- [hotWaterHeat](#)
- [steamHeat](#)
- [gasHeat](#)

Cooling method should be defined using one of the following tags:

- [chilledWaterCool](#)
- [dxCool](#)

19.2.2 Constant vs Variable Volume

An AHU should be tagged as either [constantVolume](#) or [variableVolume](#) based on its ability to adjust the volume of air flow. Typically this distinction is based on whether the

29 [ChangeLog](#)30 [License](#)

AHU's fan is single speed or a VFD.

19.2.3 Zone Delivery

The following tags define the system used to deliver air to the zones:

- [directZone](#): AHU supplies air directly to the zone
- [vavZone](#): AHU supplies air to VAV terminal units
- [chilledBeamZone](#): AHU supplies air to chilled beam terminal units
- [multiZone](#): air is split into a duct per zone

A Variable Volume Temperature or VVT system is defined as a constant volume AHU with VAV terminal units. This is indicated by the presence of both the [constantVolume](#) and [vavZone](#) tags.

19.2.4 Ductwork

In multi-duct systems, the AHU discharges into multiple ducts for simultaneous cooling, heating, or neutral air:

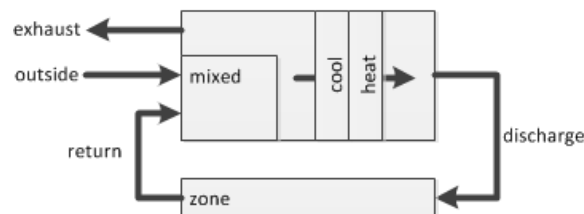
- [singleDuct](#): AHU uses a single duct
- [dualDuct](#): the AHU discharges to two ducts which is some combination of [hotDeck](#), [coldDeck](#), or [neutralDeck](#)
- [tripleDuct](#): the AHU discharges into three ducts which are the [hotDeck](#), [coldDeck](#), and [neutralDeck](#)

19.3 Sections

Most points in an AHU are associated with one of the following sections of the unit:

- [discharge](#): air exiting the unit to be supplied to the zones/terminal units
- [return](#): air returning from the zone back into the unit
- [outside](#): fresh, outside air entering the unit for air quality and economizing
- [exhaust](#): air exiting the unit back outside
- [mixed](#): return and outside air mixed together before passing through the heating/cooling elements
- [cool](#): cooling elements/coils
- [heat](#): heating elements/coils
- [zone](#): conditioned space associated with the unit

The follow diagram shows the logical flow of air through an AHU:



19.4 Points

The following lists points commonly used with an AHU:

Discharge

- [discharge air temp sensor](#)
- [discharge air humidity sensor](#)
- [discharge air pressure sensor](#)
- [discharge air flow sensor](#)

- [discharge air fan cmd](#)
- [discharge air fan sensor](#)

Return

- [return air temp sensor](#)
- [return air humidity sensor](#)
- [return air pressure sensor](#)
- [return air flow sensor](#)
- [return air co2 sensor](#)
- [return air fan cmd](#)
- [return air damper cmd](#)

Mixed

- [mixed air temp sensor](#)

Outside

- [outside air temp sensor](#)
- [outside air humidity sensor](#)
- [outside air pressure sensor](#)
- [outside air flow sensor](#)
- [outside air flow sp](#)
- [outside air damper cmd](#)

Exhaust

- [exhaust air fan cmd](#)
- [exhaust air damper cmd](#)

Conditioning

- [cool stage cmd](#)
- [heat stage cmd](#)
- [humidifier cmd](#)
- [filter sensor](#)

Misc

- [freezeStat sensor](#)
- [heatWheel cmd](#)
- [faceBypass cmd](#)
- [bypass damper cmd](#)

Zone (see [zone points](#)):

- [zone air temp sensor](#)
- [zone air temp effective sp](#)
- [zone air temp occ cooling sp](#)
- [zone air temp occ heating sp](#)
- [zone air temp unocc cooling sp](#)
- [zone air temp unocc heating sp](#)
- [zone air temp standby cooling sp](#)
- [zone air temp standby heating sp](#)
- [zone air humidity sensor](#)
- [zone air co2 sensor](#)
- [zone air co2 sp](#)



TOC

[Auth](#)[Networks](#) ►

- 1 [Intro](#)
- 2 [TagModel](#)
- 3 [Structure](#)
- 4 [TimeZones](#)
- 5 [Units](#)
- 6 [Grids](#)
- 7 [Filters](#)
- 8 [Zinc](#)
- 9 [Json](#)
- 10 [Trio](#)
- 11 [Csv](#)
- 12 [Rest](#)
- 13 [Ops](#)
- 14 [Auth](#)
- 15 [VFDs](#)
 - 15.1 [Overview](#)
 - 15.2 [Points](#)
 - 15.3 [Fans](#)
 - 15.3.1 [Fan Points](#)
 - 15.3.2 [Fan Equips](#)
 - 15.4 [Pumps](#)
- 16 [Networks](#)
- 17 [Energy](#)
- 18 [Zones](#)
- 19 [AHUs](#)
- 20 [VAVs](#)
- 21 [UnitaryEquips](#)
- 22 [Chillers](#)
- 23 [Boilers](#)
- 24 [Tanks](#)
- 25 [ElecPanels](#)
- 26 [Lighting](#)
- 27 [Builds](#)
- 28 [Bacnet](#)
- 29 [ChangeLog](#)
- 30 [License](#)

15 VFDs

15.1 Overview

Fans, pumps, and compressors which use a variable frequency drive or VFD are typically sophisticated devices that expose many points. VFDs should be modeled as their own [equip](#) entity using the [vfd](#) tag. If the VFD is a sub-component of a larger piece of equip then it can be nested via the [equipRef](#) tag.

15.2 Points

The standardized points for VFDs are:

- [run cmd](#)
- [run sensor](#)
- [enable cmd](#)
- [speed cmd](#)
- [freq cmd](#)

The primary on/off point of equipment is always modeled with the [run](#) tag. Paired with [cmd](#) it models the on/off command point; paired with [sensor](#) it models the run status point. Many VFDs also include a secondary [enable](#) point which requires both [run](#) and [enable](#) to be commanded to true in order for the equipment to be on.

Speed of the VFD is commanded separately via the [speed](#) or [freq](#) point. Use of these points require that the equipment has already been commanded on.

Many VFDs will also provide many of the same points as an electric meter. Measurements such as electric demand, consumption, voltage, and current should follow the same conventions as [elec meters](#).

15.3 Fans

Fans may optionally be defined as either an [equip](#) or a [point](#). If the fan motor is a VFD then it is recommended to make the fan a sub-equip. However in many cases a simple fan in a terminal unit such as a [vav](#) is better modeled as a [point](#).

15.3.1 Fan Points

In simple cases where the fan is just a command and/or feedback sensor then it is best to

model it as a [point](#).

If annotated as an output with the [cmd](#) tag, then the point models the command status of the fan:

- false (off) or true (on)
- variable speed then it is 0% (off) to 100% (full speed)

If annotated as an input with the [sensor](#) tag, then the point models a sensor used to verify if the fan status:

- false indicated no air flow (off) or true indicates successful airflow (fan is on)
- if numeric the point is differential pressure across the fan measured in "inH₂O" or "kPa"

15.3.2 Fan Equips

When the fan motor is a VFD it should modeled as an [equip](#) entity using the standard VFD points described above. If you wish to standardize modeling all fans as equip, then simple non-VFDs fan should define their state via a [run](#) point.

Example of a VFD fan on an AHU:

```
id:@ahu ahu equip
id:@ahu-fan equipRef:@ahu discharge fan vfd equip
id:@ahu-fan-run equipRef:@ahu-fan run cmd point
id:@ahu-fan-status equipRef:@ahu-fan run status point
id:@ahu-fan-speed equipRef:@ahu-fan speed cmd unit:"%" point
```

Note that the fan is modeled as an sub-equip of the AHU via the [equipRef](#) tag. The VFD points are defined under the fan itself.

15.4 Pumps

Pumps may optionally be defined as either an [equip](#) or a [point](#). If the pump is a VFD then it is recommended to make it an equip level entity. However if the pump is modeled a simple on/off point as a component within a large piece of equipment such as a [boiler](#) then it is modeled as just a [point](#). Pumps should follow the same point and equip level modeling conventions as [fans](#).

◀ [Auth](#)

[Networks](#) ▶

[TOC](#)

- 1 [Intro](#)
- 2 [TagModel](#)
- 3 [Structure](#)
- 4 [TimeZones](#)
- 5 [Units](#)
- 6 [Grids](#)
- 7 [Filters](#)
- 8 [Zinc](#)
- 9 [Json](#)
- 10 [Trio](#)
- 11 [Csv](#)
- 12 [Rest](#)
- 13 [Ops](#)
- 14 [Auth](#)
- 15 [VFDs](#)
- 16 [Networks](#)
- 17 [Energy](#)
- 18 [Zones](#)
 - 18.1 [Overview](#)
 - 18.2 [Zone Points](#)
- 19 [AHUs](#)
- 20 [VAVs](#)
- 21 [UnitaryEquips](#)
- 22 [Chillers](#)
- 23 [Boilers](#)
- 24 [Tanks](#)
- 25 [ElecPanels](#)
- 26 [Lighting](#)
- 27 [Builds](#)
- 28 [Bacnet](#)
- 29 [ChangeLog](#)
- 30 [License](#)

[Home](#) • [About](#) • [Docs](#) • [Tags](#) • [Blog](#) • [Forum](#) • [Downloads](#)[◀ Energy](#)[AHUs ▶](#)

18 Zones

18.1 Overview

The [zone](#) tag is used for points associated with a conditioned space in a building. Zone points are used consistently by any equipment used to condition the space including:

- [directZone ahu](#)
- [vav](#)
- [fcu](#)
- [uv](#)
- [heatPump](#)

18.2 Zone Points

The following are the standardized zone points:

- [zone air temp sensor](#)
- [zone air temp effective sp](#)
- [zone air temp occ cooling sp](#)
- [zone air temp occ heating sp](#)
- [zone air temp unocc cooling sp](#)
- [zone air temp unocc heating sp](#)
- [zone air temp standby cooling sp](#)
- [zone air temp standby heating sp](#)
- [zone air humidity sensor](#)
- [zone air co2 sensor](#)
- [zone air co2 sp](#)

[◀ Energy](#)[AHUs ▶](#)All content licensed under the [AFL 3.0](#)

◀ [Zones](#)

[VAVs](#) ▶

[Home](#) • [About](#) • [Docs](#) • [Tags](#) • [Blog](#) • [Forum](#) • [Downloads](#)

All content licensed under the [AFL 3.0](#)

[TOC](#)

- 1 [Intro](#)
- 2 [TagModel](#)
- 3 [Structure](#)
- 4 [TimeZones](#)
- 5 [Units](#)
- 6 [Grids](#)
- 7 [Filters](#)
- 8 [Zinc](#)
- 9 [Json](#)
- 10 [Trio](#)
- 11 [Csv](#)
- 12 [Rest](#)
- 13 [Ops](#)
- 14 [Auth](#)
- 15 [VFDs](#)
- 16 [Networks](#)
- 17 [Energy](#)
- 18 [Zones](#)
- 19 [AHUs](#)
- 20 [VAVs](#)
- 21 **[UnitaryEquips](#)**
 - 21.1 [Overview](#)
 - 21.2 [Fan Coil Units](#)
 - 21.3 [Units Ventilators](#)
 - 21.4 [Heat Pumps](#)
- 22 [Chillers](#)
- 23 [Boilers](#)
- 24 [Tanks](#)
- 25 [ElecPanels](#)
- 26 [Lighting](#)
- 27 [Builds](#)
- 28 [Bacnet](#)
- 29 [ChangeLog](#)
- 30 [License](#)

[Home](#) • [About](#) • [Docs](#) • [Tags](#) • [Blog](#) • [Forum](#) • [Downloads](#)

◀ [VAVs](#)

[Chillers](#) ▶

21 UnitaryEquips

21.1 Overview

This chapter defines unitary HVAC equipment which combines heating and/or cooling into packaged units.

21.2 Fan Coil Units

The `fcu` tag is used to model fan coil units. Fan coils are unitary equipment which use zone itself for supply air.

FCUs should define their [cooling/heating method](#) using AHU conventions.

FCUs should following model of [AHU points](#)

21.3 Units Ventilators

The `uv` tag is used to model unit ventilators. Unit ventilators differ from FCUs in that they have direct access to outside air.

UVs should define their [cooling/heating method](#) using AHU conventions.

UVs should following model of [AHU points](#)

21.4 Heat Pumps

The `heatPump` tag is used to model heat pumps.

◀ [VAVs](#)

[Chillers](#) ▶



TOC

- 1 [Intro](#)
- 2 [TagModel](#)
- 3 [Structure](#)
- 4 [TimeZones](#)
- 5 [Units](#)
- 6 [Grids](#)
- 7 [Filters](#)
- 8 [Zinc](#)
- 9 [Json](#)
- 10 [Trio](#)
- 11 [Csv](#)
- 12 [Rest](#)
- 13 [Ops](#)
- 14 [Auth](#)
- 15 [VFDs](#)
- 16 [Networks](#)
- 17 [Energy](#)
- 18 [Zones](#)
- 19 [AHUs](#)
- 20 **VAVs**
 - 20.1 [Overview](#)
 - 20.2 [Tags](#)
 - 20.3 [Sections](#)
 - 20.4 [Points](#)
- 21 [UnitaryEquips](#)
- 22 [Chillers](#)
- 23 [Boilers](#)
- 24 [Tanks](#)
- 25 [ElecPanels](#)
- 26 [Lighting](#)
- 27 [Builds](#)
- 28 [Bacnet](#)
- 29 [ChangeLog](#)
- 30 [License](#)

[◀ AHUs](#)[UnitaryEquips ▶](#)

20 VAVs

20.1 Overview

The [vav](#) tag is used to model variable air volume assets. VAVs should always be marked as [equip](#).

20.2 Tags

VAVs should be classified with the following type tags:

- [coolOnly](#)
- [series](#) [fanPowered](#) [elecReheat](#)
- [series](#) [fanPowered](#) [hotWaterReheat](#)
- [parallel](#) [fanPowered](#) [elecReheat](#)
- [parallel](#) [fanPowered](#) [hotWaterReheat](#)

The additional equip level tags are defined for VAVs:

- [hvac](#): always specified to mark as an HVAC asset
- [singleDuct](#) or [dualDuct](#): ductwork configuration
- [ahuRef](#): supply AHU
- [chilledWaterPlantRef](#): plant supplying chilled water if applicable
- [pressureDependent](#) or [pressureIndependent](#): control based on duct static pressure
- [hotWaterPlantRef](#): reference plant supplying hot water
- [steamPlantRef](#): reference plant supplying steam

20.3 Sections

We associate points with sections of a VAV using these tags:

- [entering](#): air entering the unit from the AHU
- [discharge](#): air exiting the unit to be supplied to the zones
- [zone](#): conditioned space associated with the unit

However since most points are not clearly associated with the entering or discharge section we omit a section tag for most points. However any points which would conflict with the zone points however must be qualified with either [discharge](#) or [entering](#) tags.

20.4 Points

VAVs points include zone points:

- zone air temp sensor
- zone air temp effective sp
- zone air temp occ cooling sp
- zone air temp occ heating sp
- zone air temp unocc cooling sp
- zone air temp unocc heating sp
- zone air temp standby cooling sp
- zone air temp standby heating sp
- zone air humidity sensor
- zone air co2 sensor
- zone air co2 sp

Other standardized points:

- discharge air temp sensor
- entering air temp sensor
- air pressure sensor
- air flow sensor
- air flow effective sp
- air flow min sp
- air flow max sp
- air flow reheating max sp
- air flow standby sp
- air fan cmd
- air fan sensor
- air damper cmd
- reheat cmd
- vavMode sp
- ductArea sp
- perimeterHeat cmd

◀ [AHUs](#)

[UnitaryEquips](#) ▶

[TOC](#)

- 1 [Intro](#)
- 2 [TagModel](#)
- 3 [Structure](#)
- 4 [TimeZones](#)
- 5 [Units](#)
- 6 [Grids](#)
- 7 [Filters](#)
- 8 [Zinc](#)
- 9 [Json](#)
- 10 [Trio](#)
- 11 [Csv](#)
- 12 [Rest](#)
- 13 [Ops](#)
- 14 [Auth](#)
- 15 [VFDs](#)
- 16 [Networks](#)
- 17 [Energy](#)
- 18 [Zones](#)
- 19 [AHUs](#)
- 20 [VAVs](#)
- 21 [UnitaryEquips](#)
- 22 [Chillers](#)
- 23 [Boilers](#)
- 24 [Tanks](#)
- 25 [ElecPanels](#)
- 26 **[Lighting](#)**
 - 26.1 [Lighting Groups \(Equip\)](#)
 - 26.2 [Lighting Points](#)
- 27 [Builds](#)
- 28 [Bacnet](#)
- 29 [ChangeLog](#)
- 30 [License](#)

[◀ ElecPanels](#)[Builds ▶](#)

26 Lighting

26.1 Lighting Groups (Equip)

The `lightsGroup` tag is used to model the equip level of the lighting system and should follow all the standard rules for [equip entities](#).

Lighting groups may model a single light switch, room, physical circuit, lighting panel, or logical grouping of lights. The lighting group purpose is primarily to organize one or more lighting points to match the standardized site+equip+point model for navigation and analytics.

26.2 Lighting Points

The following are the standard point types under lighting group:

- `lights`: primary actuator point indicating whether the lights are commanded on/off. The lights point must be either a binary point (on/off) or a numeric point if dimmable (0% to 100%). A lightsGroup must have one or more of these points.
- `lightLevel`: sensor indicating current lighting level measured in "lux" or "lumen". A lightsGroup can have zero or more of these points.
- `occupancyIndicator`: sensor indicating whether room is currently occupied. Point must be Bool where true indicates occupied and false indicates unoccupied. A lightsGroup can have zero or more of these points.

[◀ ElecPanels](#)[Builds ▶](#)



TOC

◀ Networks

Zones ▶

1	Intro
2	TagModel
3	Structure
4	TimeZones
5	Units
6	Grids
7	Filters
8	Zinc
9	Json
10	Trio
11	Csv
12	Rest
13	Ops
14	Auth
15	VFDs
16	Networks
17	Energy
17.1	Overview
17.2	Meters
17.3	Meter Loads
17.4	Elec Meter
17.4.1	Active, Reactive, Apparent
17.4.2	Import, Export, Net
17.4.3	Elec Meter Points
17.4.4	Elec Meter Diagram
17.5	Flow Meters
17.6	Thermal Meters
17.7	Example Model
18	Zones
19	AHUs
20	VAVs
21	UnitaryEquips
22	Chillers
23	Boilers
24	Tanks
25	ElecPanels
26	Lighting
27	Builds
28	Bacnet
29	ChangeLog
30	License

17 Energy

17.1 Overview

The general problems addressed by the energy tags are:

- modeling meters
- modeling submeters and their relationships
- modeling equip and point loads on meters

17.2 Meters

Meters are modeled as [equip](#) entities with the [meter](#) tag. The following meter types are defined:

- [elec meter](#)
- [gas meter](#)
- [domestic water meter](#)
- [chilled water meter](#)
- [condenser water meter](#)
- [hot water meter](#)
- [makeup water meter](#)
- [blowdown water meter](#)
- [condensate water meter](#)
- [steam meter](#)

All meters must additionally define one of these two tags:

- [siteMeter](#): marker applied to the main site level meter
- [submeterOf](#): Ref to parent meter

17.3 Meter Loads

Modeling the equip and point loads under specific meters can be used for analysis and visualization. Loads are modeled by applying a tag formatted as "{type}MeterLoad" on an [equip](#) or [point](#). The meter load tag should be Ref to its associated [meter](#). If modeling submeters, then the load should reference the closest submeter. Standardized load tags:

- [elecMeterLoad](#)
- [gasMeterLoad](#)
- [waterMeterLoad](#) (no distinction between which type of water meter)
- [steamMeterLoad](#)

Meter loads have the same types of points as their associated meters.

17.4 Elec Meter

Electricity meters are probably the most common type of meters modeled. They are tagged as [elec meter](#). Haystack supports a model designed to scale from very simple meters (just a [power](#) and [energy](#) point) up to a comprehensive point list for three-phase power quality meters.

Electricity meter points are described by combining tags from the lists given below. The tags in each set are mutually exclusive. (For example, a `power` point cannot be both `active` and `reactive`.)

The primary measured quantities in an electrical system are:

- `power`: typically measured in "kW"
- `energy`: typically measured in "kWh"
- `volt`: typically measured in "V"
- `current`: typically measured in "A"
- `freq`: typically measured in "Hz"
- `pf`: power factor

AC power measurements are further qualified by:

- `active`: typically measured in "kW" (assumed as default)
- `reactive`: typically measured in "kVAR"
- `apparent`: typically measured in "kVA"

Voltage and current measurements are further qualified by:

- `mag`: magnitude (assumed as default)
- `angle`: phase angle, typically measured in "deg"
- `imbalance`: imbalance between phases, measured in "%"
- `thd`: total harmonic distortion, measured in "%"

Three phase electrical measurements are qualified by:

- `phase`: A, B, C, AB, BC, CA, N
- `avg`: for current, voltage, and power factor (assumed as default)
- `total`: for power and energy (assumed as default)

Energy exchange with the utility is qualified by:

- `import`: energy imported from the grid
- `export`: energy exported to the grid
- `net`: net exchange (assumed as default)

In addition we define the following general purpose tags:

- `ac`: alternating current
- `dc`: direct current

17.4.1 Active, Reactive, Apparent

As the name suggests, the voltage and current in alternating current (AC) electricity networks alternate polarity many times per second. Because instantaneous power is the product of voltage times current, it constantly fluctuates in an AC network. Three quantities describe the time-averaged nature of fluctuating AC power:

- `active` power, also known as real power, represents real work: a net transfer of energy from source to load. Active power represents the "normal" definition of power: the rate of energy transfer per unit time. The standard unit of active power is the Watt, "W"; the default Haystack unit is "kW".
- `reactive` power, also known as imaginary power, represents energy that circulates in an AC system without performing any real work. Its standard unit is the volt-ampere reactive, "VAR"; the default Haystack unit is "kVAR".
- `apparent` power is the combination of active and reactive power and represents the overall magnitude of energy movement. Its standard unit is the volt-ampere, "VA"; the default Haystack unit is "kVA".

If a `power` point does not have an `active`, `reactive`, or `apparent` tag, active power is assumed as the default.

17.4.2 Import, Export, Net

Some electric meters track and report power and energy imported from the electric grid separately from power and energy exported to the electric grid. The tags `import` and `export` differentiate these quantities. More broadly, `export` indicates power or energy flowing toward the grid (in the direction of the `siteMeter`) and `import` indicates power or energy flowing toward the load.

These measurements register power or energy transfer only in their associated direction and always have positive values.

- For instantaneous `power` measurements, import and export are mutually exclusive. One will report a positive value and the other will report zero.
- For `energy` measurements tallied over time, it is possible that both import and export may report a positive quantity for that interval, which means that some energy flowed in each direction during that interval.

The `net` tag indicates the difference between `import` and `export`:

```
net = import - export
```

Haystack uses the load convention for net electric power and energy.

- Positive net quantities indicate power or energy consumed,
- Negative net quantities indicate power or energy produced.

If a power or energy point does not have an `import`, `export`, or `net` tag, it is assumed by default to be a net quantity.

17.4.3 Elec Meter Points

Common tag combinations for the points of a electric meter:

Power

- `power net sensor`
- `power export sensor`
- `power import sensor`
- `active power total sensor`
- `active power phase sensor`
- `apparent power total sensor`
- `apparent power phase sensor`
- `reactive power total sensor`
- `reactive power phase sensor`

Energy

- `energy net sensor`
- `energy export sensor`
- `energy import sensor`
- `energy total sensor`
- `energy phase sensor`

Voltage

- `volt mag avg sensor`
- `volt mag phase sensor`
- `volt angle avg sensor`
- `volt angle phase sensor`
- `volt thd avg sensor`
- `volt thd phase sensor`
- `volt imbalance sensor`

Current

- `current mag avg sensor`
- `current mag phase sensor`
- `current angle avg sensor`
- `current angle phase sensor`
- `current thd avg sensor`
- `current thd phase sensor`
- `current imbalance sensor`

Power Factor

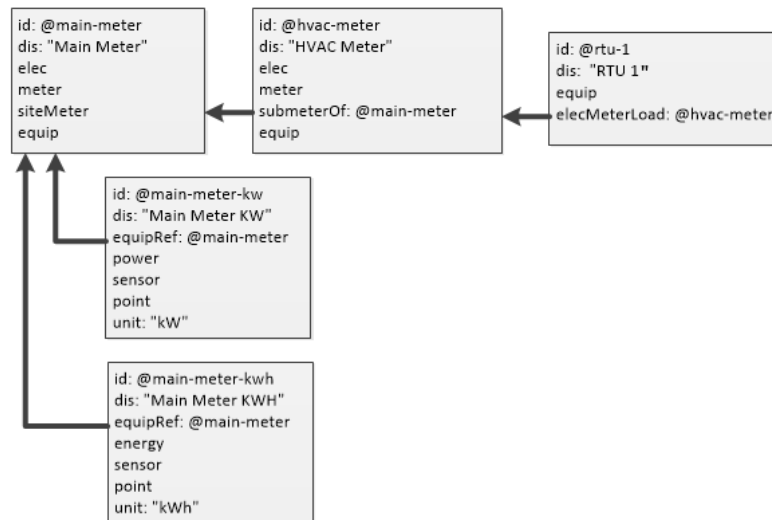
- `pf avg sensor`
- `pf phase sensor`

Frequency

- [freq sensor](#)

17.4.4 Elec Meter Diagram

The follow diagram illustrates these basic relationships with a site level electric meter and its power and energy points. A submeter is associated with a load under the main meter.



17.5 Flow Meters

Water and gas meters measure flow rate and total volume consumed. Standardized points are:

- [flow](#): rate of volume flowing through the meter per unit time
- [volume](#): total volume consumption of the meter

17.6 Thermal Meters

Thermal meters measure energy as temperature differentials. Energy demand and consumption is modeled using the same tags as electric meters:

- [power](#): energy consumed per unit time such as "BTU/h"
- [energy](#): energy consumption such as "BTU"

17.7 Example Model

Let's take a simple example. Let's assume we want to model this "tree" of meters and loads:

```

Main Elec Meter
+- LightsGroup (equip load)
  +- Lights-ZoneX (point load)
  +- Lights-ZoneY (point load)
+- HVAC Elec Submeter
  +- RTU-1 (equip load)
    +- Fan (point load)
    +- DischargeTemp (not a load)
  +- RTU-2 (equip load)
    +- Fan (point load)
    +- DischargeTemp (not a load)
  
```

The entities and their tags would look like this:

```

id:@A, dis: "Main Elec Meter", elec, meter, siteMeter, equip
dis: "Main Elec Meter Demand", equipRef @A, power, unit:"kW", sensor, point,
dis: "Main Elec Meter Consumption", equipRef:@A, energy, unit:"kWh", sensor,

id:@B, dis: "Lights", equip, elecMeterLoad:@A, lightsGroup
dis: "Lights ZoneX", equipRef:@B, elecMeterLoad:@A, lights, cmd, point, ...
dis: "Lights ZoneY", equipRef:@B, elecMeterLoad:@A, lights, cmd, point, ...
  
```

```
id:@C, dis: "HVAC Elec Submeter", elec, meter, submeterOf:@A, equip
dis: "HVAC Elec Submeter Demand", equipRef:@C, power, unit:"kW", sensor, poin
dis: "HVAC Elec Submeter Consumption", equipRef:@C, energy, unit:"kWh", senso

id:@D, dis: "RTU-1", equip, elecMeterLoad:@C, ahu
dis: "RTU-1 Fan", equipRef:@D, elecMeterLoad:@C, fan, cmd, point, ...
dis: "RTU-1 DA Temp", equipRef:@D, discharge, temp, sensor, point, ...
id:@E, dis: "RTU-2", equip, elecMeterLoad:@C, ahu
dis: "RTU-2 Fan", equipRef:@E, elecMeterLoad:@C, fan, cmd, point, ...
dis: "RTU-2 DA Temp", equipRef:@E, discharge, temp, sensor, point, ...
```

In the example above we have a top-level main electrical meter with the id @A. Note it is tagged as `elec meter` to model an electric meter. It is also tagged as `siteMeter` to indicate its the main site-level meter. It has two associated points for power (kW) and energy (kWh).

Then under the main meter, we have a HVAC submeter with the id @C. Note it is tagged as `elec meter` but not `siteMeter`, instead it is associated as a submeter of the main meter using the `submeterOf` tag. You can model submeter trees of arbitrary depth (submeters of submeters). It also has two points for kW and kWh.

Lastly we have three electrical equipment loads defined. The two RTUs are associated with HVAC submeter via `elecMeterLoad` which references the HVAC submeter via id. Since we don't have a lighting submeter, the lighting load references the main meter directly via its `elecMeterLoad` tag. We also tag one or more points under the equipment which are meaningful for the load. Actuators would often be tagged as loads since they draw energy, but sensors would typically not be considered loads.

◀ [Networks](#)

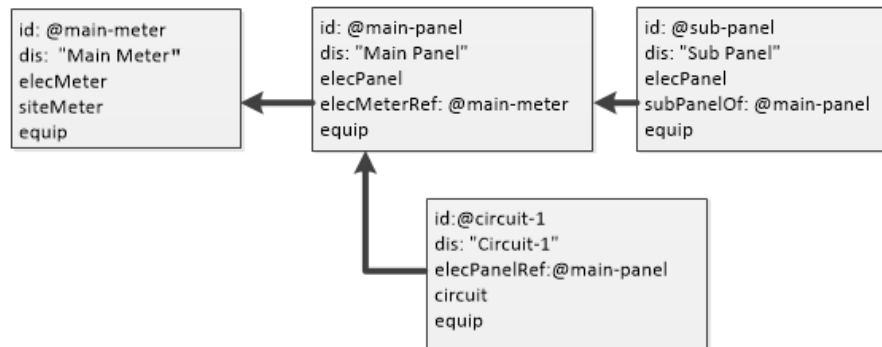
[Zones](#) ▶

[◀ Tanks](#)[Lighting ▶](#)

25 ElecPanels

25.1 Overview

A tagging model is defined for equipment definitions for electric panels and their circuits. However, no points have yet been defined for this model.



25.2 Elec Panel

The [elecPanel](#) tag models an electric panel. Equip level tags:

- [sitePanel](#): is a main, site level panel
- [subPanelOf](#): if its a panel underneath a site level panel
- [elecMeterRef](#): association with closest electric meter

An [elecPanel](#) must be either a [sitePanel](#) *or* a [subPanelOf](#), but never both.

25.3 Circuit

The [circuit](#) tag models an individual electric circuit. Equip level tags:

- [elecPanelOf](#): all circuits must be associated with their containing panel

Circuits contains meta-data about the electrical circuit such as max load, phase, etc. It also contains points associated with sensors and breakers. These tags have not yet been formalized by Project Haystack.

[◀ Tanks](#)[Lighting ▶](#)