

**FORM OF PROPOSAL**

(Addendum #1)

Coastal Engineering Building

UNC Wilmington

20 - 21673 – 01A

Contract: \_\_\_\_\_

Bidder: \_\_\_\_\_

Date: \_\_\_\_\_

The undersigned, as bidder, hereby declares that the only person or persons interested in this proposal as principal or principals is or are named herein and that no other person than herein mentioned has any interest in this proposal or in the contract to be entered into; that this proposal is made without connection with any other person, company or parties making a bid or proposal; and that it is in all respects fair and in good faith without collusion or fraud. The bidder further declares that he has examined the site of the work and the contract documents relative thereto, and has read all special provisions furnished prior to the opening of bids; that he has satisfied himself relative to the work to be performed. The bidder further declares that he and his subcontractors have fully complied with NCGS 64, Article 2 in regard 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 University of North Carolina Wilmington**

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

**Coastal Engineering Building**

in full in complete accordance with the plans, specifications, and contract documents, to the full and entire satisfaction of the State of North Carolina, and the

**University of North Carolina and SGA | Narmour Wright Design**

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" or "Deduct" as appropriate.)

**GENERAL CONTRACT:****Alternate No. G-1** West Side Door Trim / Sidelights

(Add) \_\_\_\_\_ Dollars (\$)

**Alternate No. G-2** Conference Room 1101 Storefront Glazing (North & South Wall)

(Add) \_\_\_\_\_ Dollars (\$)

**Alternate No. G-3** Faculty Open Lab 1131 Storefront Glazing (North & East Wall at Corridor)

(Add) \_\_\_\_\_ Dollars (\$)

**Alternate No. G-4** Exterior Masonry Screen Walls

(Add) \_\_\_\_\_ Dollars (\$)

**Alternate No. G-5** Pavement, Curbing on Cahill Drive

(Add) \_\_\_\_\_ Dollars (\$)

**Alternate No. G-6** Main Entry Portico

(Add) \_\_\_\_\_ Dollars (\$)

**Alternate No. G-7** Emergency Responder Radio Antenna Repeater

(Add) \_\_\_\_\_ Dollars (\$)

**Alternate No. G-8** Lightning Protection System

(Add) \_\_\_\_\_ Dollars (\$)

**Alternate No. G-9** Geosynthetic Clay Liner (2,000sf)

(Add) \_\_\_\_\_ Dollars (\$)

## PREFERRED ALTERNATES

### **Preferred Alternate No. PA-1** Notifier Fire Alarm Controls

(Add) \_\_\_\_\_ Dollars (\$)

### **Preferred Alternate No. PA-2** Lenel Access Control Equipment

(Add) \_\_\_\_\_ Dollars (\$)

### **Preferred Alternate No. PA-3** Valmont Pedestrian Height Pole Mounted Light Fixture

(Add) \_\_\_\_\_ Dollars (\$)

### **Preferred Alternate No. PA-4** Mitsubishi VRF System

(Add) \_\_\_\_\_ Dollars (\$)

### **Preferred Alternate No. PA-5** BASF Brand - Termidor Termite Control

(Add) \_\_\_\_\_ Dollars (\$)

### **Preferred Alternate No. PA-6** Door Hardware (package)

1. Continuous Geared Hinges – Select 11HD EMS/CTW – 8 RP
2. Locks Latches and Bolts – Schlage Series L9000
3. Cylinders/Cores – Schlage Everest
4. Cylinders for Rolling Overhead Doors – Schlage Everest7
5. Interior Electric Mortise Lock – Best 45 HW Series
6. Power supplies – Von Duprin – PS914 900-RL
7. Padlocks – Schlage KS41F1200
8. Keyed Removable Mullions – Von Duprin KR4954/9954 Series
9. Closers – LCN 4011/4111 Series
10. Low Energy E-M Automatic Operators – LCN 4360/4640 Series
11. Exit Devices – Von Duprin 98 Series

(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.

## GENERAL CONTRACT:

No. 1 Delivery and placement of offsite Barrow	(Per Cubic Yard)	Unit Price (\$)_____
No. 2 Offsite disposal of unsuitable materials	(Per Cubic Yard)	Unit Price (\$)_____
No. 3 Excavation below design subgrade	(Per Cubic Yard)	Unit Price (\$)_____
No. 4 Exit Signs	(Each)	Unit Price (\$)_____
No. 5 Receptacle Outlet	(Each)	Unit Price (\$)_____
No. 6 Data / Voice Outlet	(Each)	Unit Price (\$)_____
No. 7 Pull Station	(Each)	Unit Price (\$)_____
No. 8 Horn / Strobe	(Each)	Unit Price (\$)_____
No. 9 Smoke Detector	(Each)	Unit Price (\$)_____
No. 10 Duct Smoke Detector	(Each)	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

\_\_\_\_\_  
(Proprietorship or Partnership)

Name: \_\_\_\_\_  
Print or type

Title \_\_\_\_\_  
(Owner/Partner/Pres./V.Pres)

Address \_\_\_\_\_

ATTEST:

\_\_\_\_\_

By: \_\_\_\_\_

License No. \_\_\_\_\_

Title: \_\_\_\_\_  
(Corp. Sec. or Asst. Sec. only)

Federal I.D. No. \_\_\_\_\_

Email Address: \_\_\_\_\_

(CORPORATE SEAL)

Addendum received and used in computing bid:

Addendum No. 1 \_\_\_\_\_ Addendum No. 3 \_\_\_\_\_ Addendum No. 5 \_\_\_\_\_ Addendum No. 6 \_\_\_\_\_

Addendum No. 2 \_\_\_\_\_ Addendum No. 4 \_\_\_\_\_ Addendum No. 6 \_\_\_\_\_ Addendum No. 7 \_\_\_\_\_

## SECTION 01 2300 – ALTERNATES (ADD #1)

### PART 1 - GENERAL

#### 1.1 RELATED DOCUMENTS

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

#### 1.2 SUMMARY

- A. Section includes administrative and procedural requirements for alternates.

#### 1.3 DEFINITIONS

- A. Alternate: An amount proposed by bidders and stated on the Bid Form for certain work defined in the bidding requirements that may be added to or deducted from the base bid amount if the 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.
  - 1. Alternates described in this Section are part of the Work only if enumerated in the Agreement.
  - 2. The cost or credit for each alternate is the net addition to or deduction from the Contract Sum to incorporate alternates into the Work. No other adjustments are made to the Contract Sum.

#### 1.4 PROCEDURES

- A. Coordination: Revise or adjust affected adjacent work as necessary to completely integrate work of the alternate into Project.
  - 1. 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.
- B. Execute accepted alternates under the same conditions as other Work of the Contract.
- C. Schedule: A Part 3 "Schedule of Alternates" Article 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

3.1 SCHEDULE OF ALTERNATES

- A. **Alternate No. G-1:** West Side Door Trim / Sidelights.
  - 1. Base Bid: No additional work.
  - 2. Alternate: Provide exterior ornamental trim and sidelights, transom and panel door (in lieu of flush door) Det. A1/A501 & FLG-2 as indicated in the documents.
- B. **Alternate No. G-2:** Conference room storefront glazing (North and South Wall of Conference Room 1101)
  - 1. Base Bid: No additional work.
  - 2. Alternate: provide interior storefront glazing (W-1, FLG-4) as indicated in the documents.
- C. **Alternate No. G-3:** Corridor-Lab Storefront glazing (North and East wall of Faculty Open Lab 1131).
  - 1. Base Bid: No additional work.
  - 2. Alternate: provide interior storefront glazing (W-3, FLG-3) as indicated in the documents.
- D. **Alternate No. G-4:** Exterior Masonry Screen Walls.
  - 1. Base Bid: No additional work.
  - 2. Alternate: Provide exterior masonry screen walls at mechanical equipment and trash container areas indicated in the documents. Note - footings to remain in Base Bid scope of work.
- E. **Alternate No. G-5:** Pavement, curbing on Cahill Drive.
  - 1. Base Bid: No additional work.
  - 2. Alternate: provide new pavement, curb and gutter as indicated in the documents.
- F. **Alternate No. G-6:** Main Entry Portico.
  - 1. Base Bid: No additional work.
  - 2. Alternate: Provide columns, pilasters and pediment portico as indicated in the documents
- G. **Alternate No. G-7:** Emergency Responder Radio Antenna Repeater System.
  - 1. Base Bid: System Survey Report as noted on Sheet E604 Detail 2 and Specified in Section 27 5319.
  - 2. Alternate: Provide Emergency Responder Radio Antenna Repeater System as indicated on Sheet E604 Detail 2 and specified in Section 27 5319.
- H. **Alternate No. G-8:** Lightning Protection System.
  - 1. Base Bid: No additional work (no lightning protection system).
  - 2. Alternate: Provide UL master labeled lightning protection system. This is a delegated design item. E.C. is to contract with a lightning protection engineer and send shop drawings as a submittal. Refer to specification section 264113.
- I. **Alternate No. G-9:** Geosynthetic Clay Liner.
  - 1. Base Bid: No additional work.
  - 2. Alternate: Provide 2,000 SF of Geosynthetic Clay Liner as indicated in the documents.



- J. **Preferred Alternate No. PA-1:** Fire Alarm System Control Panels and Components: Notifier Brand Platform as indicated and specified.
- K. **Preferred Alternate No. PA-2:** Access Control Equipment: Lenel OnGuard Brand as indicated and specified.
- L. **Preferred Alternate No. PA-3:** VRF System: Mitsubishi brand as indicated and specified.
- M. **Preferred Alternate No. PA-4:** Pedestrian Height Pole Mounted light fixture: Valmont as scheduled and specified.
- N. **Preferred Alternate No. PA-5:** Termite Control: BASF Brand Termidor as indicated and specified
- O. **Preferred Alternate No. PA-6:** Door Hardware as indicated and specified in Section 08 7100:
  - 1. Continuous Geared Hinges – Select 11HD EMS/CTW – 8 RP
  - 2. Locks Latches and Bolts – Schlage Series L9000
  - 3. Cylinders/Cores – Schlage Everest
  - 4. Cylinders for Rolling Overhead Doors – Schlage Everest7
  - 5. Interior Electric Mortise Lock – Best 45 HW Series
  - 6. Power supplies – Von Duprin – PS914 900-RL
  - 7. Padlocks – Schlage KS41F1200
  - 8. Keyed Removable Mullions – Von Duprin KR4954/9954 Series
  - 9. Closers – LCN 4011/4111 Series
  - 10. Low Energy E-M Automatic Operators – LCN 4360/4640 Series
  - 11. Exit Devices – Von Duprin 98 Series

END OF SECTION 01 2300

## SECTION 07 1113 - BITUMINOUS DAMPPROOFING

### PART 1 - GENERAL

#### 1.1 RELATED DOCUMENTS

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

#### 1.2 SUMMARY

- A. Section Includes:
  - 1. Cold-applied, emulsified-asphalt dampproofing.

#### 1.3 ACTION SUBMITTALS

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

#### 1.4 FIELD CONDITIONS

- A. Weather Limitations: Proceed with application only when existing and forecasted weather conditions permit dampproofing to be performed according to manufacturers' written instructions.
- B. Ventilation: Provide adequate ventilation during application of dampproofing in enclosed spaces. Maintain ventilation until dampproofing has cured.

### PART 2 - PRODUCTS

#### 2.1 MANUFACTURERS

- A. Source Limitations: Obtain primary dampproofing materials and primers from single source from single manufacturer. Provide auxiliary materials recommended in writing by manufacturer of primary materials.

#### 2.2 PERFORMANCE REQUIREMENTS

- A. VOC Content: Products shall comply with VOC content limits of authorities having jurisdiction unless otherwise indicated.

#### 2.3 COLD-APPLIED, EMULSIFIED-ASPHALT DAMPPROOFING

- A. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
  - 1. BASF Corporation.
  - 2. ChemMasters, Inc.
  - 3. Henry Company.
  - 4. W.R. Meadows, Inc.
- B. Brush and Spray Coats: ASTM D 1227, Type III, Class 1.

2.4 AUXILIARY MATERIALS

- A. Furnish auxiliary materials recommended in writing by dampproofing manufacturer for intended use and compatible with bituminous dampproofing.
- B. Patching Compound: of type recommended in writing by dampproofing manufacturer.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Examine substrates, areas, and conditions, with Applicator present, for compliance with requirements for surface smoothness, maximum surface moisture content, and other conditions affecting performance of the Work.
- B. Proceed with application only after substrate construction and penetrating work have been completed and unsatisfactory conditions have been corrected.

3.2 PREPARATION

- A. Clean, prepare, and treat substrates according to manufacturer's written instructions. Provide clean, dust-free, and dry substrates for dampproofing application.
- B. Mask or otherwise protect adjoining exposed surfaces from being stained, spotted, or coated with dampproofing. Prevent dampproofing materials from entering and clogging weep holes and drains.
- C. Clean substrates of projections and substances detrimental to dampproofing work; fill voids, seal joints, and remove bond breakers if any.
- D. Apply patching compound to patch and fill tie holes, honeycombs, reveals, and other imperfections.

3.3 APPLICATION, GENERAL

- A. Comply with manufacturer's written instructions for dampproofing application, cure time between coats, and drying time before backfilling unless otherwise indicated.
  - 1. Apply dampproofing to provide continuous plane of protection.
  - 2. Apply additional coats if recommended in writing by manufacturer or to achieve a smooth surface and uninterrupted coverage.
- B. Where dampproofing footings and foundation walls, apply from finished-grade line to top of footing; extend over top of footing and down a minimum of **6 inches** over outside face of footing.
  - 1. Extend dampproofing **12 inches** onto intersecting walls and footings, but do not extend onto surfaces exposed to view when Project is completed.

3.4 COLD-APPLIED, EMULSIFIED-ASPHALT DAMPPROOFING

- A. Concrete Foundations: Apply one fibered brush or spray coat at not less than **3 gal./100 sq. ft.**
- B. Unparged Masonry Foundation Walls: Apply primer and one fibered brush or spray coat at not less than **3 gal./100 sq. ft.**

3.5 PROTECTION

- A. Protect installed insulation drainage panels from damage due to UV light, harmful weather exposures, physical abuse, and other causes. Provide temporary coverings where panels are

subject to abuse and cannot be concealed and protected by permanent construction immediately after installation.

- B. Correct dampproofing that does not comply with requirements; repair substrates, and reapply dampproofing.

END OF SECTION 07 1113

SECTION 23 0900 - CONTROL SPECIFICATIONS

PART 1 GENERAL

1.01 Section Includes

- A. Building Management System (BMS), utilizing direct digital controls.

1.02 Related Work Specified Elsewhere

A. Products Supplied but Not Installed Under This Section:

- 1. Flow switches.
- 2. Wells, sockets and other inline hardware for water sensors (temperature, pressure, flow).
- 3. Automatic control dampers, where not supplied with equipment.
- 4. Airflow measuring stations.
- 5. Terminal unit controllers and actuators, when installed by terminal unit manufacturer.
- 6. Variable frequency drives. (This does not include VFDs integral to machinery such as chillers or boilers).
- 7. In-line meters (gas, water, power, BTU).

B. Products Installed but Not Supplied Under This Section:

- 1. None.

C. Products Not Furnished or Installed But Integrated with the Work of This Section:

- 2. Refrigerant monitors.
- 3. Smoke detectors (through alarm relay contacts).
- 4. Chiller Control Systems.
- 5. Boiler Control Systems.
- 6. Pump Control Packages.
- 7. Chemical Water Treatment.

D. Work Required Under Other Divisions Related to This Section:

- 1. Power wiring to line side of motor starters, disconnects or variable frequency

drives.

2. Provision and wiring of smoke detectors and other devices relating to fire alarm system.
3. Campus LAN (Ethernet) connection adjacent to JACE network management controller.

1.03 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 LonTalk, BACnet, or IP Based open protocol bus. All controllers on the LonTalk bus shall be LonMarkcertified.
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.
  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. Acceptable specific vendor circumstances for protocol requirement such as Mitsubishi VRF System to b BACnet or Modbus interfaced to the BAS Niagara system from the factory protocol.
  4. 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.
  5. All control devices, including configurable and fully programmable controllers, furnished with this Section shall be programmable directly from the Niagara 4 Workbench embedded toolset upon completion of this project. The use of configurable or programmable controllers that require additional software tools shall not be acceptable.
  6. Any control vendor that shall provide additional BMS server software shall be unacceptable. Only systems that utilize the Niagara 4 Framework shall satisfy the requirements of this section.

7. The BMS server shall host all graphic files for the control system. All graphics and navigation schemes for this project shall match those that are on the existing campus NiagaraAX or Niagara 4 Framework server.
8. A new laptop computer including engineering/programming software to modify Operating System Server BMS programs and graphics shall be included. An IPAD may be requested for monitoring of building operations and graphic access and will be job specific per a request by UNCW if required (Owner's discrepancy)
9. 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 server, engineering and programming software required for the ongoing maintenance and operation of the BMS. UNCW will be responsible for setting up desired user accounts with necessary access limits per each user's requirements and allowances.
10. 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.
11. All JACE hardware licenses and certificates shall be stored on local MicroSD memory card employing encrypted "safe boot" technology.
12. All JACE's provided as part of this project shall be the appropriate JACE-8000 model licensed with all necessary drivers.
13. Approved Manufacturers: Honeywell, Schneider, Distech, Trane.
14. Approved Installation Contractors: Engineered Control Solutions, Brady Service, CMS Controls.

#### 1.04 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 overstated 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.
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.
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. OSS: Operating System Server, 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. WAN: Wide Area Network.
- 1.05 Submittals
- A. Submit under provisions of *Section 01 30 00*.
  - 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. Electronic submittals of the entire control system shall be submitted and shall consist of a complete list of equipment and materials, including manufacturers' catalog data sheets and installation instructions. Submit in printed electronic format. Samples of written Controller Checkout Sheets and Performance Verification Procedures for applications similar in scope shall be included for approval.

- E. Shop drawings shall also contain complete wiring and schematic diagrams, sequences of operation, control system bus layout and any other details required to demonstrate that the system has been coordinated and will properly function as a system. Terminal identification for all control wiring shall be shown on the shop drawings.
- F. 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.
- G. Any deviations from these specifications or the work indicated on the drawings shall be clearly identified in the Submittals.
- H. All control panels associated with a field device such as air handlers and water systems shall have a laminated page copy of the wiring schematic and detail attached to the control cabinet.
- I. A software copy of the controls as built shall be supplied and downloaded to the local system network controller (SNC) in 2 different formats. One PDF format and another in the format (Visio) used to produce and engineer the original document as to allow UNCW to modify the as-builts in future changes, construction, and modifications to the controls system.

1.06 Quality Assurance

- A. The Control System Contractor shall have a full service DDC office within 50 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 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 10 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 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.

1.07 Software Ownership

- A. The Owner shall have full ownership and full access rights for all network management, operating system server, engineering and programming software required for the ongoing maintenance and operation of the BMS.

1.08 Delivery, Storage & 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.

1.09 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.

1.10 Sequencing

- A. Ensure that products of this section are supplied to affected trades in time to prevent interruption of construction progress.

PART 2 PRODUCTS

2.01 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.

- B. The installed system shall provide secure strong password access to all features, functions and data contained in the overall BMS.

2.02 Open, Interoperable, Intergrated Architecture

- A. The intent of this specification is to provide a peer-to-peer networked, stand-alone, distributed control system utilizing the LonWorks technology communication protocol in one open, interoperable system.
- B. 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 or IP.
- C. 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.
- D. The supplied system shall incorporate the ability to access all data using HTML5 enabled browsers without requiring proprietary operator interface and configuration programs or browser plug-ins. An Open Database Connectivity (ODBC) or Structured Query Language (SQL) compliant server database is required for all system database parameter storage. This data shall reside on the Operating System Server located in the Facilities Office on the LAN. Systems requiring proprietary database and user interface programs shall not be acceptable.
- E. A hierarchical topology is required to assure reasonable system response times and to manage the flow and sharing of data without unduly burdening the customer's internal Intranet network. Systems employing a "flat" single tiered architecture shall not be acceptable.
  - 1. Maximum acceptable response time from any alarm occurrence (at the point of origin) to the point of annunciation shall not exceed 5 seconds for network connected user interfaces.
  - 2. Maximum acceptable response time from any alarm occurrence (at the point of origin) to the point of annunciation shall not exceed 60 seconds for remote or dial-up connected user interfaces.

2.03 BAS Server Hardware (Provided by Owner)

- A. Minimum Computer Configuration (Hardware Independent).
  - 1. Central Server. Owner shall provide a dedicated BAS server with configuration that includes the following components as a minimum:
  - 2. Processor: Intel Xeon CPU E5-2640 x64 (or better), compatible with dual- and quad- core processors.
  - 3. Memory: 8 GB or more.
  - 4. Hard Drive: 80 GB minimum, more recommended depending on archiving requirements.
  - 5. Display: Video card and monitor capable of displaying 1024 x 768-pixel resolution or greater.
  - 6. Network Support: Ethernet adapter (10/100 Mb with RJ-45 connector).
  - 7. Connectivity: Full-time high-speed ISP connection recommended for remote site access (i.e. T1, ADSL, cable modem).
- B. Standard Client: The thin-client Web Browser BAS GUI shall be Microsoft Internet Explorer (10.0 or later) running on Microsoft 7+. No special software shall be required to be installed on the PCs used to access the BAS via a web browser.

2.04 System Network Controller (SNC)

- A. These controllers are designed to manage communications between the programmable equipment controllers (PEC), application specific controllers (ASC) and advanced unitary controllers (AUC) which are connected to its communications trunks, manage communications between itself and other system network controllers (SNC) 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 controllers shall be fully programmable to meet the unique requirements of the facility it shall control.
- C. The controllers shall be capable of peer-to-peer communications with other SNC's and with any OWS connected to the BAS, whether the OWS is directly connected, connected via cellular modem or connected via the Internet.
- D. The communication protocols utilized for peer-to-peer communications between SNC's will be Niagara 4 Fox, BACnet

TCP/IP and SNMP. Use of a proprietary communication protocol for peer-to-peer communications between SNC's is not allowed.

- E. The SNC shall employ a device count capacity license model that supports expansion capabilities.
- F. The SNC 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
- G. The SNC 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 Lon Works, BACnet, and MODBUS controller data.
  - 7. Network management functions for all SNC, PEC and ASC based devices.
- H. The SNC 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 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
- I. The SNC shall be installed with a UPS battery backup with a minimum specification rating of 600VA/300W and surge protection mounted in or next to the SNC main panel.
- J. The SNC shall provide alarm recognition, storage, routing, management and analysis to supplement distributed capabilities of equipment or application specific controllers.
- K. The SNC 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.
    - 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. Pagers via paging services that initiate a page on receipt of email message.
    - d. Graphics with flashing alarm object(s).
  3. The following shall be recorded by the SNC 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
  4. Alarms classes shall be created in the local station to match N4 Supervisor class naming in the following manner with same naming for priority routing and annunciation. (listed in

order of priority from highest to lowest)

- a. Critical Alarms (Priority 1)
  - b. High Priority (Priority 2)
  - c. Space Temp Alarms (Priority 3)
  - d. Generator Alarms (Priority 3) (if required)
  - e. Plumbers Alarms (Priority 3) (if required)
  - f. Mid Priority (Priority 4)
  - g. Low Priority (Priority 5)
  - h. Ping Alarms (Priority 6)
  - i. \*Back to normal state (Priority 7) \*
5. All alarm classes in the local station shall be directed to the N4 station recipient for routing. The Supervisors "Supervisor Console" should be added to a Px view accessible via a hyperlink with a filter applied to show only the selected buildings alarms on the appropriate building's graphics alarm page.
- a. Time Stamp
  - b. Source
  - c. Source State
  - d. Alarm State
  - e. Priority
  - f. Alarm Class
  - g. Ack or Clear Action link
- L. Programming software and all controller "Setup Wizards" shall be embedded into the SNC.
- M. The SNC 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 SNC 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 SNC shall employ template functionality. Templates are a containerized set of configured data tags, graphics, histories, alarms... 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) shall have an associated template file for reuse on future project additions.
  - P. The SNC point naming shall follow a standard as set for a standardized naming convention. This naming standard shall be applied to the SNC as well as the BAS Server Supervisor for all points related to setpoints, monitoring points, trending, alarming, and graphics.
  - Q. The SNC shall be provided with a 1 Year Software Maintenance license. Labor to implement not included.
- 2.05 Building Automation System Controllers
- A. HVAC local programmable and configurable controller's communications protocol (AHU, VAV, and plant) shall be accomplished using LonMark, BACnet, or IP based devices. The controller platform shall provide options and advanced system functions, programmable and configurable using Niagara 4 Framework, that allow standard and customizable control solutions required in executing the "Sequence of Operation".
    - 1. Programmable Equipment Controllers - 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 PECs are to allow for the flexibility of custom control programming to meet the needed sequences of operation.

PEC's shall be selected based upon I/O requirements. Additional I/O may be added via expansion modules.

- a. All PECs shall be application programmable and shall at all times maintain their certification. All control sequences within or programmed into the PEC shall be stored in non-volatile memory, which is not dependent upon the presence of a battery to be retained.
  - b. The PEC shall provide LED indication of communication and controller performance to the technician, without cover removal.
  - c. PEC's shall have mixture of I/O including dry contact digital inputs, universal inputs (configurable as 0-10V, 0-10,000 ohm or, 20K NTC), analog outputs (4-20mA), and digital outputs (24 VAC TRIAC or relay).
2. Configurable DOAS Controller (DOAS) - the configurable controller shall be designed specifically for single zone unitary AHU control – temperature, humidity, complex CO<sub>2</sub>, occupancy, and emergency control. Equipment includes unitary air handling units, fan coil units, blower coil units, unit ventilators, and heat pumps.
- a. The controller shall be application specific configuration and shall at all times maintain their certification. All control sequences within or programmed into the controller shall be stored in non-volatile memory, which is not dependent upon the presence of a battery to be retained.
  - b. The controller shall provide LED indication of communication and controller performance to the technician, without cover removal.
  - c. Controllers shall have mixture of I/O including dry contact digital inputs, universal inputs (configurable as 0-10V, 0-10,000 ohm or, 20K NTC), analog outputs (4-20mA), and digital outputs (24 VAC TRIAC).

2.06 Other Control System Hardware

- A. Utility metering devices, (water, electric, and gas) shall be non-pulse devices with non-volatile memory communicated directly to a gateway such as SCADA metrics Ethermeter, Onicon D-100, or kW switchgear meters which will be communicated to the building and supervisor Niagara system.
- B. HVAC local non-programmable and non-configurable

integration devices, (boilers, VFD's, and utility meters) shall use LonMark, BACnet, Modbus, or IP based devices to communicate.

- C. Motorized control dampers that will not be integral to the equipment shall be furnished by the Control System Contractor. Control damper frames shall be constructed of galvanized steel, formed into changes, and welded or riveted. Dampers shall be galvanized, with nylon bearings. Blade edge seals shall be vinyl. Blade edge and tip seals shall be included for all dampers. Blades shall be 16-gauge minimum and 6 inches wide maximum and frame shall be of welded channel iron. Damper leakage shall not exceed 10 CFM per square foot, at 1.5 inches water gauge static pressure.
- D. Control damper actuators shall be furnished by the Control System Contractor. Two-position or proportional electric actuators shall be direct-mount type sized to provide a minimum of 5 in-lb. torque per square foot of damper area. Damper actuators shall be spring return type. Operators shall be heavy-duty electronic type for positioning automatic dampers in response to a control signal. Motor shall be of sufficient size to operate damper positively and smoothly to obtain correct sequence as indicated. All applications requiring proportional operation shall utilize truly proportional electric actuators.
- E. Wall Mount Room Temperature sensors: Each room temperature sensor shall provide temperature indication to the digital controller, provide the capability for a software-limited occupant set point adjustment (warmer-cooler slider bar or switch) and limited operation override capability. Room Temperature Sensors shall be 20,000-ohm thermistor type with a temperature range of -40 to 140 degrees F (-38 to 60 degrees C). The sensor shall be complete with a decorative cover and suitable for mounting over a standard electrical utility box. These devices shall have an accuracy of 0.5 degrees F (.024 degrees C) over the entire range.
- F. Duct-mounted and Outside Air Temperature Sensors: 20,000-ohm thermistor temperature sensors with an accuracy of  $\pm$  0.2 degrees C. Outside air sensors shall include an integral sun shield. Duct-mounted sensors shall have an insertion measuring probe of a length appropriate for the duct size, with a temperature range of -40 to 160 degrees F (-38 to 71 degrees C) The sensor shall include a utility box and a gasket to prevent air leakage and vibration noise. For all mixed air and preheat air applications, install bendable averaging duct sensors with a minimum 8 feet (2438 mm) long sensor element. These devices shall have accuracy of 0.5 degrees F (.024 degrees C) over the entire range.
- G. Humidity sensors shall be thin-film capacitive type sensor with

on-board nonvolatile memory, accuracy to plus or minus two percent (2%) at 0 to 90% RH, 12 - 30 VDC input voltage, analog output (0 - 10 VDC or 4 - 20mA output). Operating range shall be 0 to 100% RH and 32 to 140 degrees F (0 to 60 degrees C). Sensors shall be selected for wall, duct or outdoor type installation as appropriate. Honeywell is basis of design.

- H. Carbon Dioxide Sensors (CO<sub>2</sub>): Sensors shall utilize Non-dispersive infrared technology (N.D.I.R.), repeatable to plus or minus 20 PPM. Sensor range shall be 0 - 2000 PPM. Accuracy shall be plus or minus five percent (5%) or 75 PPM, whichever is greater. Response shall be less than one minute. Input voltage shall be 20 to 30 VAC or DC. Output shall be 0 - 10 VDC. Sensor shall be wall or duct mounted type, as appropriate for the application, housed in a high impact plastic enclosure.
- I. Current Sensitive Switches: Solid state, split core current switch that operates when the current level (sensed by the internal current transformer) exceeds the adjustable trip point. Current switch to include an integral LED for indication of trip condition and a current level below trip setpoint.
- J. Differential Analog (duct) Static Pressure Transmitters Provide a pressure transmitter with integral capacitance type sensing and solid-state circuitry. Accuracy shall be plus or minus 1% of full range; range shall be selected for the specific application. Provide zero and span adjustment capability. Device shall have integral static pickup tube.
- K. Differential Air Pressure Switches: Provide SPDT type, UL-approved, and selected for the appropriate operating range where applied. Switches shall have adjustable set points and barbed pressure tips.
- L. 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. A complete set of 'as-built' control drawings (relating to the controls within that panel) shall be furnished within each control panel.
- M. Pipe and Duct Temperature sensing elements: 20,000-ohm thermistor temperature sensors with an accuracy of  $\pm 1\%$  accuracy. Their range shall be -5 to 250 degrees F (-20 to 121 degrees C). Limited range sensors shall be acceptable provided they are capable of sensing the range expected for the point at the specified accuracy. Thermal wells with heat conductive gel shall be included.
- N. Low Air Temperature Sensors: Provide SPST type switch, with 15

to 55 degrees F (-9 to 13 degrees C), range, vapor-charged temperature sensor. Honeywell model L482A or approved equivalent.

- O. Variable Frequency Drives: The variable frequency drive (VFD) shall be designed specifically for use in Heating, Ventilation, and Air Conditioning (HVAC) applications in which speed control of the motor can be applied. The VFD, including all factory installed options, shall have UL & CSA approval. VFD's shall include communications capability with DDC BMS via built-in interface card (LonMark MODBUS or BACnet). Honeywell SmartVFD is basis of design.
- P. 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 subbase 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.
- Q. Emergency Stop Switches: Provide toggle-type switch with normally closed contact. Switch shall be labeled "AIR HANDLER EMERGENCY SHUTOFF, NORMAL -OFF."
- R. Transducers: Differential pressure transducers shall be electronic with a 4-20 mA output signal compatible to the Direct Digital Controller. Wetted parts shall be stainless steel. Unit shall be designed to operate in the pressure ranges involved.
- S. 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.
- T. 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.
- U. Lon Bus Surge Protectors: A Lon Bus Surge Protector, DITEK model # DTK- 2MHLP24BWB or equivalent shall be installed on the lon bus when it leaves and enters a building.

- V. Ethernet Port Surge Protector: An Ethernet Surge protector shall be installed similar to the Honeywell 14507678-004 or comparable.

AA. Airflow Monitoring Stations: Ebtron Brand airflow monitoring stations shall be Lon.

Controls Contractor shall verify installed duct sizes and airflows before ordering.

- BB. Gas Meters: Onicon brand F-5400 Series Thermal Mass Flow Meter, D-100 display with LonWorks TP/FT-10F Output. Controls Contractor shall verify installed pipe size, meter placement sizes and flows before ordering.

CC. Domestic Water Meters: Building meters: Neptune

1.5 inches and below shall be positive displacement type with matching strainer. 2 inches and above shall be compound type meter with matching strainer.

Irrigation meters: Neptune

Minimum 2" turbine meter with matching strainer

Meter Register: Neptune E-Coder register w/ the potted cable. (The R900i register is NOT compatible, since it does not feature a connection wire.)

Meter Gateway: Scadаметrics Ethermeter  
<http://www.scadametrics.com/> The gateway device shall directly interrogate the meter register and shall calculate and relay the following parameters to the BMS: Totalized Volume, Instantaneous Flowrate

- EE. Electric Meter: Digital Electric Meter with Modbus communication. Unit shall display and communicate totalized kWh, voltage, amps, kW

- FF. Liquid Flow Meters: Onicon F-3500 Electromagnetic Flow Meter, D-100 Display with LonWorks Communication (other Onicon displays allowed with designer approval)

## 2.07 BAS Server & 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 BAS server shall communicate using Ethernet and TCP. Server 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-Windows operating systems.

- C. The BAS server software shall support at least the following server platforms (Windows 7, 8.1, Server 12). The BAS server 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.
  - 8. Parameter changes 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. Server Software, Database and Web Browser Graphical User Interface.
  2. 5 Year Software Maintenance license. Labor to implement not included.
  3. Embedded System Configuration Utilities for future modifications to the system and controllers.
  4. Embedded Graphical Programming Tools.
  5. Embedded Direct Digital Control software.
  6. Embedded Application Software.
- F. BAS Server Database: The BAS server 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 (Explorer/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 BAS server shall offer encryption using 128-bit encryption technology within Secure Socket Layers (SSL). Communication protocol shall be Hyper-Text Transfer Protocol (HTTP).

2.08 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, 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 floorplans, 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 property's 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 webbrowser 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.
  9. Other actions such as Print, Help, Command, and Logout shall be available via a drop-down window.
- E. 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 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 1024 by 768 pixels 24-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. Provide a visual display of temperature relative to their respective set points. The colors shall be updated dynamically as a zone's actual comfort condition changes.
  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

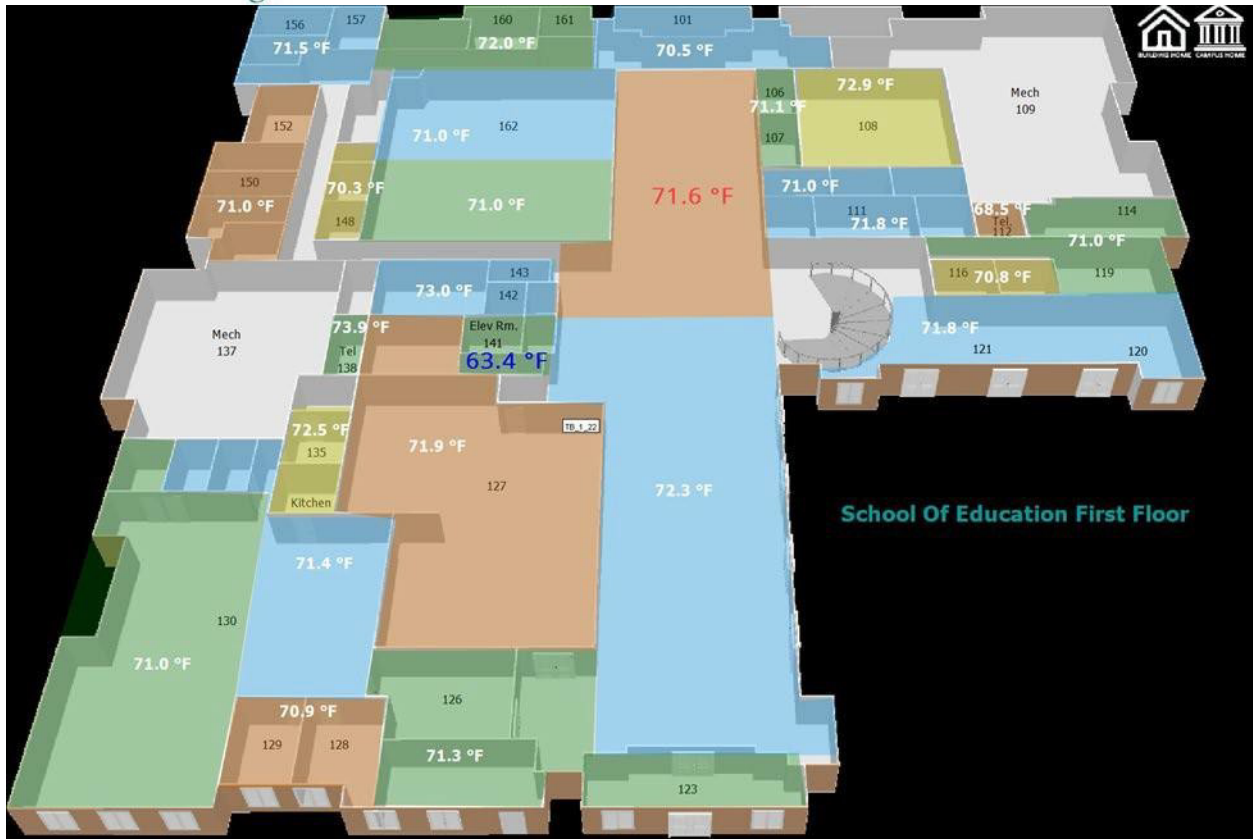
units. Animation shall be used for rotation or moving mechanical components to enhance usability.

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. Display Size: The GUI workstation software shall graphically display in a minimum of 1024 by 728 pixels 24-bit True Color.
7. General Graphic: General area maps shall show locations of controlled buildings in relation to local landmarks.
8. Color Floor Plans: Floor plan graphics shall be multi-colored to differentiate between the different zones and areas. Colors selected are based on a neutral palette as to not show a large variance in bright colors but more of a neutral, slightly different tones. Provide a visual display of temperature relative to their respective set points via the use of a color changing font and size that displays the zone temperature. The displayed temperature shall change to a red blinking, size 20 font for high space temperature and blue blinking, size 20 font for low space temperature. The colors and font size shall be updated as a zone's actual comfort condition changes from a normal range to a high or low out of range measurement.



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### *Design and Construction Guidelines*



- 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 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.

- 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:
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 GraphicPane.
  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 BAS Server database.

8. 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 BAS server 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 BAS server'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).
  - 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 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 GraphicPane.
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 BAS server 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).

- I. Security Access: Systems that Security access from the web browser GUI to BAS server

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.

#### 2.09 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 a 'live'

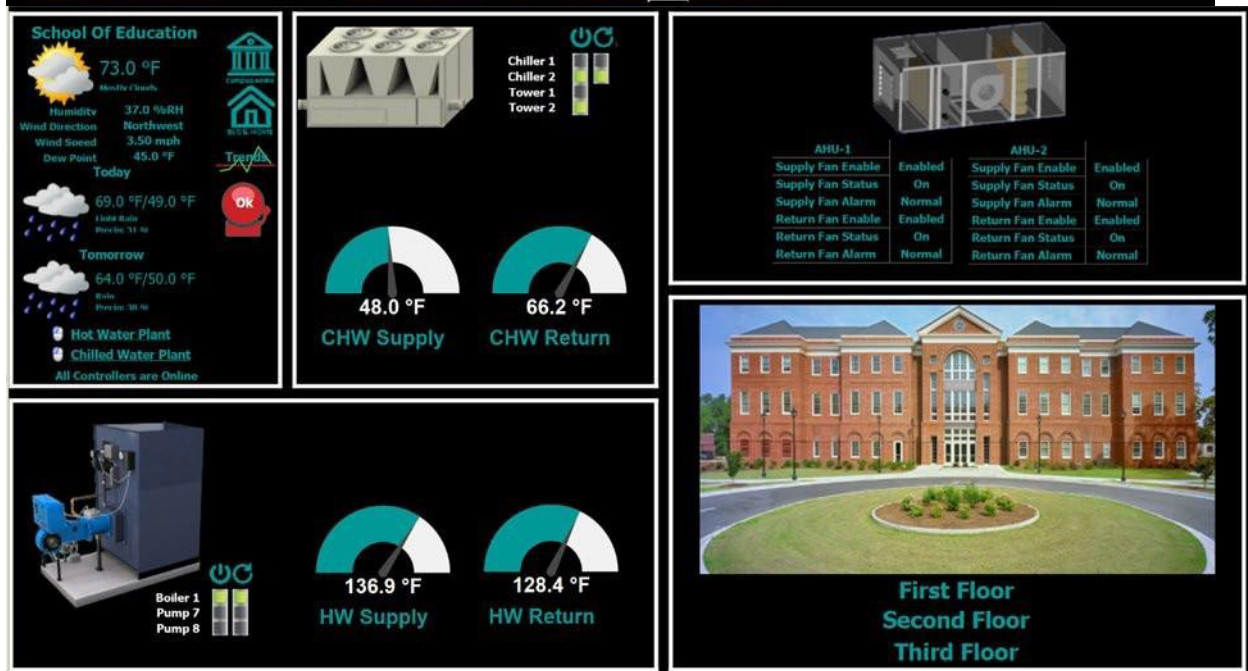
real- time mode.

2.10 Web Browser Graphical User Interface

- A. 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 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 1024 by 768 pixels 24-bit TrueColor.
  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 be multi-colored to differentiate between the different zones and areas. Colors selected are based on a neutral palette as to not show a large variance in bright colors but more of a neutral, slightly different tones. Provide a visual display of temperature relative to their respective set points via the use of a color changing font and size that displays the zone temperature. The displayed temperature shall change to a red blinking, size 20 font for high space temperature and blue blinking, size 20 font for low space temperature. The colors and font size shall be updated as a zone's actual comfort condition changes from a normal range to a high or low out of range measurement.
  4. General Graphic: A general first page for the building shall be of a standard summary format showing vital information and links to the building's operation and status. This PX page is named "overview" and is the first page to go to when accessing the building from the N4 Campus homepage.

UNCW University of North Carolina Wilmington

Design and Construction Guidelines



2.11 Lonworks Network Management

- A. Systems requiring the use of third-party LonWorks 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 LonWorks network, regardless of what network management tool(s) were used to install the existing network, so that existing LonWorks devices and newly added devices are part of a single network management database.
- E. The network management database shall be resident in the Site Network Controller (SNC), 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.
- F. 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 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 1024 by 768 pixels 24-bit True Color.
  - 2. General Graphic: A general first page for the building shall be of a standard summary format showing vital information and links to the building's operation and status. This PX page is named "overview" and is the first page to go to when accessing the building from the N4 Campus homepage.

PART 3 EXECUTION

3.01 Examination

- A. Do not begin installation until substrates have been properly prepared.
- B. If substrate preparation is the responsibility of another installer, notify Architect of unsatisfactory preparation before proceeding.

3.02 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.

3.03 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.

3.04 Wiring

- A. All electrical control wiring to the control panels shall be the responsibility of the Control System Contractor.
- B. All wiring shall be in accordance with the Project Electrical Specifications (Division 16), the National Electrical Code and any applicable local codes. All control wiring shall be installed in raceways.
- C. Excess wire shall not be looped or coiled in the controller cabinet.
- D. Incorporate electrical noise suppression techniques in relay control circuits.
- E. There shall be no drilling on the controller cabinet after the controls are mounted inside.

- F. Careful stripping of wire while inside the cabinet is required to ensure that no wire strand fragments land on circuit boards.
- G. Use manufacturer-specified wire for all network connections.
- H. Use approved optical isolation and lightning protection when penetrating building envelope.
- I. Read installation instructions carefully. Any unavoidable deviations shall be approved by owner's rep prior to installation.

3.05 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. This testing shall include a point- by-point log to validate 100% of the input and output points of the DDC system 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.

3.06 Operator Training

- A. During system commissioning and at such time acceptable performance of the Control 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 comprehensive training in multiple 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 last class is to be in the last month of 1-year warranty period.

3.07 Warranty Period Services

- A. Equipment, materials and workmanship incorporated into the work shall be warranted for a period of one year from the time of system acceptance.
- 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 1 Year Software Maintenance license. All SNC and BAS Servers 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 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.

3.08 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.

3.09 Operation & Maintenance Manuals

- A. See Division 1 for requirements. O&M manuals shall include the following elements, as a minimum:



1. As-built control drawings for all equipment.
2. As-built Network Communications Diagram.
3. General description and specifications for all components.
4. Completed Performance Verification sheets.
5. Completed Controller Checkout/Calibration Sheets.

3.10 Protection

- A. Protect installed products until completion of project.  
Touch-up, repair or replace damaged products before Final Acceptance.

# Infrastructure Standards for Installation

## University of North Carolina Wilmington

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### INFRASTRUCTURE STANDARDS FOR INSTALLATION

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Standards as of 06/01/2020

Provided by ITS

IOS / NETWORK & COMMUNICATIONS

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## Overview

The University of North Carolina Wilmington is constructing new buildings and renovating existing buildings both on and off main. This document defines voice and data cabling requirements for all future installations. The university recognizes that the integrity of the cabling systems and the use of proper installation techniques by qualified contractors, are essential for implementing a dependable network. Bandwidth requirements and fault tolerance is an important aspect of the structured solution and taken into consideration with the infrastructure design.

## Purpose

The university will implement an end-to-end manufacturer's solution that has resulted in the approval of three manufacturers:

1. CommScope SYSTIMAX® Solutions GigaSPEED XL Category 6 Structured Cabling System and Corning Cable Systems LANscape solution
2. CommScope SYSTIMAX® Solutions GigaSPEED X10D Category 6A Structured Cabling System with x91B reduced diameter cable and Corning Cable Systems LANscape solution (Access Solutions)
3. CommScope NETCONNECT/Uniprise® CAT 6 CS37 cabling system and the Corning Cable Systems LANscape
4. CommScope NETCONNECT/Uniprise® CAT 6A CS47 cabling system and the Corning Cable Systems LANscape (Access Solutions)
5. Belden System 2400 (for horizontal cabling). 2412 shall be installed. Key Connect work station outlets and Key Connect patch panels.
6. Belden System 10GXS (for wireless access point cabling). Belden System 3612 and/or 10GXS cabling shall use Belden's REVConnect modular termination system, in appropriate category, supporting either jacks or plugs. Belden System 3600 and/or 10GXS cable shall be installed. Optical fiber system shall be Corning Cable Systems LANscape solution.

This specification is to ensure that UNCW meets with a standards compliant end-to-end cabling solution with guaranteed “Channel” performance. This solution will allow UNCW to maximize productivity and value by minimizing down time and operational expenses, thus warranting our investment for 20 Years, while still providing for a future path to evolving technologies. Each of these solutions requires the contractor to provide Manufacturer certification:

1. CommScope SYSTIMAX Category 6 and Category 6A solutions require the contractor to be a current PartnerPRO network member; installers, supervisors, designers to have a current valid certification.
2. CommScope NETCONNECT/Uniprise Category 6 and Category 6A solutions require contractor to be a current PartnerPRO network member; installers, supervisors, designers to have a current valid certification.
3. Belden solution requires the contractor to be a Belden Partner Alliance (PA) program member.
4. Corning solution requires the installers to be a current EWP.

## Solution Description

The SCS Solution shall utilize a network of fiber optic and unshielded twisted pair, riser, ty and station cables. Cables and terminations located as shown and in the quantities indicated on the drawings. Fiber cables shall terminate on wall- or rack-mounted fiber patch panels located in all demarcation and termination points shown on the drawings. All cables shall terminate in an alphanumeric sequence at all termination locations. All standard copper cable terminations shall comply with, and be tested to latest revision of TIA-568-C family of standards for Category 6 and/or beyond Category 6 installations. Horizontal cabling for wireless access points (WAPs) shall comply with, and be tested to latest revision of TIA-568-C family of standards for Category 6A and/or beyond Category 6 installations. Available and unused pairs between the Equipment Room (ER) and Telecommunications Room(s) (TR) shall terminate and identified as spare at each location. Station cables shall terminate on three or four gang wall plates equipped as shown on the drawings. All copper terminations will be T-568B wiring.

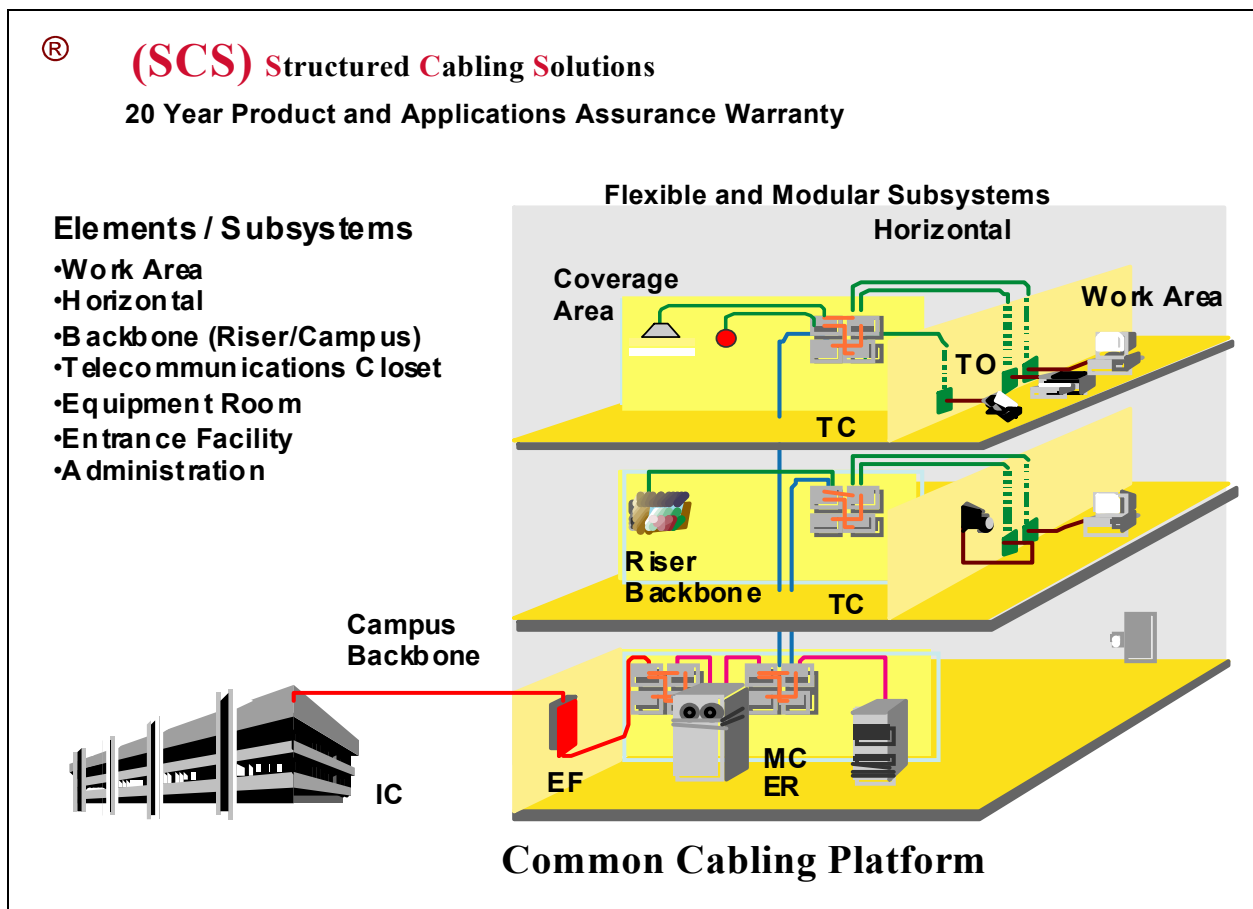
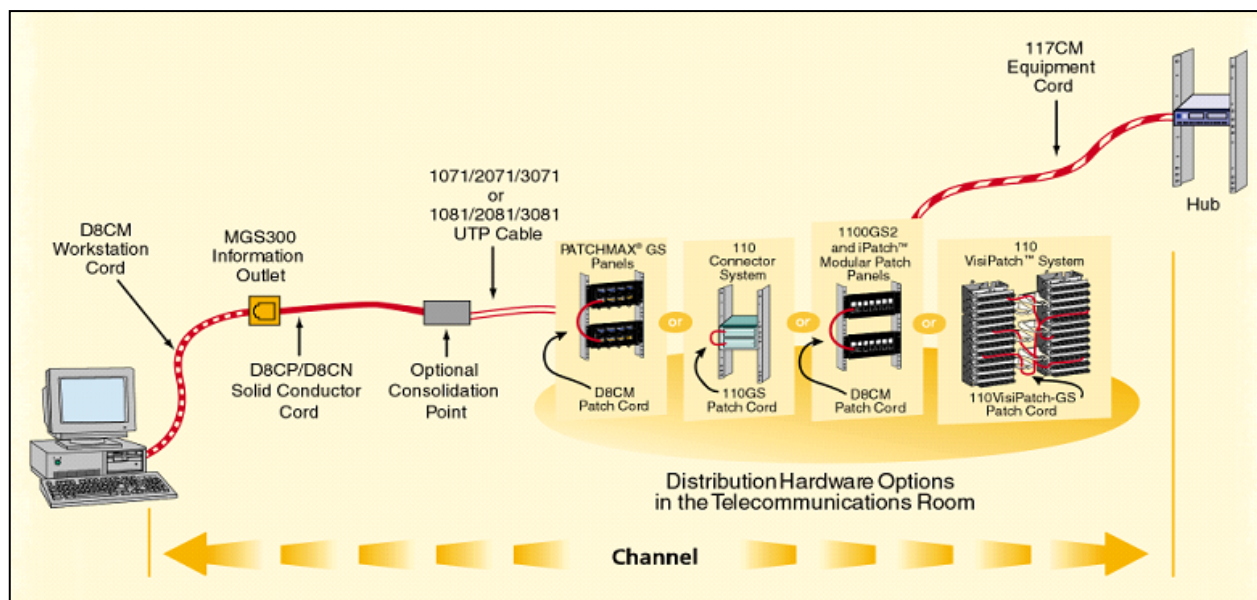


Diagram 1 - Structured Cabling Solution

## Channel Performance Specifications

The SCS solution for standard cable drops shall support a useable end-to-end system bandwidth of not less than 400 MHz. This requires substantial performance margin in all key electrical parameters beyond Category 6. Useable end-to-end system bandwidth is indicated by the maximum frequency at which a positive Power Sum Attenuation-to-Crosstalk Ratio may be obtained at both the Near (PSACRN) and Far ends (PSACRF) of a 100-meter cabling channel. This channel shall have the capability of four or six connections without failing to meet Category 6 specifications.

The required cabling system described is a “Beyond Category 6” structured cabling solution.



The SCS solution for wireless access points (WAPs) shall support a useable end-to-end system bandwidth of not less than 500 MHz. This requires substantial performance margin in all key electrical parameters beyond Category 6A. Useable end-to-end system bandwidth is indicated by the maximum frequency at which a positive Power Sum Attenuation-to-Crosstalk Ratio may be obtained at both the Near (PSACRN) and Far ends (PSACRF) of a 100-meter cabling channel. This channel shall have the capability of four or six connections without failing to meet Category 6A specifications.

The required cabling system described is a “Beyond Category 6A” structured cabling solution.



## Installation Specifics

The installation contractor shall be responsible for installing, terminating, testing, and labeling the cabling system in accordance with TIA and BICSI installation guidelines for intra and inter building. The contractor will also provide UNCW with a dedicated project manager for the life of the project who is responsible for planning the installation schedule and act as the interface with UNCW employees. Weekly update meetings will be required. The contractor will also provide UNCW with the certified installation warranty certificate at the completion of the project. This will insure that UNCW will be able to maintain a warranty on their installed communication systems.

A single manufacturer shall provide all unshielded twisted pair (UTP) end-to-end Channel (as defined by latest revision of TIA-568-C family of wiring standards) configurations. The horizontal cabling to station outlets shall consist of UTP, riser rated (CMR) cable at a minimum.

Each standard data cable shall be 'Beyond' Category 6 rated to a minimum of 400 megahertz and shall be third party verified to comply with or exceed TIA Category 6 requirements.

Each cable for wireless access points (WAPs) shall be a "Beyond" Category 6A cable rated to a minimum of 500 MHz. Each cable for WAPs shall be third party verified to comply with or exceed Category 6A requirements, and shall carry be capable of supporting 100W Power-Over-Ethernet over 100 meters.

References for the project and standards shall be as required to include:

- A. TIA-568-C.2 (or latest revision)
- B. TIA-569-D (or latest revision)
- C. TIA-606-C (or latest revision)
- D. TIA-607-C (or latest revision)
- E. NETA ATS (or latest revision)
- F. NFPA 70 (or latest revision)
- G. UL 969 (or latest revision)
- H. ISO/IEC 11801 (or latest revision)
- I. BICSI TDMM (or latest revision)
- J. BICSI CO-OSP (or latest revision)
- K. STS-1000 (or latest revision)
- L. Standards of Installation of Infrastructure Network Communications at UNCW

### Number of Drops per Room

*Faculty/Staff Offices, Class Rooms, Conference Rooms*

Will have a minimum of four (4), beyond Category 6 rated and one (1) - coax terminated on a video coupler insert or campus wide access outlet as determined on the print. Additional drops installed as requested. Each horizontal UTP cable shall terminate on one RJ-45 jack at the workstation. The termination method on the rear of the jack shall be Insulation Displacement Contact (IDC) type connectors. The pin assignments shall conform to TIA-568- B standard T568B. Rooms less than 100 square feet will have one (1) standard information outlet and rooms 100 square feet or more will have two (2) information outlets. An information outlet is two (2) voice and two (2) data.

Each information outlet will have a minimum of two (2) voice and two (2) data outlets.

### ***Wall phone locations***

Wall telephone outlets shall use Suttle 063187 or approved functional equivalent. The wall phone jack will be stainless steel and have mounting lugs with screw down termination. The mounting position will provide enough room for a standard wall phone w/ADA jack beside it.

### ***Data Projectors***

Each data projector will have a minimum of three cat 6 or beyond data cables installed.

### ***A/V Equipment Racks***

Each rack will have a minimum of five cat 6 or beyond data cables.

### ***TR Inter-connects***

Will have a minimum of three (3), Cat 6 for each Closet. Also an additional cross-connect for every twenty-four (24) installed Cat 6 jacks beyond the first twenty-four (24) connections.

### ***Print Machines***

Will have a minimum of one (1) dedicated Cat 6 for each device.

### ***Vending Machines***

minimum of one (1) dedicated Cat 6 for each device.

Will have a

### ***Irrigation Clocks***

minimum on one (1) dedicated Cat 6 with in line protection installed (Ditek or equivalent). The installation will determine the cable used to meet code.

Will have a

### ***Water Meter(s)***

Each water meter will have a minimum of one (1) dedicated cat 6 to each location. Installation of one voice line will be required in addition to the data line.

***JACE (HVAC) Communications***

Each JACE location will have a Standard drop on One (1) voice and two (2) data. The standard drop is within two feet of the JACE location.

***Freezer Location***

standard drop for each location.

Will have one (1)

***Television Location and Monitor Locations***

(2) data outlets.

Will have two

***Intercom Cabling***

Each Intercom unit will have one (1) dedicated data cable from the data rack in the Communications room.

Each Intercom

**Wireless Access Point Outlets and installation:**

Wireless access points shall terminate on a dedicated 6A patch panel that matches the structured cabling solution being installed. Each wireless access point will have two (2) dedicated cat 6A cables installed. The certified voice and data contractor for the project will install the exterior and interior wireless access points provided by the University.

***Conference and Auditorium***

16 to 25 seat- 2 outlets

25 to 30 seat- 3 outlets

30 to 50 seat-4 outlets

50 to 75 seat-5 outlets

75 to 100 seat- 6 outlets

***Work rooms*** – 2 outlets

***Hallways*** – every 100 feet

***Main Electrical rooms***- one per room

***Primary Mechanical rooms***- one per room

## Cable Installation

Cabling Termination practices: The installer will observe the cabling practices described in the TIA-568-C family of standards. Standard industry practices guided by the latest revisions of BICSI TDMM and BICSI installation manuals are required for cable installation, handling, grooming, etc. Installation of cabling is in a manner that will protect the cable from damage during install, facilitate cable management and identification and provide a neat and groomed appearance. The horizontal cables shall be bundled in the ER/TR ladder tray using Velcro cable ties. Plastic ty-wraps are unacceptable. During the installation, nicks, abrasions, burning, and scuffing of cable are unacceptable and will be prevented. Replacement of damaged cables are at the contractor's expense regardless of whether the cable passes Category 6 Level III testing standards.

***Cross-connect fields*** 110 or  
GigaBIX IDC connecting clips or blocks for every installed cable pair at the rack and WAO.

### ***Horizontal station cable***

Should have twelve inches of spare cable at the station outlet and 10 feet of spare at each rack  
Category 5e power sum cables and fiber riser cable between the ER/TR

Outside plant Category 3: Eight feet spare at each protector block.

Fiber terminating into the building: as per industry best practices, last 15 feet of fiber cable to be cut off and discarded after pulling, still leaving 20 feet of spare at each rack.

### ***Network Data Connections***

Manufacturer certification is required for installers. Information outlet terminations will be to manufacturer's specifications. The installer is responsible for end-to-end termination of all the cabling.

All data cable is blue in color unless changed by environmental standards.

### Network and Communications – Telephony

All voice cable shall be Category 6 or beyond Category 6 rated. Telecommunication's voice cable is white jacketed. Manufacturer certification is required for installers. Information outlet terminations will be to manufacturer's specifications. The installer is responsible for end-to-end termination of all the cabling.

#### ***Telephone Trunk Cables***

Cables of 25 pair and up are 24 AWG, LSPR Power Sum (Category 5e) solid conductor cables. These high pair-count cables terminate on 110-style 360 pair for the SYSTIMAX system, the Belden termination solution or the NECTONNECT Category 5e solution. The punch-down order is the traditional USOC color code order for Multi-pair telephone cables Punched on 110 blocks with insulation displacement connectors installed. All terminations will be on a dedicated voice rack.

#### Jacks (inserts, all installations)

Category 6 jack data jacks are yellow in color

Category 6 jack telecommunications voice jacks are white in color

When specifying Belden copper systems, jacks and modular plugs shall be from Belden's Key Connect & REVConnect product family. REVConnect is only for WAP locations.

CATV video coupler kits are white in color.

Work Area Outlet (WAO) faceplate is white with a minimum of four ports with label insert top and bottom.

#### Campus Copper Voice Backbone

The connection for each building on campus is with a PE-89 rated outdoor copper cable consisting of a minimum of 25 pairs. Termination shall be consistent with the units used for the voice backbone. Terminations will be on protector blocks with 110 in/110 out. Each pair on the protector block use 4c1s 5 pin solid-state protector modules. The underground or inter-building cable installation, termination, and testing by the voice /data contractor.

#### Campus Fiber-Optic Data Backbone

##### *From the MDF to the IDF(s)*

The data cables used between the MDF to the IDF(s) will be a fiber-optic cable consisting of a minimum twelve single-mode fibers. The number and type of fiber and quantities required are according to the existing and future network requirements. The existing cables are Siecor or Corning Cable Systems fiber optic cable and terminated with LC connectors mounted in Corning

Cable Systems LANscape rack-mounted hardware in the top position of the data rack. All twelve strand fibers must terminate in twelve port interconnect panels.

#### *Between Buildings*

Existing buildings use Corning Cable systems duct/aerial hybrid loose-tube fiber-optic cable. Existing hardware is the Corning Cable systems landscape rack-mounted hardware. The University, according to the existing and future network requirements will specify the number and type of fibers.

UNCW is a splice free fiber optic campus. Fiber optic cable splicing is unacceptable for any fiber optic cabling: outside plant or Intra-building.

Outside plant, fiber will terminate in Data rack fiber patch panels in each MDF.

Backbone fiber will terminate in each MDF and TR in a data rack fiber patch panel, either Corning Cable Systems LANscape.

This backbone cable shall consist of a minimum of 24 single-mode fibers.

The cable termination is with LC connectors and rack-mounted hardware.

The minimum count is 24 single mode fibers.

#### Communications Room/Equipment Room

The ER/TR(s) for each building provide for a transition between the horizontal and backbone pathways, and provide space for Network communications components including cable terminations (horizontal and backbone), active and passive equipment, cross-connections cabling, and hardware, and any other materials or equipment associated with the building Network communications, data and technology systems. All Communications Rooms shall have direct access to the hallway or other such corridor. Network communications rooms are dedicated space. Building services such as Electrical (i.e. Electrical Distribution Panels or Transformers) poses a threat of damage or EMI interference that makes them completely unacceptable for Network Communications Equipment and wiring. Supporting codes are in the TIA-568B-C and TIA-569 wiring standard unequivocally against Multi-Use Communications

rooms. In existing buildings, due to age of the building and design criteria at that, time space shared with other trades exists until the building's renovation or space is available.

1. Network communications doors should not open into network communications Rooms.
2. Network communications Rooms shall not contain any type of sink or storage for Custodial or any other such supplies.
3. Network rooms MDFs, IDF's: - do not allow storage of any kind (i.e. Books, Furniture, A/C Filters, Light Bulbs, AV Equip. etc....).
4. Floors in Network Communications Rooms shall be sealed concrete or tile. Carpeted floors are totally unacceptable for Network Communications rooms due to the associated static electricity they create posing a threat of damage to sensitive Network Electronics.
5. A minimum space of 10 ft. X 10 ft. X 8 ft. H is required for all Network Communications Rooms or as required by TIA-569-A designs considerations. Square foot size: 10,000: 10 ft. X 11 ft.; 8,000 sq. ft.: 9 ft. X 10 ft. and 5,000 sq. ft.: 7 ft. X 10 ft.
6. All walls of the Network communications room are covered in ¾" non- fire rated plywood horizontally, be void free and finished on one side; mounted 4 inches above finish floor (AFF) the total perimeter of the room. The Non-fire rated plywood has at least two coats of fire resistant white paint. The paint applied is on all six sides with a minimum of two coats. The final paint finish shall be clear of footprints, markings, etc. and be a smooth finished product. NO exceptions. The plywood will be mounted eight (8) foot vertically and four (4) foot wide around the entire communications room.
7. All Network Communications locations shall be equipped with a grounding bus bar. A solid copper grounding bus bar ¼-inch thick x4 inches high with compression fittings and standoff brackets with insulators will be required on the Network communications backboard.
8. Bus bar connection is to a backbone of insulated, solid copper (minimum #6 AWG, with 3/0 recommended). This backbone is to the main grounding bus bar in the electrical entrance facility that bonds back to the building's grounding system. This point should be at an electric panel per NEC 2005 standards. Chatsworth grounding bar 10622-010 or equivalent. The grounding bar location is mounted above the horizontal cable tray in the TR.
9. Each telecom Room connection to the MCC has a minimum of eight LSPR Power Sum Cables (Category 5e). Cables that installed outdoors will be PE-89 type and

- terminated on 110 in/ 110 out building protectors at each end. Each building entrance protector will be fully loaded with C4B1S (PTC) solid-state protector modules. The pair counts used for this backbone will vary by project due to connection requirements.
10. Each rack will also house a minimum of one (1) rack-mounted surge suppressor or UPS as specified on the print.
  11. TIA-569-D Standards usage for lighting, HVAC, perimeters and dust design are required.
  12. Fire Alarm panel installation in the TR or the ER not permitted.
  13. Electrical outlets mounted at eighty-two (82) inches above AFF to top of outlet.
  14. All electrical outlets are on the emergency generator. If the building does not have an emergency generator circuit prepping for future installed is required.
  15. Installation of electrical conduits, refrigerant pipes, water pipes, HVAC ducting or piping, elevator alarms or pump alarms cannot penetrate through the communication or ER rooms.
  16. Dedicated duplex 20 amp 110 VAC outlets on separate circuits are required. Convenience outlet mounting is at six foot. Intervals around the perimeter.
  17. One- L6-20P outlet is required. Outlet is mounted at eight-two (82) inches AFF.
  18. To improve visibility all walls are white in color.
  19. HVAC: 24 hours/day, 365 days a year, 64 degrees to 75 degrees Fahrenheit, 30 to 55% humidity, positive pressure.
  20. Lighting: Typically, 8.5 ft. high providing 50 ft. candles @ three feet above the floor.
  21. Dust: less than 100 micrograms/cubic meter/24-hour period.
  22. Audio Visual (AV) Cabling: AV cabling shall not use the communications rooms: MDF, IDF, and Entrance Facility as a pathway due to legal and auditing problems. The AV cable for riser pathways needs its own dedicated pathway. AV equipment storage is not allowed.
  23. Intercom units: The single data line for each intercom unit is a standard data cable and terminate in the communications room data rack. Network Communications maintain the cable. AV maintains the power supply and must be located in a dedicated area separate from the communications rooms.
  24. Sleeves and Pathways for Communications, data, and fiber optic cabling is dedicated and not to be used by other trades. Each trade is responsible for providing a dedicated pathway that meets code. Ty-wrapping or attaching to communications pathways or supports is not allowed.



25. Racks are two post open frame with three (3) inch deep channel, seven (7) feet in height, nineteen (19) inches wide and have a total of forty-five (45) RU's. Vertical cable management will be a minimum of six (6) inches wide and six (6) inches deep, double sided with covers. Each rack will have a vertical cable manager per side. If two (2) racks are side by side the total Vertical cable manager's width will be twelve (12) inches wide.

#### Patch Cords

The qualified contractor will provide all patch cords for the project. The voice and data contractor will install the patch cords at the rack end and the WAO locations. The following criteria apply:

1. Patch cords are included in the project and provided by the voice/data contractor for the rack end and the work area outlet(s).
2. Patch cords must be manufactured by the selected end-to-end system manufacturer and must be of correct grade to maintain the beyond Category 6 or beyond Category 6A channel rating.
3. Installation of the patch cords will be by the contractor after review with Network communications.
4. Patch cords for the work area outlet will be 50% 15 feet, 50% 20 feet. Unless otherwise designated by the Network communications department. The quantity for the Work area outlets will be for all Network communications data outlets throughout the facility.
5. Patch cords for each data cable in the data rack(s) of all communications rooms. At the rack end, the patch cords will be 40% 2 feet, 40% 3 feet, and 20% 4 feet.
6. Category 6A patch cords provided by contractor for each wireless access point. The length is a minimum of 5 feet and the quantity is for each wireless access point. The patch cord for the rack end will be included in the data cable quantity.
7. Patch cords will be from one supplier and match the end-to-end solution installed for the project.
8. Patch cords submittals are included for review and include lengths and quantities.

#### Cable Pathways

Pathways constructed from J-hooks maybe hung from Ceiling Wire installed with powder-actuated devices. J-Hooks will not be attached to independent grid wire or to the existing drop ceiling grid wiring. The added weight to the ceiling grid system can cause distortion in the grid

system. Cable tray usage is for horizontal pathways with options including channel tray, ladder tray, solid bottom, and ventilated. Cable tray with conduit from the wall, stubbed within 6 inches of the cable tray and bonded is the preferred method. Conduits will have a 200 lbs. minimum pull string installed regardless of the length of the conduit. The horizontal cable between the ER/TR and the station outlets may have different support methods.

#### Proper Use of J-Hooks

Ceiling support shall not exceed manufacturer specification for Category 6 compliance. The maximum span distance will not exceed 5 feet intervals with a maximum of 12 inches of sag between supports. There shall be a minimum distance of 3 inches between the cable support distance and ceiling grid. Cable pathways design is to avoid EMI and RFI Interference. Common causes of this interference are fluorescent lighting fixtures, air handling motors, and many kinds of electrical controls including starters, lighting contractors, and power distribution panels. All cable runs must be at least two feet away from all fluorescent lights and EMF sources. Never run parallel with electrical conduits or strap to them. Every cable, whether an individual or grouped together, shall be supported. Wherever possible, group cables together in pathways. Never cinch plastic cable ties overly tight. If it deforms the outer cable jacket, it is too tight. The ties should be trimmed of any excess length and be snug. Cable splicing is not permitted and violation corrections will be at the contractor's expense.

#### Unsuitable Conduit

During cable pulling, flexible conduit tends to:

- Creep
- Shift
- Cause sheath damage to the cable

Flexible conduit usage is only in situations where it is the only practical alternative.

NOTE: If flexible conduit is used, its size increases by one trade size relative to the size of a rigid conduit.

**IMPORTANT:** Flexible conduit (e.g., metal flex conduit) usage in buildings not recommended.

#### Acceptable conduit runs

Achieve the best direct route (e.g., usually parallel to building lines) with no bend greater than 90 degrees or an aggregate of bends in excess of 180 degrees between pull points or pull boxes. Contain no continuous sections longer than 30.5 m (100 ft.). Conduit bonding is to ground on one or both ends in accordance with national or local requirements. Conduit type selection is to withstand the environment and meet code for installation. NOTE: For runs that total more than 30.5 m (100 ft.) in length, pull points or pull boxes installed so that no segment between

points/boxes exceeds the 30.5 m (100 ft.) limit. Total conduit runs kept to 45.8 m (150 ft.) or less (including the sections through pull boxes).

## Identification and Labeling

The contractor with the following criteria will provide labels. Each end of all Category 6 cable labeled at approximately 3 to 6 inches from the Network Data/voice jack, CATV, and with a printed cable label. The contractor with consultation will provide labeling for the faceplate and block terminations from the Information Technology Network Group. All labeling will comply with the TIA-606A standard. The ER/TR labeling nomenclature will match that of the station outlet (SO) identifier as shown in the following information.

1. Rack- mounted 110-block labeling: Each 110-block position (each 4-pair connector clip) will be labeled as follows: Standard SOs/ wall phones outlets FVXX- where FVXX is the SO identifier where the Category 6 or beyond Category 6 cable on that connector clip terminates.
2. Modular patch panel labeling: Each panel has labeling. Each modular jack panel position shall be XXX where XXX matches the SO identifier. The patch panel shall have a label placed on the upper left hand corner of the panel face identifying the panel. All labels for the labeling printed using a computer, printer or Brother p-touch labeler with the TZ tape or equivalent. LABELS SHALL NOT BE HAND WRITTEN. Labels shall be different colors as detailed for identification per the 606B standard. The contractors shall meet with UNCW Telecom personnel, verify the numbering schemes, and label coloring.
3. The general numbering sequence shall conform to a sequential numbering pattern common to all floors of the facility. All cable numbering is sequentially from room to room as closely as possible. The final numbering scheme agreement is between the selected vendor and the building owner, UNCW prior to the start of the physical installation.
4. Station outlet labeling consists of two components: top faceplate label and a bottom faceplate label. The label will consist of a five-character identifier with the format f-y-xxx. F= the floor number of the building, y is D for data or V for voice and xxx is a unique identifier between 0 and 999 for any station outlet on that floor served by the same ER/TR. Faceplate labels for wall phones will consist of 4-character identifier with the format f-v-xxx. F= the floor number, V = is for voice, xx is a unique identifier between 0 and 99.
5. TIA-606 Administration standards for the Network Communications Infrastructure of Commercial Buildings is an incorporated reference. Compliance and shall be maintained.

6. Each cable record must indicate the cable type by manufacturer and manufacturer's designation and document every pair/conductor in the cable. Cable identifier linkage is to all pathways in which it runs.
7. Each piece of termination hardware such as a patch panel or wiring block must be unique named and labeled.
8. Termination position on cross-connect must be identified by type, the pair conductor terminated and a user code.
9. Each element in the route, identification labels should be completed and attached. Labels should meet the requirements of UL969 Standard for Marking and Labeling Systems.
10. A final report should record system configuration, unique identifier, fiber labels, pathways, as-built details, and as-built drawings.
11. Loss Measurements and OTDR traces shall also be included. With the records.
12. Color coding to match 606 requirements.
13. Cable numbering shall follow the example:  
  
D=DATA, V=VOICE  
5=NETWORK COMMUNICATIONS ROOM NUMBER  
2=FLOOR NUMBER  
013=13<sup>TH</sup> CABLE TO BE INSTALLED  
CABLE D.5.2.013
14. Wireless access point labeling: label the grid work at the outlet location with a printed label. Provide WAP in front of the horizontal cable label at the rack end. A green dot on the grid work is for easy location identification.

Example: WAP D.5.2.013

#### Fiber Labeling

1. The interconnect panel will be labeled on the front glass of the enclosure and include:
  - a. Size and type of the fiber.
  - b. The far end or "TO" will be shown
  - c. The building the fibers termination point location is.
  - d. The Enclosure will be identified.
  - e. The interconnect panel will be identified.

2. Panel A 12 SM to (bldg. abbreviation) Enclosure (A thru Z identified on enclosure) to Panel A thru Z identified on enclosure)
3. EX. Panel A 12 SM to TSC Enclosure D Panel G.

## **Testing, Documentation and Warranty**

Copper category 5e and/or 6 channels shall be tested as appropriate, with only PASSing values accepted, using a TIA-568-compliant Cat 6 Time-Domain Reflectometer. Copper category 6A channels shall be tested, with only PASSing values accepted, using a TIA-568-compliant Augmented Cat 6 (Cat 6A) Time-Domain Reflectometer.

### Horizontal Cable Testing

1. Channel testing: Each equipment Network communications room patch cord, patch panel, horizontal cable, RJ 45 jack, Station patch cord will be tested end- to- end for compliance with category 6 level III parameters as stated in the TIA- 568 family of standards. Only certified cat 6-cable testing allowed on each all beyond cat 6 cables. The Test equipment used for horizontal category six cable tests complies with the industry standard Category 6 cable testers level III and comply with TIA test procedures. Each link shall be tested to TIA-568-C pinout, with only PASS results accepted. The contractor, at no charge to UNCW, shall bring any pairs not meeting the requirements of the standard into compliance and complete end-to-end test results documentation to UNCW. The test results will require 2-cd copies.

### Fiber Optic Testing

Each 62.5 OR 50/125-micron fiber will be tested patch panel to patch panel at the 850 and 1300 nm wavelength in both directions using a light meter. Each single mode fiber will be tested patch panel to patch panel at the 1310 and 1550 nm wavelength both directions using a light meter. The maximum total attenuation for any single fiber between patch panels will not exceed 2.0 db.

- Power meter tests: For building risers, power meter tests are required.
- Provide a power test and OTDR test for length, attenuation, and micro bends for each individual fiber. Documentation will include the power test and OTDR results.
- Test results included for inclusion into the documentation package.
- Link attenuation does not include any active devices or passive devices other than cable connectors and splices.
- A final report shall be compiled that records system configuration, fiber labels, cable routes, and as-bilts details and as-built drawings.

### Computer Generated Report

All cables/connectors shall be tested provide test equipment generated print out for each cable/connector, indicating that the channel end-to-end solution has passed or failed. Test results: Provide two cd copies.

All testing must meet manufacturer's warranty requirements.

### Manufacturer Warranty

Contractor shall provide a minimum Twenty (20) year cabling Extended Product Warranty and Application Assurance. The warranty will support any performance claims the manufacturer makes over and above the Cat. Six standards stated herein. A Warranty statement from the Manufacturer stating the period of the warranty for all the products specified for the project and the name and address of the authorized manufacturers agent who will honor the warranty claims.

### Extended Product Warranty

The Extended Product Warranty will cover product defects for all passive manufactured channel components. Passive components are those exhibiting no gain or contributing no energy. Manufacturer warrants, from the date a Registration Certificate passes to the end-user, the following:

1. That the passive products that comprise the registered Channel solution will be free from manufacturing defects in material or workmanship under normal and proper use;
2. That all channel approved passive cabling products that comprise the registered channel solution exceed the specification of TIA 568 and exceed ISO/IEC 11801 standards and will be equal to or exceed to the performance specifications of the associated Communication product data sheet in effect at the time the Registration Certificate is issued;
3. That the installation will exceed the insertion and return loss, attenuation and near end cross talk (NEXT) requirements of TIA 568-B and the ISO/IEC 11801 standards for cabling links/channel configurations specified in these standards.
4. That each channel is comprised exclusively of a single manufacturer solution and is capable of delivering 1.2 Gbps (Cat 5e), 3.6 Gbps (Cat 6) or 10 Gbps (Cat 6A) to the workstations or WAPs in accordance with applications standards.
5. This extended Product Warranty is applicable to the channel cabling solution products only on the original site of installation. Under the Extended Product Warranty, Manufacturer will either repair or replace the defective product itself at Manufacturers' cost. The U.S.A., Manufacturer will pay an Authorized cable installation Reseller for the cost of labor to repair or replace any such defective product on behalf of Manufacturer.

6. Corning Cable Systems LANscape solutions “landscape extended warranty” a 25-year guarantee on complete fiber optic cabling solutions. The telecom contractor shall be an authorized Corning Cabling Systems extended warranty (NPI) installer.

#### Application Assurance

Application Assurance covers failure of the channel SCS to operate the applications, that the Solution is to support, as well as additional application(s) included in the numbered list. Manufacturer warrants that the registered channel SCS solution will be free from failures which prevent operation of the specific applications for which the original channel SCS was designed. The Application Assurance Program also covers the following additional applications:

1. Those identified in the current (at the time of installation) channel SCS Performance Specifications; and
2. In accordance with application standards specifications, any applications introduced in the future by recognized standards or user forums that use TIA/EIA 568 or ISO/IEC 11801 components and link/channel specifications for cabling.
3. The contractor’s certifications are current for the manufacturer’s solution installation. The contractor shall provide standards compliant, warranted, end-to-end channel solution for structured cabling solutions.

#### Additional Warranty

Contractor shall state any additional Contractor supplied warranty. This contractor warrants the Network communications cabling infrastructure system to be free of defects in the materials and workmanship for the period of one year after the date of final payment. The effective date of this warranty applies to all components of these systems regardless of any equipment manufacturer’s warranties, which may expire at an earlier date. Any system malfunctions or any previously undiscovered non-compliance with the plans and specifications during the warranty period are repaired at no cost to the Owner are brought into compliance.

Self-Install Warranty: The beyond cat 6 structured cabling manufacturers shall issue The University of North Carolina at Wilmington a Self-Install Warranty for all future moves, adds and changes that are warrantied under this contract document ‘Extended product warranty and application assurance program for an end-to –end channel solution’.

#### Inspection

The Project Manager and/or the SCS System Manager shall perform on-going inspections during construction. All work performed is in a high-quality manner. In addition, the overall appearance shall be clean, neat and orderly. These items need to meet compliance:

1. Is the design documentation complete- Are all the cables properly labeled, from end-to-end?
2. Have all terminated cables been properly tested in accordance with the specifications. Testing includes for the specific category as well as tested for opens, shorts, polarity reversals, transposition and presence of AC and/or DC voltage?
3. Is the cable type suitable for its pathway? Are the cables bundled in parallel?
4. The manufacturer's pathway Guidelines are used. Is all cable penetrations installed properly and fire stopped according to code?
5. Have the Contractors avoided excessive cable bending?
6. The potential for EMI and RFI sources been considered?
7. Is Cable Fill Ratio Correct?
8. Are hanging supports within 1.5 meters (5 feet)?
9. Does hanging cable exhibit some sag?
10. Are Network communications room terminations compatible with applications equipment?
11. The patch Panel instructions are followed?
12. Jacket removal point.
13. Termination positions.
14. All pair terminations tight with minimal pair distortions.
15. Twists maintained up to Index Strip.
16. The Modular Panel instructions been followed?
  - o Cable dressing first
  - o Jackets remain up to the Connecting Block
  - o All pair terminations tight and undistorted
  - o Twists maintained up to the Connecting Block
17. Connectors are correct side- up in the Jack Panels without cables wrapped or twisted around the Mounting Collars.
18. Are the correct outlet connectors used (T568B)?
19. That the jacket maintained right up to the manufacture specifications.
20. Are identification markings uniform, permanent and readable?

### Damages

The contractor is responsible for all damages to portions of the building caused by it, its employees or subcontractors including but not limited to the following:

1. All damage to any [portion of the building caused by the movement of tools, materials or equipment.



2. All damage to any component of the construction of spaces “turned over” to the contractor.
3. All damage to the electrical distribution system and/or other space “turned over” to the contractor.
4. All damage to the electrical, mechanical and/or life safety or other systems caused by inappropriate operation or connections made by the Contractor or other actions of Contractor.
5. Other damage to the materials, tools and/or equipment of UNCW, its consultants, General Contractor, subcontractors, Architect, other contractors, agents and leases.

#### Recorded Documents

Prepare record documents in accordance with the requirements in Division 27 Section “PROJECT CLOSEOUT”. In addition to requirements specified in Division I, indicate installed conditions:

1. Backbone and horizontal cabling, station outlets, layout of ER and TR, all labeling of all cabling, connectors, equipment, conduits, cable trays, etc.
2. Equipment locations (exposed and concealed), dimensioned from prominent building lines.
3. Approved substitutions, contract Modifications, and actual equipment and materials installed.

#### Documentation

The cabling contractor shall provide the following documentation to the owner within 2 weeks following the completion of the installation:

1. Marked up floor plans identifying as-built cable routing for all horizontal backbone cabling. Submitted in electronic format (AutoCAD) and hard copy print out.
2. Marked up floor plans with station outlet identifier listed adjacent to each station outlet. Submitted in electronic format (AutoCAD) and hard copy print out. In addition, the contractor will provide full size laminated prints or framed prints installed by the contractor in each ER and each TR. All required full size drawings installed as required in each TR and ER to reference all station outlets served by a specific ER or TR.
3. Test results for each jack in each station outlet compiled in a binder with the tests listed in numerical order grouped by ER/TR. Provide two CD copies.

4. Tests results for all horizontal and backbone UTP, Co-Ax and fiber cables complied in a binder with the tests grouped by the backbone cable. Provide two 8-1/2 x 11 hardcopies in notebooks and 2 CD copies.
5. A scaled plan of each building showing the placement of each individual item of equipment as well as raceway size and routing, junction boxes, and conductor size, quantity, and color in each raceway.

### Quality Assurance

Installers Qualifications: Contractor with a minimum of five years documented successful installation experience on projects utilizing cabling infrastructure work similar to that required for this project. The contractor shall be an experienced firm regularly engaged in the layout and the installation of cabling infrastructure systems. The contractor must be able to show evidence that he has successfully completed projects of similar size and scope in the last 12 months. The contractor shall be a manufacturer certified Business Partner, CVA, or for the TE solution the installers, supervisors, registered certifier, and designers to have a current valid certification card.

1. The Network Communications project manager must have experience in this type of project and he/she expected to provide technical support.
2. The Network Communications project manager shall attend the monthly progress meetings held by the state and additional meetings as scheduled or required.
3. BICSI registration must be current and the installer and technicians must be in good standing.
4. During the shop drawing process, provide copies of all manufacturer and BICSI certifications, the contractor shall meet the following criteria: 15% of work force shall be BICSI certified Technician level or better (RCDD). 15% of work force shall be BICSI certified Installer level 2 or higher; 15% of work force shall be BICSI certified installer level 1 or of equivalent experience/training.
5. Contractor employees will wear visible ID badges on the job site with current picture and company name at all times.

### **General Requirements**

1. Work under this section shall include providing all labor, materials, equipment, and services necessary for and reasonably incidental to the proper completion of all Network communications work as shown on the drawings and herein specified. Work

shall also include, but not be limited to the furnishings, unloading, handling, distribution, setting, supporting, and installation of all required components.

2. Refer to electrical drawings for each buildings equipment room, Telecom room (TR) and station outlet location.
3. Refer to the Network communications riser diagrams and diagram drawings for the following:
  - a) Outlet elevation: showing all components required for the installation and mounting of the outlet. The faceplate of a typical quad station outlet and all outlet configurations used.
  - b) Outlet pathway elevation: shows the details of how the cables routing from the horizontal pathway to the outlet. Conduit size is at a minimum  $\frac{3}{4}$  inch stubbed out to within six inches of the cable tray and bonded to the cable tray. In a typical cable tray, voice and data will be located on one side of the cable with the A/V cabling located on the opposite side.
  - c) Grounding and bonding drawing: Shows the five major components for the grounding of the Network communications infrastructure throughout the building. The five components shown are the Bonding conductor, the Network communications main grounding bus bar, the Network communications grounding bus bar, the Network communications bonding backbone, Network communications bonding backbone interconnecting bonding conductor. All grounding and bonding shall meet the TIA/EIA –607 standards and the NEC code.
  - d) Campus Wide Drawings: Show all details for each individual campus wide access door interior and exterior. Drawings are not to scale. Refer to architectural and structural drawings for building construction and dimensions and to roof finish schedule on architectural drawings for the materials, finish and construction method of walls, floor and ceiling in order to insure proper rough in and installation of work.

#### Additional Standards and Codes

1. Work to conform with any city, State law, regulation, code, ordinance, and ruling or Fire Underwriters requirement applicable to this class of work.
2. Contractor will comply with the stricter requirement when a conflict occurs.
3. The following guidelines and standards will apply wherever applicable
  - TIA-568-C Commercial Building Standards for Telecommunications
  - TIA- 569-D Commercial Building standards for Pathways and Spaces

- TIA-606-B Administration (Labeling)
- TIA- 607-C Grounding and bonding of premises cable
- BICSI TDMM Telecommunications Distribution Methods Manual
- BICSI CO-OSP Customer-owned Outside Plant Design Manual
- ANSI/NECA/BICSI 568-2001

### Renovations

The Voice, data, CATV, and AV must be coordinated through Network Communications. A certified contractor for the building solution-SYSTIMAX, NETCONNCET/Uniprise or Belden, does voice, data, CATV, and AV cabling that is in the renovation. Work under this section shall include providing all labor, materials, equipment, and services necessary for and reasonably incidental to the proper completion of all Network communications work as shown on the drawings and herein specified. Work shall also include, but not be limited to the furnishings, unloading, handling, distribution, setting, supporting, and installation of all required components. The contractor will install as-bilts updating all changes in each TR and ER. Electronic copies of the as built will be provided to UNCW project management CAD department. Requirements for projects listed in the standards apply to all renovations involving voice, data, CATV, and AV.

### Manholes and Duct banks

1. Seal all ducts at terminations or all conduit entry points with expandable reusable conduit plugs capable of withstanding 15-psi minimum hydro static pressure in manholes and buildings.
2. All duct banks will have a trace wire installed and a 1250-pound tensile test ½ "wide marking cord equivalent to NEPTCO Inc. or MULETAPE part # 1250P.
3. All conduits pulled as full as possible without damage to the cable.
4. All cables secured to the wall of the vault.
5. All cables clearly labeled using stamped aluminum.
6. The labeling for the cables will show destination, origination, cable size and pair count.
7. Cables labeled in all ER, MDF's, and IDF's.
8. Three 11/4-inch ID inner ducts or one four inch 3-cell MaxCell edge. placed in a minimum of one 4-inch conduit leading to every building.

9. The entrance conduit into each building, which contains the inner ducts, shall be equipped with a hole plug designed to seal around each individual inner duct.
10. Each inner duct sealed to prevent leakage into the building.
11. Manhole diagrams and duct bank diagrams shown on the Network communications drawings.
12. Each cable will have a slack loop in each manhole. The slack loop will be one full circle inside the manhole.
13. The distance between manholes should not exceed 450 feet.
14. Manhole lids will be equivalent to a U.S.F. FABRICATION, INC. APD 300.
15. Install conduits with gradual, sweeping elbows and offsets. Hard 90s are not acceptable.
16. Provide non-metallic cable rack on each wall in the manhole with a minimum of three arms each wall.
17. All duct banks inspected and approved prior to the placement of any concrete.
18. Duct bank poured with 3,000-psi concrete and encased all sides with a minimum of three inches.
19. After the duct line is completed, a standard flexible mandrel used for cleaning followed by a brush with stiff bristles. Mandrels shall be at least 12 inches long and have a diameter  $\frac{1}{4}$  inch less than the inside diameter of the duct being cleaned.
20. A minimum of 2- 4-inch conduits schedule 40 PVC and is required for all Network communications duct banks. Schedule 80 PVC conduit is required for installation under roads and heavy traffic areas.

#### Joint Trench Required Separations

When a joint-trench method is used, the following vertical or horizontal separations for Network communications facilities and other facilities are used.

Vertical/horizontal separations

Adjacent Structure Minimum Separation

Power or other foreign conduit

- 76 mm (3 in) of concrete, or
- 101 mm (4 in) of masonry, or
- 305 mm (12 in) of well-tamped earth.

- Pipes (gas, oil, water)
- 152 mm (6 inch) when crossing
- 305 mm (12 in) when parallel.
- Street railways 10 mm (3.3 ft.) below top rail.

**NOTES:** Place cable in rigid PVC conduit for a distance of 3 m (10 ft.) on either side of the pipeline crossing. If multiple pipelines exist, then extend conduit 3 m (10 ft.) from the outside pipes. Place rigid steel conduit for a minimum distance of 7.6 m (25 ft.) on either side of the center of the track (e.g., rails) crossing. If there are multiple tracks, the conduit should extend out 7.6 m (25 ft.) on either side  
Of the center of the outside tracks.

#### Confined space Entry Procedures

The purpose of this safe work practice is to provide a procedure when working around an 'open' manhole or preparing to enter a manhole for routine maintenance or inspection. A manhole structure is a confined space that presents possible fall hazards where there is a potential for toxic gases to be present. Therefore, ALL personnel assigned to enter Network Communications manholes shall follow the procedures in this work practice.

#### Required Safety Equipment and Procedures

All personnel working around open manholes and preparing to enter the manhole shall use the following safety equipment:

1. Approved gas detector (properly calibrated)
2. Fresh air blower;
3. Safety harness, rope, and tripod safety system; and
4. Approved hardhat.

All Network Communications manholes designed for entrance and inspection maintenance on a regular basis use the following procedures before entering the confined space:

1. Atmospheric Testing: Before allowing any personnel inside the confined space, test the space for all three atmospheric conditions, oxygen content, flammable or explosive gases and hydrogen sulfide.
  - a) Oxygen content must be at least 19.5% in the confined space, measured at all levels (bottom, middle, and top). The safe oxygen level is between 19.5% and 21%. Do not enter the confined space if the oxygen level is below 19.5% or above 21%. Due to the extreme danger of suffocation in confined spaces, constant and continuous oxygen monitoring is required throughout each work period. Oxygen content above 23% can cause explosions or vigorous burning of flammable materials, including hair or clothing.
  - b) After you have determined oxygen content, use the detector to measure flammability at all levels of the confined space (bottom, middle, and top). Flammability measured in terms of the Lower Flammable Limit (LFL) or Lower Explosive Limit (LEL). This is the smallest concentration of a combustible gas in air that will explode when it contacts a spark or open flame.
  - c) Finally, test the atmosphere for any toxic concentrations of vapors. Toxicity measured in terms of the Threshold Limit Value (TLV). Use the detector to measure toxicity at all levels of the confined space (bottom, middle, and top). Since toxic concentrations may be lighter or heavier than air, they can be present at the top or the bottom of the confined space. Note: The confined space tested at three levels for each atmospheric condition. Each level tested for a minimum of 60 seconds. The gas detector itself lowered into the confined space atmosphere with a safety line or the detector with an aspirator pump. Consult the detector operating procedures manual if you have any operating questions.
2. Ventilation: A fresh air ventilation system shall be set up and in operation before and during all inspection and maintenance procedures.
3. After the air ventilation system has been in operation and the confined space has been tested and determined to be safe for entry, the operator shall be equipped with:
  - a) A safety harness and lifeline, attached to the tripod safety retrieval system.
  - b) An approved, properly calibrated gas detector that is in operation the entire time the employee is in the confined space. This is necessary due to the possibility of a rapid change in the confined space atmosphere.
  - c) An approved hard hat.

4. If permanent ladder steps are not in the confined space, use an aluminum ladder in good operating condition to enter the confined space. Any employee who descends into a man hole/sewer will have safety harness, rope, and tripod safety system attached to the employee.
5. At least one person stationed above ground for support purposes whenever a confined space is ready for entrance. .
6. Emergency Action Plan -- No person shall enter a confined space (manhole, to retrieve someone who is unconscious without having additional trained personnel above ground to assist. The person entering the confined space for rescue purposes must be equipped with the required rescue equipment and follow the specific rescue procedure.
7. A qualified person shall inspect all safety devices and instruct all involved employees on proper confined space safety procedures. All defective safety devices reported to the supervisor immediately. It shall be the supervisor's responsibility to insure that crews assigned to enter
8. Confined spaces have the required safety devices in their possession. The supervisor must assure the assigned employee has the required safety devices in their possession. The supervisor must assure the assigned employee trained to operate all safety equipment and understands all safety procedures.

#### General Manhole Safe Work Practices

1. Use caution when working around manholes.
2. Do not smoke, light open flames, or produce sparks in the immediate vicinity of open manholes.
3. Before removing manhole or entrance covers, test the atmosphere inside the manhole by using remote sampling probe or aspirators. If the lower explosive limit is above 10% inside the manhole, do not remove the cover.
4. Use picks, hooks to open manhole covers.
5. Lift manhole covers and heavy hatches with the legs. Never lift with the back muscles.
6. Lay removed manhole and heavy hatch covers flat on the ground several feet away from the opening.
7. With the manhole or entrance covers removal, the opening requires a railing, temporary cover, or other temporary barrier that will prevent an accidental fall through the opening and protect each employee working in the space from foreign objects entering the space.
8. Use barricades and/or warning devices to direct traffic around open manholes.
9. Follow Public Services Department directions for Confined Space Entry Program and all safety procedures before entering and during entry into any manhole.



10. Have at least two persons present before entering a manhole: One person to enter the manhole and one person in the clear to observe in the event of an emergency. One of the persons must be a “qualified person” as defined by the Public Services Department’s Confined Space Entry Program. This person bears the responsibility of completing the Confined Space Entry Permit. Never enter a manhole unattended.
11. Wear protective clothing and nonslip, non-sparking shoes in a manhole.
12. Test each individual manhole step carefully. Be sure to check ladder for overall structural soundness and ability to support weight before using.
13. Use ladders to access manholes whenever the structural soundness and support ability of the manhole steps/stairs are in question.
14. Take proper safety precautions when using ladders in a manhole.
15. Use a safety harness and life line when entering a vertical entry manhole, unless the lifeline creates an entanglement hazard.
16. Watch out for slippery footing in a manhole.
17. Do not hand carry tools and/or equipment while climbing up or down steps or a ladder into a manhole.
18. Raise or lower tools and/or equipment into a manhole using a rope, sling, or bucket.
19. Use only explosion-proof portable lighting and non-sparking tools in a manhole.
20. Avoid using electrical tools in or near water. Never stand in water when using electrical tools.
21. Constant ventilation is required when performing “hot-work” within a manhole, if the above safe works, practices is not accomplishable, or if there is a positive reading

### Fire Stopping

1. This Section includes requirements for the furnishing and installing of fire rated wiring devices.
2. Furnish and install all fire rated wiring devices and associated hardware as shown on the Contract Drawings and as hereinafter specified.
3. All devices shall be heavy-duty specification grade with an intumescent insert material allowing for 0 to 100-percent visual fill of conductors.
4. The same manufacturer shall supply all furnished fire rated devices and associated hardware.

5. Fire rated wiring devices shall bear the UL Classification marking.
6. Device testing in accordance with ASTM E 814 (ANSI/UL1479).

#### Fire rated wiring devices

1. Cables passing through fire-rated floors or walls shall pass through fire-rated wiring devices which contain an intumescent insert material that adjusts automatically to cable additions or subtractions.
2. The device shall have an F Rating equal to the rating of the barrier in which the device installation is applied.
3. Wiring devices shall be capable of allowing a 0 to 100-percent visual fill of cables.
4. Wire devices shall be of a sufficient size to accommodate the quantity and size of data cables required.
5. Wire devices provided with steel wall plates for single or multiple devices allowing them to be joined.
6. Manufacturers' accepted for fire rated devices include Specified Technologies INC., Hilti, and 3M.

#### Installation

1. Wiring device installation is in locations where drawings indicate on the blue print, and are arranged singly or ganged at the height specified.
2. Install the devices in strict accordance with the approved shop drawings and the equipment manufacturer's recommendations.
3. Apply the factory supplied gasketing material prior to the installation of the wall plates.
4. Secure wall plates to devices per the equipment manufacturer's recommendations.
5. Buildings at UNC-W wiring is according to the established campus –wide wiring standards since the early 1990's. The fire safety considerations of the pathway systems shall comply with all applicable fire safety and electrical codes. In general, the N.C. Department of Insurance determines the compliance of these systems with codes, and reserves the right to inspect and approve/disapprove their installation. If the pathway system is a metallic, enclosed system non-plenum cabling installation within unless otherwise noted. All wireway and conduit penetrations of rated walls and floors shall be fire stopped per applicable UL assembly. Plenum cable installed as required per the guidelines on an individual building basis. UNC-W adheres to the BICSI, NEC, and ANSI/TIA/EIA-569-A guidelines for fire stopping.

#### Cleaning

1. After the installation is complete contractor shall clean all systems.
2. Vacuum debris from system component, enclosures, junction boxes and pull boxes prior to testing and again prior to completion.
3. Thoroughly clean equipment of stains, paint spots, dirt and dust. Remove temporary labels not used for instruction or operation.

Codes, Permits, and Fees

1. Comply with all applicable laws, ordinances, rules, regulations, codes, or rulings of governmental units having jurisdiction as well as standards of the National Fire Protection association and serving utility requirements.
2. Obtain and pay for all permits, fees, inspections, utility connections and extensions and the like associated with work in each section of this division.
3. Comply with SCO for inspections as required.

END OF SECTION 27 0000

## SECTION 27 1513 - COMMUNICATIONS COPPER HORIZONTAL CABLING

### PART 1 - GENERAL

#### 1.1 SUMMARY

A. Section Includes:

1. Category 6 twisted pair cable.
2. Category 6A twisted pair cable.
3. Twisted pair cable hardware, including plugs and jacks.
4. Cable management system.
5. Grounding provisions for twisted pair cable.

#### 1.2 COPPER HORIZONTAL CABLING DESCRIPTION

- A. Horizontal cabling system shall provide interconnections between Distributor A, Distributor B, or Distributor C, and the equipment outlet, otherwise known as "Cabling Subsystem 1," in the telecommunications cabling system structure. Cabling system consists of horizontal cables, intermediate and main cross-connects, mechanical terminations, and patch cords or jumpers used for horizontal-to-horizontal cross-connection.
1. TIA-568-C.1 requires that a minimum of two equipment outlets be installed for each work area.
  2. Horizontal cabling shall contain no more than one transition point or consolidation point between the horizontal cross-connect and the telecommunications equipment outlet.
  3. Bridged taps and splices shall not be installed in the horizontal cabling.
- B. A work area is approximately 100 sq. ft and includes the components that extend from the equipment outlets to the station equipment.
- C. The maximum allowable horizontal cable length is 295 feet. This maximum allowable length does not include an allowance for the length of 16 feet to the workstation equipment or in the horizontal cross-connect.
- D. Refer to 270000 UNCW ITS Infrastructure Standards for Installation for additional information. Information contained in 270000 shall take precedence.

#### 1.3 ACTION SUBMITTALS

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

- B. Shop Drawings: Reviewed and stamped by RCDD.
  - 1. System Labeling Schedules: Electronic copy of labeling schedules, in software and format selected by Owner.
  - 2. System Labeling Schedules: Electronic copy of labeling schedules that are part of the cabling and asset identification system of the software.
  - 3. Cabling administration Drawings and printouts.
  - 4. Wiring diagrams and installation details of telecommunications equipment, to show location and layout of telecommunications equipment.
- C. Twisted pair cable testing plan.
- D. Contractor shall submit floor plans of cable category, cable color and jack color at each location for designer/owner approval prior to commencing work.

#### 1.4 INFORMATIONAL SUBMITTALS

- A. Qualification Data: For RCDD, Installer, installation supervisor, and field inspector.
- B. Product Certificates: For each type of product.
- C. Source quality-control reports.
- D. Field quality-control reports.

#### 1.5 CLOSEOUT SUBMITTALS

- A. Maintenance data.

#### 1.6 QUALITY ASSURANCE

- A. Installer Qualifications: Cabling Installer must have personnel certified by BICSI on staff.
  - 1. Layout Responsibility: Preparation of shop drawings, cabling administration drawings, and field-testing program development by an RCDD.
  - 2. Installation: Installer shall be manufacturer certified to install cabling system submitted.
  - 3. Installation Supervision: Installation shall be under the direct supervision of Technician, who shall be present at all times when work of this section is performed at project site.
  - 4. Testing Supervisor: Currently certified by BICSI as a RCDD to supervise on-site testing.
- B. Testing Agency Qualifications: Testing agency must have personnel certified by BICSI on staff.
  - 1. Testing Agency's Field Supervisor: Currently certified by BICSI as a RCDD.

## 1.7 COORDINATION

- A. Coordinate layout and installation of telecommunications pathways and cabling with Owner's telecommunications and LAN equipment and service suppliers.

## PART 2 - PRODUCTS

### 2.1 PERFORMANCE REQUIREMENTS

- A. General Performance: Horizontal cabling system shall comply with transmission standards in TIA-568-C.1, when tested according to test procedures of this standard.
- B. Telecommunications Pathways and Spaces: Comply with TIA-569-D.

### 2.2 GENERAL CABLE CHARACTERISTICS

- A. Listed and labeled by an NRTL acceptable to authorities having jurisdiction as complying with the applicable standard and NFPA 70 for the following types:
  - 1. Communications Plenum Rated: Type CMP complying with UL 1685 or Type CMP in listed plenum communications raceway.
  - 2. Communications, Plenum Rated: Type CM, Type CMG, Type CMP, Type CMR, or Type CMX in metallic conduit installed according to NFPA 70, Article 300.22, "Wiring in Ducts, Plenums, and Other Air-Handling Spaces."
- B. Surface-Burning Characteristics: Comply with ASTM E 84; testing by a qualified testing agency. Identify products with appropriate markings of applicable testing agency.
  - 1. Flame-Spread Index: 25 or less.
  - 2. Smoke-Developed Index: 450 or less.
- C. RoHS compliant.

### 2.3 CATEGORY 6 TWISTED PAIR CABLE

- A. Description: Four-pair, balanced-twisted pair cable, with internal spline, certified to meet transmission characteristics of Category 6 cable at frequencies up to 250MHz.
- B. Manufacturers:
  - 1. CommScope SYSTIMAX GigaSPEED XL
  - 2. CommScope NETCONNECT/Uniprise CS37
  - 3. Belden 2412

- C. Standard: Comply with NEMA WC 66/ICEA S-116-732 and TIA-568-C.2 for Category 6 cables.
- D. Conductors: 100-ohm, 23 AWG solid copper.
- E. Shielding/Screening: Unshielded twisted pairs (UTP)
- F. Jacket Colors:
  - a. Category 6 Data – Blue (Unless otherwise noted on plan)
  - b. Category 6 Telecommunications Voice – White

#### 2.4 CATEGORY 6A TWISTED PAIR CABLE

- A. Description: Four-pair, balanced-twisted pair cable, with internal spline, certified to meet transmission characteristics of Category 6A cable at frequencies up to 500MHz.
- B. Manufacturers:
  - 1. CommScope SYSTIMAX GigaSPEED X10D - x91B
  - 2. CommScope NETCONNECT/Uniprise CS47
  - 3. Belden 10GXS
  - 4. Belden 2400 System (2412)
- C. Standard: Comply with TIA-568-C.2 for Category 6A cables.
- D. Conductors: 100-ohm, 23 AWG solid copper.
- E. Shielding/Screening: Unshielded twisted pairs (UTP)
- F. Jacket Colors:
  - a. Category 6A Wireless Access Points - Confirm with UNCW

#### 2.5 TWISTED PAIR CABLE HARDWARE

- A. Description: Hardware designed to connect, splice, and terminate twisted pair copper communications cable.
- B. Manufacturers:
  - 1. Belden REVConnect
  - 2. Belden KeyConnect
- C. General Requirements for Twisted Pair Cable Hardware:
  - 1. Comply with the performance requirements of Category 6 and Category 6A respectively.

2. Comply with TIA-568-C.2, IDC type, with modules designed for punch-down caps or tools.
  3. Cables shall be terminated with connecting hardware of same category or higher.
- D. Source Limitations: Obtain twisted pair cable hardware from single source from single manufacturer.
- E. Connecting Blocks:
1. 110-style IDC or GigaBIX for Category 6.
  2. 110-style IDC or GigaBIX for Category 6A.
  3. Provide blocks for the number of cables terminated on the block, plus 25% spare, integral with connector bodies, including plugs and jacks where indicated.
- F. Cross-Connect: Modular array of connecting blocks arranged to terminate building cables and permit interconnection between cables.
1. Number of Terminals per Field: One for each conductor in assigned cables.
- G. Patch Panel: Modular panels housing numbered jack units with IDC-type connectors at each jack location for permanent termination of pair groups of installed cables.
1. Features:
    - a. Universal T568A and T568B wiring labels.
    - b. Labeling areas adjacent to conductors.
    - c. Replaceable connectors.
    - d. 24 or 48 ports.
  2. Construction: 16-gauge steel and mountable on 19-inch equipment racks.
  3. Number of Jacks per Field: One for each four-pair conductor group of indicated cables, plus spares and blank positions adequate to suit specified expansion criteria.
- H. Patch Cords: Factory-made, four-pair cables terminated with an eight-position modular plug at each end.
1. Patch cords shall have bend-relief-compliant boots and color-coded icons to ensure performance. Patch cords shall have latch guards to protect against snagging.
  2. Patch cords shall have color-coded boots for circuit identification.
  3. Lengths by type:
    - a. WAO (Work Area Outlets): 50% 15 feet, 50% 20 feet. Unless otherwise designated by the Network communications department. The quantity for the Work area outlets will be for all Network communications data outlets throughout the facility.
    - b. Data Racks: 40% 2 feet, 40% 3 feet, and 20% 4 feet.



- c. WAPs (Wireless Access Points): minimum of 5 feet and the quantity is for each wireless access point.
- 4. All patch cords to be included in the data cable quantity.
- I. Plugs and Plug Assemblies:
  - 1. Male; eight position; color-coded modular telecommunications connector designed for termination of a single four-pair, 100-ohm, unshielded or shielded twisted pair cable.
  - 2. Standard: Comply with TIA-568-C.2.
  - 3. Marked to indicate transmission performance.
- J. Jacks and Jack Assemblies:
  - 1. Female; eight position; modular; fixed telecommunications connector designed for termination of a single four-pair, 100-ohm, unshielded or shielded twisted pair cable.
  - 2. Jack Colors:
    - a. Category 6 Data – Yellow
    - b. Category 6 Telecommunications Voice - White
  - 3. Designed to snap-in to a patch panel or faceplate.
  - 4. Standard: Comply with TIA-568-C.2.
  - 5. Marked to indicate transmission performance.
  - 6. Belden copper systems, jacks and modular plugs shall be from Belden's Key Connect & REVConnect product family. REVConnect is only for WAP locations.
- K. Faceplate:
  - 1. Shall match adjacent receptacle material and finish. Coordinate with Architect.
  - 2. For use with snap-in jacks accommodating any combination of twisted pair, optical fiber, and coaxial work area cords.
  - 3. Work Area Outlet (WAO) faceplate is white with a minimum of four ports with label insert top and bottom.
- L. Legend:
  - 1. Machine printed, in the field, using adhesive-tape label.
  - 2. Snap-in, clear-label covers and machine-printed paper inserts.

### PART 3 - EXECUTION

#### 3.1 INSTALLATION OF TWISTED-PAIR HORIZONTAL CABLES

- A. Comply with NECA 1 and NECA/BICSI 568.
- B. Wiring Method: Install cables in raceways and cable trays, except within consoles, cabinets, desks, and counters. Conceal all raceway, except where not possible in unfinished mechanical/electrical spaces.

- C. Wiring within Enclosures: Bundle, lace, and train cables within enclosures. Connect to terminal points with no excess and without exceeding manufacturer's limitations on bending radii. Provide and use lacing bars and distribution spools. Install conductors parallel with or at right angles to sides and back of enclosure.
- D. General Requirements for Cabling:
  - 1. Comply with TIA-568-C.1.
  - 2. Comply with BICSI's Information Transport Systems Installation Methods Manual, Ch. 5, "Copper Structured Cabling Systems," "Cable Termination Practices" Section.
  - 3. Install 110-style IDC termination hardware unless otherwise indicated.
  - 4. Do not untwist twisted pair cables more than 1/2 inch from the point of termination to maintain cable geometry.
  - 5. Terminate all conductors; no cable shall contain unterminated elements. Make terminations only at indicated outlets, terminals, cross-connects, and patch panels.
  - 6. Cables may not be spliced. Secure and support cables at intervals not exceeding 30 inches and not more than 6 inches from cabinets, boxes, fittings, outlets, racks, frames, and terminals.
  - 7. Install lacing bars to restrain cables, prevent straining connections, and prevent bending cables to smaller radii than minimums recommended by manufacturer.
  - 8. Bundle, lace, and train conductors to terminal points without exceeding manufacturer's limitations on bending radii, but not less than radii specified in BICSI information Transport Systems Installation Methods Manual, Ch. 5, "Copper Structured Cabling Systems," "Cable Termination Practices" Section. Use lacing bars and distribution spools.
  - 9. Do not install bruised, kinked, scored, deformed, or abraded cable. Do not splice cable between termination, tap, or junction points. Remove and discard cable if damaged during installation, and replace it with new cable.
  - 10. Cold-Weather Installation: Bring cable to room temperature before dereeling. Heat lamps shall not be used for heating.
  - 11. In the communications equipment room, install a minimum 10-foot long service loop unless otherwise noted.
  - 12. Pulling Cable: Comply with BICSI Information Transport Systems Installation Methods Manual, Ch. 5, "Copper Structured Cabling Systems," "Pulling and Installing Cable" Section. Monitor cable pull tensions.
- E. Group connecting hardware for cables into separate logical fields.
- F. Separation from EMI Sources:
  - 1. Comply with recommendations from BICSI's "Telecommunications Distribution Methods Manual" and TIA-569-D for separating unshielded copper communication cable from potential EMI sources, including electrical power lines and equipment.

### 3.2 FIRESTOPPING

- A. Comply with requirements in Section 078413 "Penetration Firestopping."
- B. Comply with TIA-569-D, Annex A, "Firestopping."
- C. Comply with "Firestopping Systems" Article in BICSI's "Telecommunications Distribution Methods Manual."

### 3.3 GROUNDING

- A. Comply with requirements in Section 270526 "Grounding and Bonding for Communications Systems" for grounding conductors and connectors.
- B. Comply with latest TIA-607 standard and NECA/BICSI-607.

### 3.4 IDENTIFICATION

- A. Identify system components, wiring, and cabling complying with TIA-606-B. Comply with requirements for identification specified in Section 270553 "Identification for Communications Systems."
- B. Paint and label colors for equipment identification shall comply with TIA-606-B.
- C. Equipment grounding conductors.
- D. Cable and Wire Identification:
  - 1. Label each cable within 4 inches of each termination and tap, where it is accessible in a cabinet or junction or outlet box, and elsewhere as indicated.
  - 2. Each wire connected to building-mounted devices is not required to be numbered at the device if wire color is consistent with associated wire connected and numbered within panel or cabinet.
  - 3. Label each terminal strip, and screw terminal in each cabinet, rack, or panel.
    - a. Individually number wiring conductors connected to terminal strips, and identify each cable or wiring group, extended from a panel or cabinet to a building-mounted device, with the name and number of a particular device.
    - b. Label each unit and field within distribution racks and frames.
  - 4. Identification within Connector Fields in Equipment Rooms and Wiring Closets: Label each connector and each discrete unit of cable-terminating and -connecting hardware. Where similar jacks and plugs are used for both voice and data communication cabling, use a different color for jacks and plugs of each service.

- E. Labels shall be preprinted or computer-printed type, with a printing area and font color that contrast with cable jacket color but still comply with TIA-606-B requirements for the following:

- 1. Cables use flexible vinyl or polyester that flexes as cables are bent.

### 3.5 FIELD QUALITY CONTROL

- A. Perform tests and inspections with the assistance of a factory-authorized service representative.
- B. Tests and Inspections:
  - 1. Test instruments shall be recently calibrated to manufacturers standards.
  - 2. Test instruments shall be updated to manufacturers most recent firmware.
  - 3. Visually inspect jacket materials for NRTL certification markings. Inspect cabling terminations in communications equipment rooms for compliance with color-coding for pin assignments and inspect cabling connections for compliance with TIA-568-C.1.
  - 4. Visually inspect cable placement, cable termination, grounding and bonding, equipment and patch cords, and labeling of all components.
  - 5. Test twisted pair cabling for DC loop resistance, shorts, opens, intermittent faults, and polarity between conductors. Test operation of shorting bars in connection blocks. Test cables after termination but not cross-connection.
- C. Data for each measurement shall be documented. Data for submittals shall be printed in a summary report that is formatted similarly to Table 10.1 in BICSI's "Telecommunications Distribution Methods Manual," or shall be transferred from the instrument to the computer, saved as text files, printed, and submitted.
- D. Remove and replace cabling where test results indicate that they do not comply with specified requirements.
- E. End-to-end cabling will be considered defective if it does not pass tests and inspections.
- F. Prepare test and inspection reports.

### 3.6 WARRANTY

- A. Cable Manufacturer shall warranty cabling and cabling hardware for a 20-year period.

END OF SECTION 27 1513