Buildings 220, 221, 223, & 225: Fire Alarm Replacements

National Institute of Standards and Technology

Specifications
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SECTION 010000

UNIT QUANTITY WORK ITEMS

PART 1 - GENERAL

1.1 UNIT QUANTITIES SPECIFIED

A. Initially, Contract Sum will be deemed to include, for all Unit Price Work, amount equal to sum of established unit prices for each separately identified item of Unit Price Work times estimated quantity of each item as indicated in the Bid Form and/or Schedule of Values.

B. Estimated quantities of items of Unit Price Work are not guaranteed and are solely for purpose of comparison of Bids and determining initial Contract Sum. Owner reserves right to increase or decrease quantities at same unit cost, as required by job conditions. Review and approval of actual quantities and classifications of Unit Price Work performed by Contractor will be by the Engineer.

C. The Engineer shall have right under Contract to make increases and decreases in quantities and changes in plans, as may be necessary to ensure completion of contemplated Work.

1.2 PAYMENT

A. Progress payments on account of Unit Price Work will be based on number of units completed.

B. The Engineer will review and approve actual quantities and determine classification of Unit Price Work performed by Contractor. The Engineer will review Contractor's preliminary determinations on such matters before rendering written decision thereon (by recommendation of Application for Payment or otherwise). The Engineer's written decisions thereon will be final and binding upon Owner and Contractor, unless within ten days after date of any such decision, either Owner or Contractor delivers to the other party to their Agreement, and to the Engineer, written notice of intention to appeal such decision.

C. Each unit price will be deemed to include the amount considered by the Contractor to be adequate to cover Contractor's overhead and profit for each separately identified item.

1.3 DEFECT ASSESSMENT

A. Replace the Work, or portions of the Work, not conforming to specified requirements.

B. If, in the opinion of the Engineer, it is not practical to remove and replace the Work, the Engineer will direct one of the following remedies:

1. The defective Work may remain, but the unit sum/price will be adjusted to a new sum/price at the discretion of the Engineer.

2. The defective Work will be partially repaired in accordance with the instructions of the Engineer, and the unit sum/price will be adjusted to a new sum/price at the discretion of the Engineer.
3. The individual Specification Sections may modify these options or may identify a specific formula or percentage sum/price reduction.

C. The authority of the Engineer to assess the defect and to identify payment adjustment is final.

PART 2 - PRODUCTS (Not Used)

PART 3 - EXECUTION (Not Used)

END OF SECTION 010000

SECTION 011000

SUMMARY

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:

1. Project information.
2. Work covered by Contract Documents.
3. Work by Contracting Officer.
4. Work under separate contracts.
5. Purchase contracts.
6. Contractor-furnished, Contracting Officer-installed products.
7. Work restrictions.
8. Specification and drawing conventions.
9. Contractor Responsibilities and Coordination

B. Related Section:

1. Division 01 Section "Temporary Facilities and Controls" for limitations and procedures governing temporary use of Contracting Officer's facilities.

1.3 PROJECT INFORMATION

A. Project Identification: Buildings 220, 221, 223, & 225 Fire Alarm Replacements

1. Project Location: Bureau Drive, Gaithersburg, Maryland.

2. Contracting Officer: Trent Stevens

3. Contracting Officer Representative: Stephen Bielewicz

4. Contract No. 1333ND21DNB190025, Task Order No. 1333ND24FNB190117

1.4 WORK COVERED BY CONTRACT DOCUMENTS

A. Replacement of the fire alarm systems in the following NIST buildings: B220, B221, B223, & B225

B. Design of all fire alarm systems and system components shall be in accordance with the most recent edition of codes and standards specified in the NIST suborder S 7401.01 FIRE PROTECTION & LIFE SAFETY FOR DESIGN AND CONSTRUCTION at the time of contract award.
   1. International Building Code
   2. International Fire Code
   3. NFPA 70
   4. NFPA 72
   5. NFPA 90A
   6. American National Standards Institute (ANSI) A117.1, Accessible and Usable Buildings and Facilities
   7. NIST S 7401.01: *Fire Protection & Life Safety for Design and Construction*
   8. NIST S 7401.03: *Fire Protection and Life Safety System Impairments*

C. The Contractor shall design all fire alarm circuits to be Class A as defined in NFPA 72.

D. The Contractor shall design the conversion of all MapNet signaling line circuits to IDNet circuits. The Contractor shall replace all existing to remain initiating devices or control relays that are not compatible with IDNet. Additionally, the Contractor shall convert any conventional devices to addressable if environmental/research conditions permit.

E. Devices and appliances in the incoming service utility rooms must be rated/appropriate for the expected temperature and humidity. This could include conventional device(s) on an initiating device circuit to an addressable module located in an adjacent conditioned space.

F. The Contractor shall design duct smoke detection in accordance with NFPA 90A to replace the existing fire stats to be demolished. Duct smoke detectors shall be two-wire type with separate addressable control relay(s) as required to affect the intended HVAC shutdown.

G. The Contractor shall design the removal of all initiating devices that are not required by code or NIST standards and do not serve a necessary fire safety function, including but not limited to all Priority 2 mechanical and electrical monitoring points. Removal of any fire detection device shall be approved by the NIST AHJ.

H. The Contractor shall design all fire safety interfaces for elevators in accordance with ANSI/ASME A17.1 and NFPA 72.

I. The Contractor shall design the installation of new fire alarm notification appliances in all public or assembly spaces that are lacking notification in compliance with NFPA 72.

J. Voltage loads on some visual circuits are such that the circuits are over capacity, appropriate safety factors are not met, or adding devices or increasing candela ratings in response to building modifications is not possible. NIST requires a maximum voltage drop of 10% for all new visual circuits and a 5% safety factor added to the minimum device operating voltage for

all existing circuits. The Contractor shall study circuits that do not meet these requirements and design a solution.

K. The current fire alarm system is being used by NIST as an in-building mass notification system. However, the audibility and/or intelligibility of some spaces are not sufficient to meet NFPA 72 requirements and/or provide effective emergency notification to the building occupants. The Contractor shall study the audible characteristics of the existing system and design a solution. In the design, the Contractor shall determine acoustically distinguishable spaces per NFPA 72, determine which of these spaces should be provided with voice intelligibility, and design necessary modifications to the existing notification system in these spaces.

L. The Contractor shall design the installation of new fire alarm notification devices to provide live voice and prerecorded messaging to areas surrounding the building and other outdoor designated areas per NFPA 72. This must include fire alarm speakers at each building entrance and one loudspeaker (Hyper Spike or approved equal) adjacent to the evacuation assembly area designated by the NIST Emergency Services Office.

M. NIST general purpose laboratory buildings are connected by pedestrian concourses known as the "spine". The Contractor shall investigate the fire alarm arrangement at each spine connection to the included building and present their recommendations for NIST review and approval. This investigation and proposed upgrade must consider the boundary between notification zones and associated sequence of operations, manual fire alarm box locations and functions, and whether smoke detectors for door control are required.

N. The Contractor shall design the batteries for 72 hours of standby followed by 15 minutes of alarm for all fire alarm control panels and transponders, and 24 hours of standby followed by 15 minutes of alarm for all NAC panels.

O. The Contractor shall design revisions to the fire alarm textual and graphic reporting so that all information for existing, modified, and new devices and circuits is accurate. Graphics must show the entire floor.

P. The Contractor shall be responsible for designing this system. It is understood that SIMPLEX may provide technical information on their products. In the end, the Contractor shall be wholly responsible for providing a complete design. Performance based specifications are not acceptable.

Q. The Contractor shall design modifications to the system so the fire alarm system remains operational at all times except for temporary, coordinated outages.

R. Additional building specific requirements include the following:
   1. For Building 220
      a. Provide flame detection for the Wax Vat in the East Basement.
      b. Provide black detectors and bases for the Basement Photo Tunnel and Tape Tunnel.

1.5 WORK RESTRICTIONS

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

1. Comply with limitations on use of public streets and other requirements of authorities having jurisdiction.

B. Nonsmoking Building: Smoking is not permitted within the building or within 25 feet of entrances, operable windows, or outdoor air intakes.

1.6 ACCESS TO SITE

A. General: Contractor shall have limited use of Project site for construction operations as indicated on Drawings by the Contract limits and as indicated by requirements of this Section.

B. Use of Site: Limit use of Project site to areas within the contract limits indicated. Do not disturb portions of Project site beyond areas in which the Work is indicated.
1. Limits: Confine construction operations to limits of disturbance as indicated on drawings.
2. Driveways, Walkways, and Entrances: Keep driveways and entrances serving the premises clear and available to the Contracting Officer, Contracting Officer's representatives, and emergency vehicles at all times. Do not use these areas for parking or storage of materials.
3. Parking: Parking will be restricted to the area shown adjacent to the laydown area. Requests for additional or alternate parking should be made in writing to the COR. Fifteen (15) feet of clearance shall be maintained around all fire hydrants at all times.
4. The Contractor and his employees and subcontractors shall become familiar with and obey all NIST Site Regulations, including fire, traffic, and security regulations. All personnel employed on the site shall keep within the limits of the work (and avenues of ingress and egress), and shall not enter any restricted areas unless required to do so and are cleared for such entry. The Contractor's equipment shall be conspicuously marked for identification.
5. Material Storage: All materials shall be stored in the lay down area. The Contractor shall adequately protect all materials from the weather.

C. Condition of Existing Building: Maintain existing building in a weathertight condition throughout construction period. Repair damage caused by construction operations.

1.7 SPECIFICATION AND DRAWING CONVENTIONS

A. Specification Content: The Specifications use certain conventions for the style of language and the intended meaning of certain terms, words, and phrases when used in particular situations. These conventions are as follows:

1. Imperative mood and streamlined language are generally used in the Specifications. The words "shall," "shall be," or "shall comply with," depending on the context, are implied where a colon (:) is used within a sentence or phrase.
2. Specification requirements are to be performed by Contractor unless specifically stated otherwise.

B. Division 01 General Requirements: Requirements of Sections in Division 01 apply to the Work of all Sections in the Specifications.

C. Drawing Coordination: Requirements for materials and products identified on the Drawings are described in detail in the Specifications. One or more of the following are used on the Drawings to identify materials and products:

1. Terminology: Materials and products are identified by the typical generic terms used in the individual Specifications Sections.
2. Abbreviations: Materials and products are identified by abbreviations published as part of the U.S. National CAD Standard and scheduled on Drawings.
3. Keynoting: Materials and products are identified by reference keynotes referencing Specification Section numbers found in this Project Manual.

1.8 MISCELLANEOUS PROVISIONS

A. Public Release of Information:
1. The Contractor shall not publicly release information, photographs, or other documents concerning any aspect of the materials or services relating to this bid, contract, or purchase order without the prior written approval of the Contracting Officer.
2. Insert the substance of clause "#1" above in each sub-contract and purchase order related to this project.

B. Permits: In addition to the requirements of the clause entitled "Permits and Responsibilities", permits are required for but not necessarily limited to welding, grinding and burning. Prior to commencing these activities, the Contractor shall submit an application for a permit to the COR.

C. Asbestos Material: Asbestos containing material could be encountered by the Contractor on this project. If material is encountered that looks suspicious but must be disturbed, do not touch the material and immediately notify the COR in writing. Within fourteen (14) calendar days, the Government will perform laboratory tests to determine if there is asbestos. If asbestos is not a danger, the Contracting Officer will direct the Contractor to proceed without change. If the material encountered is asbestos and must handled, the Contracting Officer will direct a change.

1.9 OCCUPATIONAL SAFETY AND HEALTH

A. NIST, as a Federal government facility in the State of Maryland, is under the jurisdiction of the OSHA Region III regional office, which may assign an OSHA Compliance Safety and Health Officer (CSHO) to conduct safety and health inspections of the Contractor's operations at the NIST Gaithersburg site. Accordingly, the Contractor is subject to OSHA Citations and Notices of Penalty for noncompliance with OSHA standards. To protect its own interests, NIST may also conduct periodic safety and health inspections to assure that NIST employees/property are not at risk of injury/damage from Contractor operations, and to avoid the risk of OSHA Citations under the OSHA multi-employer worksite provisions.

1. Pre-work Safety Meeting: Representatives of the Contractor shall meet with the Contracting Officer and his/her safety representative(s) prior to the start of work under this contract for the purpose of reviewing the Contractor's safety and health programs and discussing implementation of all safety and health provisions pertinent to the work to

be performed under the contract. The Contractor shall be prepared to discuss, in detail, the measures he/she intends to take in order to control any unsafe or unhealthy conditions associated with the work to be performed under the contract. If directed by the Contracting Officer, this meeting may be held in conjunction with other meetings which are scheduled to take place prior to start of work under this contract. The level of detail for the safety meeting is dependent upon the nature of the work and the potential inherent hazards. The Contractor's principal on-site representative(s), the general superintendent, and his/her safety representative(s) shall attend this meeting.

2. Safety and Health Standards Compliance: The Contractor shall comply (and shall ensure that firms acting as agents or subcontractors to the prime Contractor also comply) with all applicable OSHA Safety and Health Standards for Construction (29CFR1926) and OSHA General Industry Occupational Safety and Health Standards (29CFR1910). Additionally, the Contractor shall comply with all applicable site safety and health requirements. The NIST Safety Office will provide guidance/consultation regarding specific site requirements.
3. Special Emphasis Standards: While the Contractor is responsible for compliance with all applicable OSHA Safety and Health Standards, special emphasis will be placed upon the following:
    a. Fall Protection: Fall protection measures shall be implemented as required via use of suitable guardrails/ barricades; safety belts/harnesses/lanyards/ lifelines; safety nets; or other approved means. Particular emphasis is to be focused on the requirements stipulated in Subpart L (Scaffolding), Subpart M (Floor and Wall Openings), Subpart R (Steel Erection) and Subpart X (Stairways and Ladders) of 29CFR1926 (Safety and Health Standards for Construction).
    b. Excavations and Trenching: With regard to excavations (including trenches), the soil at the NIST Gaithersburg site shall be considered previously excavated and therefore unstable. Accordingly, persons entering excavations five (5) or more feet deep shall be protected from cave-ins by an adequate protective system designed in accordance with the requirements of 29CFR1926.652(b) or (c). All other applicable requirements for excavations as contained in Subpart P (Excavations) of 29CFR1926 shall be implemented.
    c. Confined Spaces: Entry into permit-required confined spaces must be in accordance with the requirements stipulated in the OSHA Permit-Required Confined Space standard (29CFR1910.146). The Contractor shall be responsible for all confined space entry requirements including personnel training, documented entry permit system, atmospheric contractor funded testing/ monitoring, forced ventilation, personal protective equipment, and emergency procedures/equipment.
    d. Hazard Communication: As applicable (i.e., when chemicals are used on-site by the Contractor), the Contractor shall develop, implement and maintain at the workplace a written hazard communication program meeting the requirements of 29CFR1926.59 (for construction contracts) or 29CFR1910.1200 (for other than construction contracts). The contractor shall ensure that each container of hazardous chemicals at the worksite is labeled, tagged or otherwise marked with the identity of the hazardous chemical(s) contained therein and that such markings show hazard warnings appropriate for employee protection. The Contractor shall provide employees with information and training on hazardous chemicals in their work area at the time of initial assignment and whenever a new hazardous chemical is introduced into their work area. The Contractor shall also provide employees with information on any operations in their work area where hazardous chemicals are present; and the location and availability of the written hazard

communication program, including the required list(s) of hazardous chemicals, and material safety data sheets (MSDS) required by the standard.

e. Control of Hazardous Energy (Lockout/Tag out): In accordance with the provisions of OSHA standards 29CFR1910.147 and 29CFR1926.417, the Contractor shall establish and implement a program consisting of energy control procedures, employee training and periodic inspections to ensure that before any employee performs any servicing or maintenance on electrical circuits/equipment, machines or other equipment/systems where the unexpected energizing, start up or release of stored energy could occur and cause injury, the circuit/machine/equipment/system shall be isolated from the energy source and rendered inoperative.

   1) When Lockout/Tag (LOTO) out is required, LOTO devices and verification of LOTO shall first be performed by NIST electricians. Verification of zero energy and application of LOTO devices by the contractor is also required. Verification of zero energy by NIST electricians does not constitute verification of zero energy by the contractor. Contractor shall also perform verification of zero energy. The last LOTO device to be removed shall be that of a NIST electrician.

f. Electrical Installations and Work Practices: The Contractor shall comply with all applicable installation safety requirements, safety-related maintenance and environmental considerations, and safety requirements for special equipment as contained in Subpart K (Electrical) of 29CFR1926.

g. Personal Protective and Life Saving Equipment: In accordance with the provisions of Subpart E (Personal Protective and Life Saving Equipment) of 29CFR1926, the Contractor shall ensure that protective equipment (including personal protective equipment for eyes, head, face, head and extremities; protective clothing; respiratory devices; and protective shields and barriers) shall be provided, used and maintained in a sanitary and reliable condition whenever it is necessary by reason of hazards of process or environment, chemical hazards, radiological hazards, or mechanical irritants encountered in a manner capable of causing injury or impairment in the function of the body through absorption, inhalation or physical contact.

h. Tools-Hand and Power: The Contractor shall ensure compliance with all applicable safety requirements for tools (hand and power) as outlined in Subpart I (Tools-Hand and Power) of 29CFR1926.

i. Welding and Cutting: The Contractor shall ensure compliance with all applicable safety requirements pertaining to welding and cutting operations as outlined in Subpart J (Welding and Cutting) of 29CFR1926.

j. Motor Vehicles and Mechanized Equipment: The Contractor shall ensure compliance with the safety requirements pertaining to motor vehicles and mechanized equipment (materials handling equipment and pile driving equipment) as contained in Subpart O (Motor Vehicles, Mechanized Equipment, and Marine Operations) of 29CFR1926.

4. General Site Safety Requirements: For the protection of NIST employees, other agency employees and the general public, the following general worksite safety requirements shall be observed by the Contractor.

a. Precautions: The Contractor shall take all necessary precautions to prevent injury to the public, building occupants, and damage to property of others. For the purposes of this contract, the public or building occupants shall include all persons not employed by the Contractor or a subcontractor working under his/her direction.
b. Housekeeping: Form and scrap lumber with protruding nails/fasteners and all other debris shall be kept clear from all work areas. Combustible scrap and debris shall be removed at regular intervals. Containers shall be provided for collection and separation of all refuse. Covers shall be provided on containers used for flammable or harmful substances. Wastes should be disposed of at frequent intervals.
c. Storage: Storing, positioning, and use of equipment, tools, materials, scraps, and trash in a manner likely to present a hazard to the public or building occupants by its accidental shifting, ignition, or other hazardous qualities is prohibited.
d. Obstructions: No corridor, aisle, stairway, door, or exit shall be obstructed or used in such a manner as to encroach upon routes or ingress or egress utilized by the public or building occupant, or to present un-safe or unhealthy condition to the public or building occupant.
e. Radiation Safety: the Contractor shall not bring to or use at NIST any radioactive materials or radio-graphic devices without explicit prior approval from Health Physics for each use of such devices. Any such use shall be in compliance with restrictions and procedures prescribed by NIST Health Physics (Bldg. 245, Room C125, x5800). Any work conducted in a NIST Restricted Area (as defined by the Nuclear Regulatory Commission and applied by NIST) shall comply with NIST procedural requirements and, in particular, specific training requirements for all persons entering that area. No area posted with Radioactive Material, Radiation Area, High Radiation Area, or Very High Radiation Area sign shall be entered without prior approval from Health Physics (i.e., all work in such areas requires prior clearance from NIST Health Physics).
f. Work Area Restrictions: Work shall not be performed in any area occupied by the public or Federal employees unless specifically permitted by the contract or the Contracting Officer and unless adequate steps are taken for the protection of the public or Federal employees.
g. Fences and Barricades: Wherever practicable, the work area shall be fenced, barricaded, or otherwise blocked off from the public or building occupants to prevent unauthorized entry into the work area.
h. Alternate Precautions: When the nature of the work prevents isolation of the work area and the public or building occupants may be in or pass through, under, or over the work area, alternate precautions such as the posting of signs, the use of signal persons, the erection of barricades, or similar protection around particularly hazardous operations shall be used as appropriate.
i. Public Thoroughfare: When work is to be performed over a public thoroughfare, such as a sidewalk, road, lobby, or corridor, the thoroughfare shall be closed, if possible, or other precautions taken such as the installation of screens or barricades.
j. Removal of Fences and Barricades: Fences and barricades shall be removed upon completion of the project, in accordance with local ordinance and to the satisfaction of the Contracting Officer or his/her representative(s).

1.10 CONTRACTOR RESPONSIBILITIES AND COORDINATION

A. Plant to remain operational during all phases of construction

B. Report in to the Shift Supervisor at the beginning of each day of work and when work is completed for the day.

C. Work that requires securing plant equipment/services must be performed during semi-annual outage. Activities must be coordinated closely with the COR and Plant Management to ensure all work can be completed to not delay start-up of the plant.

D. Concrete repair work must only be performed during the NIST planned site outage weekends. Close coordinate must be made when scheduling this work.

1.11 SALVAGE

A. The Government does not assume responsibility for any loss or damage to materials or structures on the site salvage value of which the Contractor may have reflected in his bid.

1.12 PUBLIC RELEASE OF INFORMATION

A. The contractor shall not publicly release information, photographs, or other documents concerning any aspect of the materials or services relating to this bid, contract, or purchase order without the prior written approval of the Contracting Officer.

PART 2 - PRODUCTS (Not Used)

PART 3 - EXECUTION (Not Used)

END OF SECTION 011000

SECTION 013100

PROJECT MANAGEMENT AND COORDINATION

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

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

1. General project coordination procedures.
2. Administrative and supervisory personnel.
3. Coordination drawings.
4. Requests for Information (RFIs).
5. Project meetings.
6. Inspections

B. Each contractor shall participate in coordination requirements. Certain areas of responsibility are assigned to a specific contractor.

C. Related Sections:

1. Division 01 Section "Construction Progress Documentation" for preparing and submitting Contractor's construction schedule.
2. Division 01 Section "Execution" for procedures for coordinating general installation and field-engineering services, including establishment of benchmarks and control points.
3. Division 01 Section "Closeout Procedures" for coordinating closeout of the Contract.

1.3 DEFINITIONS

A. RFI: Request from Contracting Officer, COR, or Contractor seeking information from each other during construction.

1.4 DOCUMENTATION FOR CONTRACTOR

A. In addition to one set of reproducible large-scale contract drawings, a set of electronic files of the contract drawings will be furnished to the Contractor without charge. Additional sets will be furnished on request at the cost of reproduction.

B. Omissions from the drawings or specifications or the mis-description of details of work which are manifestly necessary to carry out the intent of the drawings and specifications, or which are customarily performed, shall not relieve the Contractor from performing such omitted or mis-described details of the work but they shall be performed as if fully and correctly set forth and described in the drawings and specifications.

C. The Contractor shall check all drawings and specifications furnished him immediately upon their receipt and shall in writing within fourteen (14) calendar days from receipt of award, notify the Contracting Officer of any discrepancies. Figures marked on drawings shall in general be followed in preference to scale measurements. Large-scale drawings shall in general govern small-scale drawings; the Contractor shall compare all drawings and verify the figures before laying out the work and will be responsible for any errors which might have been avoided thereby.

1.5 INFORMATIONAL SUBMITTALS

A. Subcontract List: Prepare a written summary identifying individuals or firms proposed for each portion of the Work, including those who are to furnish products or equipment fabricated to a special design. Use CSI Form 1.5A. Include the following information in tabular form:

1. Name, address, and telephone number of entity performing subcontract or supplying products.
2. Number and title of related Specification Section(s) covered by subcontract.
3. Drawing number and detail references, as appropriate, covered by subcontract.

B. Key Personnel Names: Prior to 15 days of starting construction operations, submit a list of key personnel assignments, including superintendent and other personnel in attendance at Project site. Any changes to the key personnel shall be submitted for Approval in advance. Identify individuals and their duties and responsibilities; list addresses and telephone numbers, including home, office, and cellular telephone numbers and e-mail addresses. Provide names, addresses, and telephone numbers of individuals assigned as alternates in the absence of individuals assigned to Project.

1. Post copies of list in project meeting room, in temporary field office and by each temporary telephone. Keep list current at all times.

C. Contractor shall submit safety plan to the government for approval. Submitted safety plan shall comply with site safety requirements specified in section 011000 paragraph 1.9 “OCCUPATIONAL SAFETY AND HEALTH”.

D. Contractor shall submit acceptance testing and commissioning guidelines to the government for approval.

E. All information submittals shall be submitted in the bid submittal package at no additional cost to the government.

1.6 COORDINATION

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

1. Schedule construction operations in sequence required to obtain the best results where installation of one part of the Work depends on installation of other components, before or after its own installation.
2. Coordinate installation of different components to ensure maximum performance and accessibility for required maintenance, service, and repair.
3. Make adequate provisions to accommodate items scheduled for later installation.

B. Prepare memoranda for distribution to each party involved, outlining special procedures required for coordination. Include such items as required notices, reports, and list of attendees at meetings.

1. Prepare similar memoranda for Contracting Officer and separate contractors if coordination of their Work is required.

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

1. Preparation of Contractor's construction schedule.
2. Preparation of the schedule of values.
3. Installation and removal of temporary facilities and controls.
4. Delivery and processing of submittals.
5. Progress meetings.
6. Preinstallation conferences.
7. Project closeout activities.
8. Startup and adjustment of systems.
9. Project closeout activities.

D. Conservation: Coordinate construction activities to ensure that operations are carried out with consideration given to conservation of energy, water, and materials. Coordinate use of temporary utilities to minimize waste. The Contractor must also provide manufacturer’s Material Data Safety Sheets (MSDS), VOC limits and other material content or manufacturing specification information as required and noted in subsequent Specification sections.

E. Contractor shall have all material on site and verified by COR prior to beginning work for each phase of the project.

1.7 AS BUILT DRAWINGS

A. The Contractor shall maintain at the job site one set of full-size contract drawings marked to show any changes and/or revisions which have been made from the contract drawings, including buried or concealed construction and utility features revealed during the course of construction. Marked up drawings shall include RFI number of the approved change. The

Contractor shall record the horizontal and vertical location of all buried utilities that differ from the contract drawings. These drawings shall be available for review by the COR at all times. Upon completion of the work, the Contractor shall deliver the marked sets of prints to the COR in the original units of measure. Requests for partial payments will not be approved if the marked prints are not current, and request for final payment will not be approved until the marked prints are delivered to the Contracting Officer.

1.8 REQUESTS FOR INFORMATION (RFIs)

A. General: Immediately on discovery of the need for additional information or interpretation of the Contract Documents, Contractor shall prepare and submit an RFI in the form specified.

1. COR will return RFIs submitted to COR by other entities controlled by Contractor with no response.
2. Coordinate and submit RFIs in a prompt manner so as to avoid delays in Contractor's work or work of subcontractors.

B. Content of the RFI: Include a detailed, legible description of item needing information or interpretation and the following:

1. Project name.
2. Project number.
3. Date.
4. Name of Contractor.
5. Name of COR.
6. RFI number, numbered sequentially.
7. RFI subject.
8. Specification Section number and title and related paragraphs, as appropriate.
9. Drawing number and detail references, as appropriate.
10. Field dimensions and conditions, as appropriate.
11. Contractor's suggested resolution. If Contractor's solution(s) impacts the Contract Time or the Contract Sum, Contractor shall state impact in the RFI.
12. Contractor's signature.
13. Attachments: Include sketches, descriptions, measurements, photos, Product Data, Shop Drawings, coordination drawings, and other information necessary to fully describe items needing interpretation.

    a. Include dimensions, thicknesses, structural grid references, and details of affected materials, assemblies, and attachments on attached sketches.

C. RFI Forms: Use forms provided by the COR.

D. COR's Action: COR will review each RFI, determine action required, and respond. Allow 15 calendar days for COR's response for each RFI. RFIs received by COR after 1:00 p.m. will be considered as received the following working day.

1. The following RFIs will be returned without action:

    a. Requests for approval of submittals.
    b. Requests for approval of substitutions.

c. Requests for coordination information already indicated in the Contract Documents.
d. Requests for adjustments in the Contract Time or the Contract Sum.
e. Requests for interpretation of COR's actions on submittals.
f. Incomplete RFIs or inaccurately prepared RFIs.

2. COR's action may include a request for additional information, in which case COR's time for response will date from time of receipt of additional information.
3. COR's action on RFIs that may result in a change to the Contract Time or the Contract Sum may be eligible for Contractor to submit Change Proposal according to Division 01 Section "Contract Modification Procedures."

a. If Contractor believes the RFI response warrants change in the Contract Time or the Contract Sum, notify the Contracting Officer in accordance with the Changes clause.

E. On receipt of COR's action, update the RFI log and immediately distribute the RFI response to affected parties. Review response and notify COR within seven days if Contractor disagrees with response.

F. RFI Log: Prepare, maintain, and submit a tabular log of RFIs organized by the RFI number. Submit log weekly. Include the following:

1. Project name.
2. Name and address of Contractor.
3. Name and address of COR.
4. RFI number including RFIs that were dropped and not submitted.
5. RFI description.
6. Date the RFI was submitted.
7. Date COR's response was received.

1.9 PROJECT MEETINGS

A. General: Schedule and conduct meetings and conferences at Project site, unless otherwise indicated or directed by the Contracting Officer.

1. Attendees: Inform participants and others involved, and individuals whose presence is required, of date and time of each meeting. Notify contracting officer and COR of scheduled meeting dates and times.
2. Agenda: Prepare the meeting agenda. Distribute the agenda to all invited attendees.
3. Minutes: Entity responsible for conducting meeting will record significant discussions and agreements achieved. Distribute the meeting minutes to everyone concerned, including Contracting Officer**,** and COR, within three days of the meeting.
4. Performance of the contract includes the Contractor attending all meetings deemed necessary by the Contracting Officer.

B. Preconstruction Conference: CO will schedule and conduct a preconstruction conference before starting construction, at a time convenient to Contracting Officer and COR, but no later than 15 days after approval of health and safety plan and issuance of security badges.

C. Conduct the conference to review responsibilities and personnel assignments.
   1. Attendees: Authorized representatives of Contracting Officer, COR, and their consultants; Contractor and its superintendent; major subcontractors; suppliers; and other concerned parties shall attend the conference. Participants at the conference shall be familiar with Project and authorized to conclude matters relating to the Work.
   2. Agenda: Discuss items of significance that could affect progress, including the following:

      a. Tentative construction schedule.
      b. Critical work sequencing and long-lead items.
      c. Designation of key personnel and their duties.
      d. Lines of communications.
      e. Procedures for processing field decisions and Change Orders.
      f. Procedures for RFIs.
      g. Procedures for testing and inspecting.
      h. Procedures for processing Applications for Payment.
      i. Distribution of the Contract Documents.
      j. Submittal procedures.
      k. Sustainable design requirements.
      l. Preparation of record documents.
      m. Use of the premises.
      n. Work restrictions.
      o. Working hours.
      p. Contracting Officer's occupancy requirements.
      q. Responsibility for temporary facilities and controls.
      r. Procedures for moisture and mold control.
      s. Procedures for disruptions and shutdowns.
      t. Construction waste management and recycling.
      u. Parking availability.
      v. Office, work, and storage areas.
      w. Equipment deliveries and priorities.
      x. First aid.
      y. Security.
      z. Progress cleaning.

   3. Minutes: Entity responsible for conducting meeting will record and distribute meeting minutes.

D. Preinstallation Conferences: Conduct a preinstallation conference at Project site before each construction activity that requires coordination with other construction.

   1. Attendees: Installer and representatives of manufacturers and fabricators involved in or affected by the installation and its coordination or integration with other materials and installations that have preceded or will follow, shall attend the meeting. Advise COR of scheduled meeting dates.
   2. Agenda: Review progress of other construction activities and preparations for the particular activity under consideration, including requirements for the following:

      a. Contract Documents.
      b. Options.
      c. Related RFIs.
      d. Related Change Orders.

e. Purchases.
f. Deliveries.
g. Submittals.
h. Review of mockups.
i. Possible conflicts.
j. Compatibility requirements.
k. Time schedules.
l. Weather limitations.
m. Manufacturer's written instructions.
n. Warranty requirements.
o. Compatibility of materials.
p. Acceptability of substrates.
q. Temporary facilities and controls.
r. Space and access limitations.
s. Regulations of authorities having jurisdiction.
t. Testing and inspecting requirements.
u. Installation procedures.
v. Coordination with other work.
w. Required performance results.
x. Protection of adjacent work.
y. Protection of construction and personnel.

3. Record significant conference discussions, agreements, and disagreements, including required corrective measures and actions.
4. Reporting: Distribute minutes of the meeting to each party present and to other parties requiring information.
5. Do not proceed with installation if the conference cannot be successfully concluded. Initiate whatever actions are necessary to resolve impediments to performance of the Work and reconvene the conference at earliest feasible date.

E. Project Closeout Conference: Schedule and conduct a Project closeout conference, at a time convenient to Contracting Officer and COR, but no later than 90 days prior to the scheduled date of Substantial Completion.

1. Conduct the conference to review requirements and responsibilities related to Project closeout.
2. Attendees: Authorized representatives of Contracting Officer, COR, and their consultants; Contractor and its superintendent; major subcontractors; suppliers; and other concerned parties shall attend the meeting. Participants at the meeting shall be familiar with Project and authorized to conclude matters relating to the Work.
3. Agenda: Discuss items of significance that could affect or delay Project closeout, including the following:

a. Preparation of record documents.
b. Procedures required prior to inspection for Substantial Completion and for final inspection for acceptance.
c. Submittal of written warranties.
d. Requirements for completing LEED documentation.
e. Requirements for preparing operations and maintenance data.
f. Requirements for delivery of material samples, attic stock, and spare parts.
g. Requirements for demonstration and training.

h. Preparation of Contractor's punch list.
i. Procedures for processing Applications for Payment at Substantial Completion and for final payment.
j. Submittal procedures.
k. Coordination of separate contracts.
l. Contracting Officer's partial occupancy requirements.
m. Installation of Contracting Officer's furniture, fixtures, and equipment.
n. Responsibility for removing temporary facilities and controls.

4. Minutes: Entity conducting meeting will record and distribute meeting minutes.

F. Progress Meetings: Conduct progress meetings at biweekly intervals unless otherwise directed by the NIST COR.

1. Coordinate dates of meetings with preparation of payment requests.
2. Attendees: In addition to representatives of Contracting Officer and COR, each contractor, subcontractor, supplier, and other entity concerned with current progress or involved in planning, coordination, or performance of future activities shall be represented at these meetings. All participants at the meeting shall be familiar with Project and authorized to conclude matters relating to the Work.
3. Agenda: Review and correct or approve minutes of previous progress meeting; distribute corrected meeting minutes within 48 hours. Review other items of significance that could affect progress. Include topics for discussion as appropriate to status of Project.

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

1) Review schedule for next period.

b. Review present and future needs of each entity present, including the following:

1) Interface requirements.
2) Sequence of operations.
3) Status of submittals.
4) Deliveries.
5) Off-site fabrication.
6) Access.
7) Site utilization.
8) Temporary facilities and controls.
9) Progress cleaning.
10) Quality and work standards.
11) Status of correction of deficient items.
12) Field observations.
13) Status of RFIs.
14) Status of proposal requests.
15) Pending changes.
16) Status of Change Orders.

17) Pending claims and disputes.
18) Documentation of information for payment requests.

4. Minutes: Contractor shall be responsible for conducting the meeting, will record, and distribute the meeting minutes to each party present and to parties requiring information.

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

G. Coordination Meetings: Conduct Project coordination meetings at regular intervals. Project coordination meetings are in addition to specific meetings held for other purposes, such as progress meetings and pre-installation conferences.

1. Attendees: In addition to representatives of Contracting Officer and COR, each contractor, subcontractor, supplier, and other entity concerned with current progress or involved in planning, coordination, or performance of future activities shall be represented at these meetings. All participants at the meetings shall be familiar with Project and authorized to conclude matters relating to the Work.
2. Agenda: Review and correct or approve minutes of the previous coordination meeting. Review other items of significance that could affect progress. Include topics for discussion as appropriate to status of Project.

a. Combined Contractor's Construction Schedule: Review progress since the last coordination meeting. Determine whether each contract is on time, ahead of schedule, or behind schedule, in relation to combined Contractor's construction schedule. Determine how construction behind schedule will be expedited; secure commitments from parties involved to do so. Discuss whether schedule revisions are required to ensure that current and subsequent activities will be completed within the Contract Time.
b. Schedule Updating: Revise combined Contractor's construction schedule after each coordination meeting where revisions to the schedule have been made or recognized. Issue revised schedule concurrently with report of each meeting.
c. Review present and future needs of each contractor present, including the following:

1) Interface requirements.
2) Sequence of operations.
3) Status of submittals.
4) Deliveries.
5) Off-site fabrication.
6) Access.
7) Site utilization.
8) Temporary facilities and controls.
9) Work hours.
10) Hazards and risks.
11) Progress cleaning.
12) Quality and work standards.
13) Change Orders.

3. Reporting: Record meeting results and distribute copies to everyone in attendance and to others affected by decisions or actions resulting from each meeting.

1.10 SCHEDULING OF INSPECTIONS

A. When specified inspections or tests are required by the Contract Documents, the work involved shall not proceed beyond the point until such inspections or tests have been approved by the COR. The Contractor shall inform the COR of progress of the work and shall give the COR a minimum of three (3) working days written notice of appropriate times for specified inspections and tests. The Contractor shall insure that the portion of work to be inspected is safe and accessible.

B. The Contractor and COR shall jointly develop agendas subject to the COR's approval for all inspections/tests. All required labor, materials, equipment, instruments, lubricants and incidentals necessary to perform these inspections/tests shall be furnished by the Contractor. All discrepancies and deficiencies observed during each inspection/test shall be noted and corrected and, if directed by the COR, the inspection/test of equipment and systems previously found deficient shall be rescheduled and performed at no additional cost to the Government.

1.11 FIELD INVESTIGATIONS

A. Contractors shall adhere to the requirements of the "Guidelines for Contractors and A/E Firms Performing Site Investigations and Field Work at NIST" when they are performing site investigations and fieldwork.

PART 2 - PRODUCTS (Not Used)

PART 3 - EXECUTION

3.1 GENERAL COORDINATION PROVISIONS

A. Inspection of Conditions: Prior to installations, require the installer of each component to inspect both the substrate and conditions under which work is to be performed.

B. Do not proceed until unsatisfactory conditions have been corrected in an acceptable manner.

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

D. Construction in Progress: Keep construction in progress, adjoining materials in place, and adjoining materials clean during handling and installation. Apply protective coverings where required for protection from damage or deterioration.

E. Completed Construction: Clean completed construction, and provide maintenance, as frequently as necessary to prevent damage or soiling or other deterioration through the remainder of the construction period. Adjust and lubricate operable components as necessary to assure operability without damage.

F. Limiting Exposures: Supervise construction operations to prevent exposure of any part of construction, completed or in progress, to harmful, dangerous, damaging or otherwise deleterious conditions during the construction period. Such conditions include but are not limited to the following:
   1. Excessive static or dynamic loading.
   2. Excessive internal or external pressures.
   3. Excessively high or low temperatures.
   4. Thermal shock.
   5. Excessively high or low humidity.
   6. Pollution and air contamination.
   7. Water or ice.
   8. Chemicals and solvents.
   9. Light
   10. Radiation
   11. Puncture
   12. Abrasion
   13. Heavy Traffic
   14. Soiling, staining, and corrosion
   15. Bacteria
   16. Rodent and insect infestation
   17. Combustion
   18. Electrical Current
   19. High-speed operation
   20. Improper lubrication
   21. Unusual wear or other misuse
   22. Contact between incompatible materials
   23. Destructive testing
   24. Misalignment
   25. Excessive weathering
   26. Unprotected storage
   27. Improper shipping or handling
   28. Theft or vandalism

END OF SECTION 013100

SECTION 013200

CONSTRUCTION PROGRESS DOCUMENTATION

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 documenting the progress of construction during performance of the Work, including the following:

1. Start-up construction schedule.
2. Contractor's construction schedule.
3. Daily construction reports.
4. Material location reports.
5. Field condition reports.
6. Special reports.

B. Related Sections:

1. Division 01 Section "Submittal Procedures" for submitting schedules and reports.
2. Division 01 Section "Quality Requirements" for submitting a schedule of tests and inspections.

1.3 DEFINITIONS

A. Activity: A discrete part of a project that can be identified for planning, scheduling, monitoring, and controlling the construction project. Activities included in a construction schedule consume time and resources.

1. Critical Activity: An activity on the critical path that must start and finish on the planned early start and finish times.
2. Predecessor Activity: An activity that precedes another activity in the network.
3. Successor Activity: An activity that follows another activity in the network.

B. Cost Loading: The allocation of the schedule of values for the completion of an activity as scheduled. The sum of costs for all activities must equal the total Contract Sum, unless otherwise approved by COR.

C. CPM: Critical path method, which is a method of planning and scheduling a construction project where activities are arranged based on activity relationships. Network calculations determine when activities can be performed and the critical path of the Project.

D. Critical Path: The longest connected chain of interdependent activities through the network schedule that establishes the minimum overall Project duration and contains no float.

E. Event: The starting or ending point of an activity.

F. Float: The measure of leeway in starting and completing an activity.

1. Float time belongs to Contracting Officer.
2. Free float is the amount of time an activity can be delayed without adversely affecting the early start of the successor activity.
3. Total float is the measure of leeway in starting or completing an activity without adversely affecting the planned Project completion date.

G. Resource Loading: The allocation of manpower and equipment necessary for the completion of an activity as scheduled.

1.4 INFORMATIONAL SUBMITTALS

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

1. PDF electronic file.
2. Two paper copies.

B. Start-up construction schedule.

1. Approval of cost-loaded start-up construction schedule will not constitute approval of schedule of values for cost-loaded activities.

C. Start-up Network Diagram: Of size required to display entire network for entire construction period. Show logic ties for activities.

D. Contractor's Construction Schedule: Initial schedule, of size required to display entire schedule for entire construction period.

1. Submit a working electronic copy of schedule, using software indicated, and labeled to comply with requirements for submittals. Include type of schedule (initial or updated) and date on label.

E. CPM Reports: Concurrent with CPM schedule, submit each of the following reports. Format for each activity in reports shall contain activity number, activity description, cost and resource loading, original duration, remaining duration, early start date, early finish date, late start date, late finish date, and total float in calendar days.

1. Activity Report: List of all activities sorted by activity number and then early start date, or actual start date if known.

2. Logic Report: List of preceding and succeeding activities for all activities, sorted in ascending order by activity number and then early start date, or actual start date if known.
3. Total Float Report: List of all activities sorted in ascending order of total float.
4. Earnings Report: Compilation of Contractor's total earnings from commencement of the Work until most recent Application for Payment.

F. Daily Construction Reports: Submit at weekly intervals.

G. Material Location Reports: Submit at weekly intervals.

H. Field Condition Reports: Submit at weekly intervals.

I. On Site Equipment Report: Submit at daily intervals.

J. Special Reports: Submit at time of unusual event.

K. Qualification Data: For scheduling consultant.

L. Contractor shall submit statement to government that final installation is installed in accordance with the latest edition of the NEC, NFPA 70, and warranted as such for the period of the 1-year warranty.

1.5 QUALITY ASSURANCE

A. Scheduling Consultant Qualifications: An experienced specialist in CPM scheduling and reporting, with capability of producing CPM reports and diagrams within 24 hours of COR's request.

B. Prescheduling Conference: Conduct conference at Project site to comply with requirements in Division 01 Section "Project Management and Coordination." Review methods and procedures related to the preliminary construction schedule and Contractor's construction schedule, including, but not limited to, the following:

1. Review software limitations and content and format for reports.
2. Verify availability of qualified personnel needed to develop and update schedule.
3. Discuss constraints, including work stages and interim milestones.
4. Review delivery dates for Contracting Officer-furnished products.
5. Review schedule for work of Contracting Officer's separate contracts.
6. Review time required for review of submittals and resubmittals.
7. Review requirements for tests and inspections by independent testing and inspecting agencies.
8. Review time required for completion and startup procedures.
9. Review and finalize list of construction activities to be included in schedule.
10. Review submittal requirements and procedures.
11. Review procedures for updating schedule.

1.6 COORDINATION

A. Coordinate preparation and processing of schedules and reports with performance of construction activities and with scheduling and reporting of separate contractors.

B. Coordinate Contractor's construction schedule with the schedule of values, list of subcontracts**,** submittal schedule, progress reports, payment requests, and other required schedules and reports.

1. Secure time commitments for performing critical elements of the Work from entities involved.
2. Coordinate each construction activity in the network with other activities and schedule them in proper sequence.

PART 2 - PRODUCTS

2.1 CONTRACTOR'S CONSTRUCTION SCHEDULE, GENERAL

A. Time Frame: Extend schedule from date established for commencement of the Work to date of Substantial Completion.

1. Contract completion date shall not be changed by submission of a schedule that shows an early completion date, unless specifically authorized by Change Order.

B. Activities: Treat each story or separate area as a separate numbered activity for each principal element of the Work. Comply with the following:

1. Activity Duration: Define activities so no activity is longer than 20 days, unless specifically allowed by COR.
2. Procurement Activities: Include procurement process activities for the following long lead items and major items, requiring a cycle of more than 60 days, as separate activities in schedule. Procurement cycle activities include, but are not limited to, submittals, approvals, purchasing, fabrication, and delivery.
3. Submittal Review Time: Include review and resubmittal times indicated in Division 01 Section "Submittal Procedures" in schedule. Coordinate submittal review times in Contractor's construction schedule with submittal schedule.
4. Startup and Testing Time: Include not less than 15 days for startup and testing.
5. Substantial Completion: Indicate completion in advance of date established for Substantial Completion, and allow time for COR's administrative procedures necessary for certification of Substantial Completion.
6. Punch List and Final Completion: Include not more than 30 days for punch list and final completion.

C. Constraints: Include constraints and work restrictions indicated in the Contract Documents and as follows in schedule, and show how the sequence of the Work is affected.

1. Work under More Than One Contract: Include a separate activity for each contract.

2. Work by Contracting Officer: Include a separate activity for each portion of the Work performed by Contracting Officer.
3. Products Ordered in Advance: Include a separate activity for each product. Include delivery date indicated in Division 01 Section "Summary." Delivery dates indicated stipulate the earliest possible delivery date.
4. Contracting Officer-Furnished Products: Include a separate activity for each product. Include delivery date indicated in Division 01 Section "Summary." Delivery dates indicated stipulate the earliest possible delivery date.
5. Work Restrictions: Show the effect of the following items on the schedule:
   a. Limitations of continued occupancies.
   b. Uninterruptible services.
   c. Use of premises restrictions.
   d. Provisions for future construction.
   e. Seasonal variations.
   f. Environmental control.

6. Work Stages: Indicate important stages of construction for each major portion of the Work, including, but not limited to, the following:

   a. Subcontract awards.
   b. Submittals.
   c. Purchases.
   d. Mockups.
   e. Fabrication.
   f. Sample testing.
   g. Deliveries.
   h. Installation.
   i. Tests and inspections.
   j. Adjusting.
   k. Curing.
   l. Startup and placement into final use and operation.

7. Construction Areas: Identify each major area of construction for each major portion of the Work. Indicate where each construction activity within a major area must be sequenced or integrated with other construction activities to provide for the following:

   a. Structural completion.
   b. Permanent space enclosure.
   c. Completion of mechanical installation.
   d. Completion of electrical installation.
   e. Substantial Completion.

D. Milestones: Include milestones indicated in the Contract Documents in schedule, including, but not limited to, the Notice to Proceed, Substantial Completion, and final completion.

E. Cost Correlation: At the head of schedule, provide a cost correlation line, indicating planned and actual costs. On the line, show dollar volume of the Work performed as of dates used for preparation of payment requests.

F. Upcoming Work Summary: Prepare summary report indicating activities scheduled to occur or commence prior to submittal of next schedule update. Summarize the following issues:

1. Unresolved issues.
2. Unanswered RFIs.
3. Rejected or unreturned submittals.
4. Notations on returned submittals.

G. Recovery Schedule: When periodic update indicates the Work is 14 or more calendar days behind the current approved schedule, submit a separate recovery schedule indicating means by which Contractor intends to regain compliance with the schedule. Indicate changes to working hours, working days, crew sizes, and equipment required to achieve compliance, and date by which recovery will be accomplished.

H. Computer Scheduling Software: Prepare schedules using current version of a program that has been developed specifically to manage construction schedules.

1. Utilize Microsoft Project, for Windows operating system.

2.2 CONTRACTOR'S CONSTRUCTION SCHEDULE (CPM SCHEDULE)

A. General: Prepare network diagrams using cost loaded format.

B. Start-up Network Diagram: Prepare a fully developed network analysis of the project. The network shall be of the type generally referred to as the Critical Path Method (CPM), Critical Path Schedule (CPS), and Critical Path Analysis (CPA). Submit within 15 days of the date established for “Notice to Proceed”.

1. The network analysis shall include as a minimum a graphic representation of all activities and events included in the construction of the project. The network shall show the major subdivisions of the work, the activities involved in each part, the relations of activities to each other as to dependency, concurrency, etc., the duration of each activity, and the critical path of activities for the overall job showing a total job duration equal to the contract time. A written statement of explanation is to be submitted with the network designation.
2. An initial schedule, generated by the network design shall be submitted showing the following for each activity.
   a. The earliest activity starting time, the latest activity starting time, the earliest activity finishing time, the latest activity finishing time, total float time (slack time), free float (of slack). These times are to be given in calendar dates.
   b. Status reports for the approved network diagram will be required monthly throughout the life of the contract or at other times if unusual conditions exist, at the direction of the Contracting Officer. These reports will indicate actual completion dates of completed activities and expected completion dates of other activities.
   c. Any changes in the original network plan desired by the Contractor must be approved by the Contracting Officer.
   d. Allow 21 calendar days for NIST to process and review major submittal packages submitted to NIST for review and approval.

e. Clearly indicate the critical path for the project. Highlight NIST actions that are on the critical path.
f. Phasing: Provide notations on the schedule to show how the sequence of the Work is affected by requirements for phased completion to permit Work by separate Contractors and partial occupancy by the Government prior to Substantial Completion.
g. Work Stages: Indicate important stages of construction for each major portion of the Work, including contractor funded testing and installation.
h. Area Separations: Provide a separate time bar to identify each major construction area for each major portion of the Work. Indicate where each element in an area must be sequenced or integrated with other activities.
i. Cost Correlation: At the head of the schedule, provide a two item cost correlation line, indicating “pre-calculated” and “actual” costs. On the line show dollar-volume of Work performed as of the dates used for preparation of payment requests.

C. CPM Schedule: Prepare Contractor's construction schedule using a cost loaded CPM network analysis diagram for the Work.

1. Failure to include any work item required for performance of this Contract shall not excuse Contractor from completing all work within applicable completion dates, regardless of COR's approval of the schedule.
2. Conduct educational workshops to train and inform key Project personnel, including subcontractors' personnel, in proper methods of providing data and using CPM schedule information.
3. Establish procedures for monitoring and updating CPM schedule and for reporting progress. Coordinate procedures with progress meeting and payment request dates.
4. Use "one workday" as the unit of time for individual activities. Indicate nonworking days and holidays incorporated into the schedule in order to correlate with Contract Time.
5. All costs applicable to the requirements for network analysis, reports, etc. shall be included in the lump sum offer.
6. Update the equipment delivery schedule at monthly intervals or as directed by the COR; reflect any changes occurring since the last updating. Submit copies of purchase orders and confirmation of delivery dates as directed. Update the equipment schedule with each invoice for progress payment.

D. CPM Schedule Preparation: Prepare a list of all activities required to complete the Work. Using the start-up network diagram, prepare a skeleton network to identify probable critical paths.

1. Activities: Indicate the estimated time duration, sequence requirements, and relationship of each activity in relation to other activities. Include estimated time frames for the following activities:

a. Preparation and processing of submittals.
b. Mobilization and demobilization.
c. Purchase of materials.
d. Delivery.
e. Fabrication.
f. Utility interruptions.
g. Installation.

h. Work by Contracting Officer that may affect or be affected by Contractor's activities.
i. Testing and commissioning.
j. Punch list and final completion.
k. Activities occurring following final completion.

2. Critical Path Activities: Identify critical path activities, including those for interim completion dates. Scheduled start and completion dates shall be consistent with Contract milestone dates.
3. Processing: Process data to produce output data on a computer-drawn, time-scaled network. Revise data, reorganize activity sequences, and reproduce as often as necessary to produce the CPM schedule within the limitations of the Contract Time.
4. Format: Mark the critical path. Locate the critical path near center of network; locate paths with most float near the edges.

   a. Subnetworks on separate sheets are permissible for activities clearly off the critical path.

5. Cost-Loading of CPM Schedule: Assign cost to construction activities on the CPM schedule. Do not assign costs to submittal activities. Obtain COR's approval prior to assigning costs to fabrication and delivery activities. Assign costs under principal subcontracts for contractor funded testing and commissioning activities, operation and maintenance manuals, punch list activities, Project record documents, LEED documentation**,** and demonstration and training (if applicable), in the amount of 5 percent of the Contract Sum.

   a. Each activity cost shall reflect an appropriate value subject to approval by COR.
   b. Total cost assigned to activities shall equal the total Contract Sum.
   c. All costs applicable to the requirements for network analysis, reports, etc. shall be included in the lump sum offer.

E. Contract Modifications: For each proposed contract modification and concurrent with its submission, prepare a time-impact analysis using a network fragment to demonstrate the effect of the proposed change on the overall project schedule.

F. Initial Issue of Schedule: Prepare initial network diagram from a sorted activity list indicating straight "early start-total float." Identify critical activities. Prepare tabulated reports showing the following:

1. Contractor or subcontractor and the Work or activity.
2. Description of activity.
3. Principal events of activity.
4. Immediate preceding and succeeding activities.
5. Early and late start dates.
6. Early and late finish dates.
7. Activity duration in workdays.
8. Total float or slack time.
9. Average size of workforce.
10. Dollar value of activity (coordinated with the schedule of values).

G. Schedule Updating: Concurrent with making revisions to schedule, prepare tabulated reports showing the following: Update the equipment delivery schedule at monthly intervals or as directed by the COR; reflect any changes occurring since the last updating. Submit copies of purchase orders and confirmation of delivery dates as directed. Update the equipment schedule with each invoice for progress payment.

1. Identification of activities that have changed.
2. Changes in early and late start dates.
3. Changes in early and late finish dates.
4. Changes in activity durations in workdays.
5. Changes in the critical path.
6. Changes in total float or slack time.
7. Changes in the Contract Time.

H. Value Summaries: Prepare two cumulative value lists, sorted by finish dates.

1. In first list, tabulate activity number, early finish date, dollar value, and cumulative dollar value.
2. In second list, tabulate activity number, late finish date, dollar value, and cumulative dollar value.
3. In subsequent issues of both lists, substitute actual finish dates for activities completed as of list date.
4. Prepare list for ease of comparison with payment requests; coordinate timing with progress meetings.

    a. In both value summary lists, tabulate "actual percent complete" and "cumulative value completed" with total at bottom.
    b. Submit value summary printouts one week before each regularly scheduled progress meeting.

2.3 REPORTS

A. Daily Construction Reports: Prepare a daily construction report recording the following information concerning events at Project site:

1. List of subcontractors at Project site.
2. List of separate contractors at Project site.
3. Approximate count of personnel at Project site.
4. Equipment at Project site.
5. Material deliveries.
6. High and low temperatures and general weather conditions, including presence of rain or snow.
7. Accidents.
8. Meetings and significant decisions.
9. Unusual events (refer to special reports).
10. Stoppages, delays, shortages, and losses.
11. Meter readings and similar recordings.
12. Emergency procedures.
13. Orders and requests of authorities having jurisdiction.
14. Change Orders received and implemented.

15. Construction Change Directives received and implemented.
16. Services connected and disconnected.
17. Equipment or system tests and startups.
18. Partial completions and occupancies.
19. Substantial Completions authorized.

B. Material Location Reports: At monthly intervals, prepare and submit a comprehensive list of materials delivered to and stored at Project site. List shall be cumulative, showing materials previously reported plus items recently delivered. Include with list a statement of progress on and delivery dates for materials or items of equipment fabricated or stored away from Project site.

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

2.4 SPECIAL REPORTS

A. General: Submit special reports directly to Contracting Officer within one day(s) of an occurrence. Distribute copies of report to parties affected by the occurrence.

B. Reporting Unusual Events: When an event of an unusual and significant nature occurs at Project site, whether or not related directly to the Work, prepare and submit a special report. List chain of events, persons participating, and response by Contractor's personnel, evaluation of results or effects, and similar pertinent information. Advise Contracting Officer in advance when these events are known or predictable.

C. Equipment Delivery Schedule:

1. Within ten (10) calendar days after Notice of Award, submit to the COR for approval, a schedule shown in the procurement plans for materials, plans and equipment. The submittal shall be in the format prescribed by the Contracting Officer and include as a minimum the following information.
   a. Description
   b. Date of purchase order
   c. Promised shipping date
   d. Name of manufacturer or supplier
   e. Date delivery is expected
   f. Date material or equipment is required, according to current progress schedule or network.
2. The Contractor shall update the equipment delivery schedule at monthly intervals or as directed by the COR. This delivery schedule shall reflect any changes occurring since the last update. The Contractor shall submit copies of purchase orders and confirmation of delivery dates as directed by the COR and update the equipment schedule with each invoice for progress payment.

PART 3 - EXECUTION

3.1 CONTRACTOR'S CONSTRUCTION SCHEDULE

A. Scheduling: Contractor to provide planning, evaluation, and reporting using CPM scheduling.

B. Contractor's Construction Schedule Updating: At monthly intervals, update schedule to reflect actual construction progress and activities. Issue schedule one week before each regularly scheduled progress meeting.

1. Revise schedule immediately after each meeting or other activity where revisions have been recognized or made. Issue updated schedule concurrently with the report of each such meeting.
2. Include a report with updated schedule that indicates every change, including, but not limited to, changes in logic, durations, actual starts and finishes, and activity durations.
3. As the Work progresses, indicate final completion percentage for each activity.

C. Distribution: Distribute copies of approved schedule to COR**,** Contracting Officer, separate contractors, testing and inspecting agencies, and other parties identified by Contractor with a need-to-know schedule responsibility.

1. Post copies in Project meeting rooms and temporary field offices.
2. When revisions are made, distribute updated schedules to the same parties and post in the same locations. Delete parties from distribution when they have completed their assigned portion of the Work and are no longer involved in performance of construction activities.

END OF SECTION 013200

SECTION 013300

SUBMITTAL PROCEDURES

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 requirements for the submittal schedule and administrative and procedural requirements for submitting Shop Drawings, Product Data, Samples, and other submittals.

B. Related Sections:

1. Division 01 Section "Construction Progress Documentation" for submitting schedules and reports, including Contractor's construction schedule.
2. Division 01 Section "Operation and Maintenance Data" for submitting operation and maintenance manuals.

1.3 DEFINITIONS

A. Action Submittals: Written and graphic information and physical samples that require COR's responsive action. Action submittals are those submittals indicated in individual Specification Sections as action submittals.

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

C. File Transfer Protocol (FTP): Communications protocol that enables transfer of files to and from another computer over a network and that serves as the basis for standard Internet protocols. An FTP site is a portion of a network located outside of network firewalls within which internal and external users are able to access files.

D. Portable Document Format (PDF): An open standard file format licensed by Adobe Systems used for representing documents in a device-independent and display resolution-independent fixed-layout document format.

E. Base Manufacturer:

1. The term “base manufacturer” as used in the Specifications refers to a manufacturer of equipment, materials, articles, or patented processes, designated by trade name, make, or catalog number, that have been used as the basis of design.
2. Base manufacturer’s products shall be regarded as establishing a standard of quality and shall not be construed as limiting competition.

F. Optional Manufacturer:

1. Subject to the limitations set out in Sections 016400 and 016401, the term “optional manufacturer” as used in the Specifications refers to a manufacturer of equipment, materials, articles, or patented processes that may provide the same functions and meet the same performance standards as the base manufacturer’s product but may require different structural support or different utility hookups or other adjustments. Optional manufacturer’s products are acceptable for performance but the Contractor is responsible for the costs for any dimensional, operational, structural, or utility adjustments to make the products fit the Project. If the Contractor intends to supply an optional manufacturer’s product, the “or equal” terms and conditions of Construction Contract Clauses title “Materials and Workmanship” shall apply, except as otherwise specifically provided in Sections 016400

2. Listing of an optional manufacturer as a supplier of the product, but only if the optional manufacturer’s product complies or can be successfully made to comply with the specified requirements, including the salient qualities included but are not necessarily limited to the following:
   a. Purpose and function.
   b. Materials and finish.
   c. Strength, durability and other applicable physical properties.
   d. Compatibility and performance attributes for the indicated application.
   e. Capacity and operating characteristics, where applicable.
   f. Size and configuration to the extent required for fit with adjoining and adjacent conditions and within spatial limitations.
   g. Appearance, including exposed dimensions, profile, texture, pattern, and color, where visible to personnel in finished spaces or from the exterior.

1.4 ACTION SUBMITTALS

A. Submittal Schedule: Submit a schedule of submittals, arranged in chronological order by dates required by construction schedule. Include time required for review, ordering, manufacturing, fabrication, and delivery when establishing dates. Include additional time required for making corrections or modifications to submittals noted by the COR and additional time for handling and reviewing submittals required by those corrections.

1. Coordinate submittal schedule with list of subcontracts, the schedule of values, and Contractor's construction schedule.
2. Initial Submittal: Submit concurrently with start-up construction schedule. All action submittals are to be submitted within 30 days of contract notice to proceed. List those submittals required to maintain orderly progress of the Work and those required early because of long lead time for manufacture or fabrication.
3. Final Submittal: Submit concurrently with the first complete submittal of Contractor's construction schedule.

a. Submit revised submittal schedule to reflect changes in current status and timing for submittals.

4. Format: Arrange the following information in a tabular format:

a. Scheduled date for first submittal.
b. Specification Section number and title.
c. Submittal category: Action, informational.
d. Name of subcontractor.
e. Description of the Work covered.
f. Scheduled date for COR's final release or approval.
g. Scheduled dates for purchasing.
h. Scheduled dates for installation.
i. Activity or event number.

1.5 SUBMITTAL ADMINISTRATIVE REQUIREMENTS

A. COR's Digital Data Files: Electronic copies of CAD Drawings of the Contract Drawings will be provided by COR for Contractor's use in preparing submittals.

a. COR and Engineer make no representations as to the accuracy or completeness of digital data drawing files as they relate to the Contract Drawings.

b. Digital Drawing Software Files: The Contract Drawings are available in AutoCAD 2007.

1) Contractor shall sign the Engineer’s standard Digital Release Agreement.

c. The following PDF files will by furnished for each appropriate discipline:

1) Floor plans.
2) Reflected ceiling plans.

B. Coordination: Coordinate preparation and processing of submittals with performance of construction activities.

1. Coordinate each submittal with fabrication, purchasing, contractor funded testing, delivery, other submittals, and related activities that require sequential activity.
2. Submit all submittal items required for each Specification Section concurrently unless partial submittals for portions of the Work are indicated on approved submittal schedule.
3. Submit action submittals and informational submittals required by the same Specification Section as separate packages under separate transmittals.
4. Coordinate transmittal of different types of submittals for related parts of the Work so processing will not be delayed because of need to review submittals concurrently for coordination.

a. COR reserves the right to withhold action on a submittal requiring coordination with other submittals until related submittals are received.

C. Processing Time: Allow time for submittal review, including time for resubmittals, as follows. Time for review shall commence on COR's receipt of submittal. No extension of the Contract Time will be authorized because of failure to transmit submittals enough in advance of the Work to permit processing, including resubmittals.

1. Initial Review: Allow 21 calendar days for initial review of each submittal. Allow additional time if coordination with subsequent submittals is required. COR will advise Contractor when a submittal being processed must be delayed for coordination.
2. Intermediate Review: If intermediate submittal is necessary, process it in same manner as initial submittal.
3. Reprocessing: Allow 14 calendar days for reprocessing each submittal.
4. Re-submittal Review: Allow 21 calendar days for review of each resubmittal.
5. Sequential Review: Where sequential review of submittals by COR's consultants, Contracting Officer, or other parties is indicated, allow 28 calendar days for initial review of each submittal.
6. Concurrent Consultant Review: Where the Contract Documents indicate that submittals may be transmitted simultaneously to COR and to COR's consultants, allow 21 calendar days for review of each submittal. Submittal will be returned to COR before being returned to Contractor.
7. No extension of Contract Time will be authorized because of failure by the Contractor to transmit submittals to the Government sufficiently in advance of the Work to permit processing.

D. Identification and Information: Place a permanent label or title block on each paper copy submittal item for identification.

1. Indicate name of firm or entity that prepared each submittal on label or title block.
2. Provide a space approximately 4 by 5 inches on label or beside title block to record Contractor's review and approval markings and action taken by COR.
3. Include the following information for processing and recording action taken:

a. Project name.
b. Date.
c. Name and Address of Engineer
d. Name and Address of Contractor
e. Name and Address of Sub-Contractor.
f. Name and Address of Supplier.
g. Name of manufacturer.
h. Submittal number or other unique identifier, including revision identifier.

1) Submittal number shall use Specification Section number followed by a decimal point and then a sequential number (e.g., 061000.01). Resubmittals shall include an alphabetic suffix after another decimal point (e.g., 061000.01.A).

i. Number and title of appropriate Specification Section.
j. Drawing number and detail references, as appropriate.
k. Location(s) where product is to be installed, as appropriate.
l. Other necessary identification.

E. Identification and Information: Identify and incorporate information in each electronic submittal file as follows:

1. Assemble complete submittal package into a single indexed file with links enabling navigation to each item.
2. Name file with submittal number or other unique identifier, including revision identifier.

    a. File name shall use project identifier and Specification Section number followed by a decimal point and then a sequential number (e.g., LNHS-061000.01). Resubmittals shall include an alphabetic suffix after another decimal point (e.g., LNHS-061000.01.A).

3. Provide means for insertion to permanently record Contractor's review and approval markings and action taken by COR.
4. Include the following information on an inserted cover sheet:

    a. Project name.
    b. Date.
    c. Name and Address of Engineer
    d. Name and Address of Contractor
    e. Name and Address of Sub-Contractor.
    f. Name and Address of Supplier.
    g. Name of manufacturer.
    h. Number and title of appropriate Specification Section.
    i. Drawing number and detail references, as appropriate.
    j. Location(s) where product is to be installed, as appropriate.
    k. Related physical samples submitted directly.
    l. Other necessary identification.

5. Include the following information as keywords in the electronic file metadata:

    a. Project name.
    b. Number and title of appropriate Specification Section.
    c. Manufacturer name.
    d. Product name.

F. Options: Identify options requiring selection by the COR.

G. Deviations: Identify deviations from the Contract Documents on submittals.

H. Additional Paper Copies: Unless additional copies are required for final submittal, and unless COR observes noncompliance with provisions in the Contract Documents, initial submittal may serve as final submittal.

1. Submit one copy of submittal to concurrent reviewer in addition to specified number of copies to COR.

I. Transmittal: Assemble each submittal individually and appropriately for transmittal and handling. Transmit each submittal from Contractor to NIST using a transmittal form. COR will return submittals, without review, received from sources other than Contractor. Transmittal form: Use format agreeable to COR

1. Transmittal Form: Provide locations on form for the following information:

    a. Project name.
    b. Date.
    c. Destination (To :).
    d. Source (From :).
    e. Names of subcontractor, manufacturer, and supplier.
    f. Category and type of submittal.
    g. Submittal purpose and description.
    h. Specification Section number and title.
    i. Indication of full or partial submittal.
    j. Drawing number and detail references, as appropriate.
    k. Transmittal number.
    l. Submittal and transmittal distribution record.
    m. Remarks.
    n. Signature of transmitter.

2. On an attached separate sheet, prepared on Contractor's letterhead, record relevant information, requests for data, revisions other than those requested by COR on previous submittals, and deviations from requirements in the Contract Documents, including minor variations and limitations. Include same identification information as related submittal.

J. Resubmittals: Make resubmittals in same form and number of copies as initial submittal.

1. Note date and content of previous submittal.
2. Note date and content of revision in label or title block and clearly indicate extent of revision.
3. Resubmit submittals until they are marked with approval notation from COR's action stamp.

K. Distribution: Furnish copies of final submittals to manufacturers, subcontractors, suppliers, fabricators, installers, authorities having jurisdiction, and others as necessary for performance of construction activities. Show distribution on transmittal forms.

L. Use for Construction: Use only final submittals that are marked with approval notation from COR's action stamp.

PART 2 - PRODUCTS

2.1 SUBMITTAL PROCEDURES

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

1. Submit submittals via mail or other delivery service to COR for review.

a. COR will return annotated file. Annotate and retain one copy of file as an electronic Project record document file.

2. Submittals: The Contractor shall prepare submittals in accordance with the Special Contract Requirements and the Technical Specifications and submit to the COR for approval. Each submittal shall be accompanied with a cover letter signed by the Contractor. The Contractor shall clearly mark each item proposed to be incorporated into the contract and identify in the submittals, with cross-references to the contract drawings and specifications so as to identify clearly the use for which it is intended. Stamp each sheet of submittal with the Contractor's certification stamp. Data submitted in a bound volume or on one sheet printed on two sides, may be stamped on the front of the first sheet only. The Contractor's certification stamp shall be worded as follows

   a. "It is hereby certified that the (equipment) (material) shown and marked in this submittal is that proposed to be incorporated into Contract Number _____, is in compliance with the Contract drawings and specifications, can be installed in the allocated spaces, and is submitted for Government approval.
   b. Certified by_____Date_____"
   c. The person signing the certification shall be one designated in writing by the Contractor as having that authority. The signature shall be in original ink. Stamp signatures are not acceptable.

3. Action Submittals: Submit Six (6) paper copies of each submittal, unless otherwise indicated. COR will return two copies.
4. Informational Submittals: Submit Six (6) paper copies of each submittal, unless otherwise indicated. COR will return Two (2) copies.
5. Closeout Submittals and Maintenance Material Submittals: Comply with requirements specified in Division 01 Section "Closeout Procedures."
6. Certificates and Certifications Submittals: Provide a statement that includes signature of entity responsible for preparing certification. Certificates and certifications shall be signed by an officer or other individual authorized to sign documents on behalf of that entity.

   a. Provide a digital signature with digital certificate on electronically-submitted certificates and certifications where indicated.
   b. Provide a notarized statement on original paper copy certificates and certifications where indicated.

7. Test and Inspection Reports Submittals: Comply with requirements specified in Division 01 Section "Quality Requirements."

8. Submittal Status Logs: The Contractor shall utilize the submittal log provided by the COR of Construction. The Contractor shall verify the log for accuracy and completeness, and shall notify the COR, in writing, within seven (7) calendar days with regards to the same. The Contractor is required to maintain at the job-site an up-to-date log showing the status of all submittals required by the Contract. Use of a numbering system is required.

9. Shop Drawings: These submittals shall be in accordance with the requirements of the clause entitled "Shop Drawings"

10. Manufacturer's Data: Catalogue cuts, technical data sheets, descriptive literature, and samples shall be submitted in accordance with the clause entitled, "Submittal Procedures"

11. Certified Test Reports: Before delivery of materials and equipment, five (5) certified copies of the reports of all test listed in the technical sections shall be submitted and approved. The contractor funded testing shall have been performed in a laboratory meeting the requirements specified herein. The tests shall have been performed within three (3) years of submittal of the reports for approval. Test reports shall be accompanied by the certificates from the manufacturers certifying that the material and equipment proposed to be supplied is of the same type, quality, manufacture, and make as that tested

12. Manufacturer's Certificates of Conformance: Before delivery, manufacturer's certifications shall be furnished by the Contractor as required on items of materials and equipment indicated in the technical sections. Pre-printed certifications will not be acceptable. All certifications shall be in the original. The original of all manufacturers' certifications shall name the appropriate item of equipment or material, specification, standard, or other document specified as controlling the quality of that item and shall have attached thereto certified copies of test data upon which the certifications are based. All certificates shall be signed by the manufacturer's official authorized to sign certificates of conformance.

13. Laboratory Reports: Reports shall cite the contract requirements, the test or analysis procedures used, the actual test results, and include a statement that the item tested or analyzed conforms or fails to conform to the specification requirements. Each report shall be conspicuously stamped on the cover sheet in large red letters "CONFORMS" or "DOES NOT CONFORM" to the specification requirements as the case may be. All test reports shall be signed by a representative of the contractor funded testing laboratory authorized to sign certified test reports. The Contractor shall arrange for immediate and direct delivery of the signed original of all reports, certifications, and other documentation to the Contracting Officer.

14. Tabulation of Tests: Prior to final payment, the Contractor shall obtain from each laboratory a tabulation of all tests it has performed in connection with the construction contract. Conforming, nonconforming, and contractor funded testing shall be tabulated. The tabulation(s) shall be certified as complete, and signed by the authorized representative of the laboratory, and shall be delivered to the Contracting Officer.

15. Deviations: Deviations from contract requirements are discouraged. In the event the Contractor determines that a deviation is necessary, the Contractor shall state specifically what portion varies, why a deviation is necessary, and includes a complete breakdown of the difference in cost, either additive or deductive, in compliance with Section, Paragraph , entitled "Changes". Without such documentation, deviations will not be considered by the Contracting Officer.

16. Warrants for Deviations: If the Contractor determines that a deviation is necessary, the Contractor shall warrant.
    a. That the entire contract has been reviewed in order to establish that the deviation, when incorporated, will be compatible with all other elements of construction.
    b. That any action shall be taken and any additional expense borne which may arise by reason of incorporating the proposed deviation, including, but not limited to,

change in this or other elements of construction resulting from the incompatibility of the proposed deviation with any other element of construction.

B. Product Data: Collect information into a single submittal for each element of construction and type of product or equipment.

1. If information must be specially prepared for submittal because standard published data are not suitable for use, submit as Shop Drawings, not as Product Data.
2. Mark each copy of each submittal to show which products and options are applicable.
3. Include the following information, as applicable:

a. Manufacturer's catalog cuts.
b. Manufacturer's product specifications.
c. Standard color charts.
d. Statement of compliance with specified referenced standards.
e. Contractor funded testing by recognized testing agency.
f. Application of contractor funded testing agency labels and seals.
g. Notation of coordination requirements.
h. Availability and delivery time information.

4. For equipment, include the following in addition to the above, as applicable:

a. Wiring diagrams showing factory-installed wiring.
b. Printed performance curves.
c. Operational range diagrams.
d. Clearances required to other construction, if not indicated on accompanying Shop Drawings.

5. Submit Product Data before or concurrent with Samples.
6. Submit Product Data in the following format:

a. PDF electronic file.
b. Three paper copies of Product Data, unless otherwise indicated. COR will return two copies.

C. Shop Drawings: Prepare Project-specific information, drawn accurately to scale. Do not base Shop Drawings on reproductions of the Contract Documents or standard printed data.

1. Preparation: Fully illustrate requirements in the Contract Documents. Include the following information, as applicable:

a. Identification of products.
b. Schedules.
c. Compliance with specified standards.
d. Notation of coordination requirements.
e. Notation of dimensions established by field measurement.
f. Relationship and attachment to adjoining construction clearly indicated.
g. Seal and signature of professional engineer if specified.

2. Sheet Size: Except for templates, patterns, and similar full-size drawings, submit Shop Drawings on sheets at least 8-1/2 by 11 inches but no larger than 30 by 42 inches

3. Submit Shop Drawings in the following format:

    a. PDF electronic file.
    b. Six copies (bond). COR will return two copies.

D. Product Schedule: As required in individual Specification Sections, prepare a written summary indicating types of products required for the Work and their intended location. Include the following information in tabular form:

1. Type of product. Include unique identifier for each product indicated in the Contract Documents.
2. Manufacturer and product name, and model number if applicable.
3. Number and name of room or space.
4. Location within room or space.
5. Submit product schedule in the following format:

    a. PDF electronic file.
    b. Three paper copies of product schedule or list, unless otherwise indicated. COR will return two copies.

E. Spare Parts Data:

1. As soon as practicable after approval of the list of equipment, the Contractor shall furnish spare parts data for each different item of equipment listed. The data shall include a complete list of parts and supplies with current unit price and source of supply; a list of parts and supplies that are either normally furnished at no extra cost with the purchase of the equipment, or specified hereinafter to be furnished as part of the Contract and a list of additional items recommended by the manufacturer to assure efficient operation. The foregoing shall not relieve the Contractor of any responsibilities under the guarantee specified hereinafter

F. Contractor's Construction Schedule: Comply with requirements specified in Division 01 Section "Construction Progress Documentation."

G. Application for Payment: Comply with requirements specified in Division 01 Section "Payment Procedures."

H. Schedule of Values: Comply with requirements specified in Division 01 Section "Payment Procedures."

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

1. Name, address, and telephone number of entity performing subcontract or supplying products.
2. Number and title of related Specification Section(s) covered by subcontract.
3. Drawing number and detail references, as appropriate, covered by subcontract.
4. Submit subcontract list in the following format:

a. Number of Copies: Five (5) paper copies of subcontractor list, unless otherwise indicated. COR will return two copies.

J. Qualification Data: Prepare written information that demonstrates capabilities and experience of firm or person. Include lists of completed projects with project names and addresses, contact information of COR and Contracting Officer, and other information specified.

K. Installer Certificates: Submit written statements on manufacturer's letterhead certifying that Installer complies with requirements in the Contract Documents and, where required, is authorized by manufacturer for this specific Project.

L. Manufacturer Certificates: Submit written statements on manufacturer's letterhead certifying that manufacturer complies with requirements in the Contract Documents. Include evidence of manufacturing experience where required.

M. Product Certificates: Submit written statements on manufacturer's letterhead certifying that product complies with requirements in the Contract Documents.

N. Material Certificates: Submit written statements on manufacturer's letterhead certifying that material complies with requirements in the Contract Documents.

O. Material Test Reports: Submit reports written by a qualified contractor funded testing agency, on testing agency's standard form, indicating and interpreting test results of material for compliance with requirements in the Contract Documents.

P. Product Test Reports: Submit written reports indicating current product produced by manufacturer complies with requirements in the Contract Documents. Base reports on evaluation of tests performed by manufacturer and witnessed by a qualified contractor funded testing agency, or on comprehensive tests performed by a qualified contractor funded testing agency.

Q. Research Reports: Submit written evidence, from a model code organization acceptable to authorities having jurisdiction, that product complies with building code in effect for Project. Include the following information:

1. Name of evaluation organization.
2. Date of evaluation.
3. Time period when report is in effect.
4. Product and manufacturers' names.
5. Description of product.
6. Test procedures and results.
7. Limitations of use.

R. Schedule of Tests and Inspections: Comply with requirements specified in Division 01 Section "Quality Requirements."

S. Preconstruction Test Reports: Submit reports written by a qualified contractor funded testing agency, on testing agency's standard form, indicating and interpreting results of tests performed before installation of product, for compliance with performance requirements in the Contract Documents.

T. Compatibility Test Reports: Submit reports written by a qualified contractor funded testing agency, on testing agency's standard form, indicating and interpreting results of compatibility tests performed before installation of product. Include written recommendations for primers and substrate preparation needed for adhesion.

U. Field Test Reports: Submit reports indicating and interpreting results of field tests performed either during installation of product or after product is installed in its final location, for compliance with requirements in the Contract Documents.

V. Maintenance Data: Comply with requirements specified in Division 01 Section "Operation and Maintenance Data."

W. Design Data: Prepare and submit written and graphic information, including, but not limited to, performance and design criteria, list of applicable codes and regulations, and calculations. Include list of assumptions and other performance and design criteria and a summary of loads. Include load diagrams if applicable. Provide name and version of software, if any, used for calculations. Include page numbers.

PART 3 - EXECUTION

3.1 CONTRACTOR'S REVIEW

A. Action and Informational Submittals: Review each submittal and check for coordination with other Work of the Contract and for compliance with the Contract Documents. Note corrections and field dimensions. Mark with approval stamp before submitting to COR.

B. Project Closeout and Maintenance/Material Submittals: Refer to requirements in Division 01 Section "Closeout Procedures."

C. Approval Stamp: Stamp each submittal with a uniform, approval stamp. Include Project name and location, submittal number, Specification Section title and number, name of reviewer, date of Contractor's approval, and statement certifying that submittal has been reviewed, checked, and approved for compliance with the Contract Documents.

3.2 COR'S ACTION

A. General: COR will not review submittals that do not bear Contractor's approval stamp and will return them without action.

B. Action Submittals: COR will review each submittal, make marks to indicate corrections or modifications required, and return it. COR will stamp each submittal with an action stamp and will mark stamp appropriately to indicate action**.**

C. Informational Submittals: COR will review each submittal and will not return it, or will return it if it does not comply with requirements. COR will forward each submittal to appropriate party.

D. Partial submittals prepared for a portion of the Work will be reviewed when use of partial submittals has received prior approval from COR.

E. Incomplete submittals are not acceptable, will be considered nonresponsive, and will be returned without review.

F. Submittals not required by the Contract Documents may not be reviewed and may be discarded.

END OF SECTION 013300

SECTION 014000

QUALITY REQUIREMENTS

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 quality assurance and quality control.

B. Contractor funded testing and inspecting services are required to verify compliance with requirements specified or indicated. These services do not relieve Contractor of responsibility for compliance with the Contract Document requirements.

1. Specific quality-assurance and -control requirements for individual construction activities are specified in the Sections that specify those activities. Requirements in those Sections may also cover production of standard products.
2. Specified tests, inspections, and related actions do not limit Contractor's other quality-assurance and -control procedures that facilitate compliance with the Contract Document requirements.
3. Requirements for Contractor to provide quality-assurance and -control services required by COR, Contracting Officer, or authorities having jurisdiction are not limited by provisions of this Section.

C. Related Sections:
1. Division 01 Section "Construction Progress Documentation" for developing a schedule of required tests and inspections.
2. Divisions 02 through 49 Sections for specific test and inspection requirements.

1.3 DEFINITIONS

A. Quality-Assurance Services: Activities, actions, and procedures performed before and during execution of the Work to guard against defects and deficiencies and substantiate that proposed construction will comply with requirements.

B. Quality-Control Services: Tests, inspections, procedures, and related actions during and after execution of the Work to evaluate that actual products incorporated into the Work and completed construction comply with requirements. Services do not include contract enforcement activities performed by COR.

C. Preconstruction Contractor funded testing: Tests and inspections performed specifically for the Project before products and materials are incorporated into the Work to verify performance or compliance with specified criteria.

D. Product Contractor funded testing: Tests and inspections that are performed by an NRTL, an NVLAP, or a Contractor funded testing agency qualified to conduct product Contractor funded testing and acceptable to authorities having jurisdiction, to establish product performance and compliance with specified requirements.

E. Certified Test Reports: Test reports signed by an authorized official stating that tests were performed in accordance with the test method specified, that the results reported are accurate, and that items tested either meet or fail to meet the stated minimum requirements. These test reports include those performed by Factory Mutual, Underwriters Laboratories, Inc., and others.

F. Certified Inspection Reports: Reports signed by approved inspectors at Contractor funded testing that the items inspected meet the specification requirements other than any exception included in the report.

G. Manufacturer's Certificate of Conformance: A certificate signed by an authorized manufacturer's official at Contractor funded testing that the material or equipment delivered meets the specification requirements.

H. Source Quality-Control Contractor funded testing: Tests and inspections that are performed at the source, i.e., plant, mill, factory, or shop.

I. Field Quality-Control Contractor funded testing: Tests and inspections that are performed on-site for installation of the Work and for completed Work.

J. Factory Tests: Tests made on various products and component parts prior to shipment to the job site, including but no limited to such items as transformers, boilers, air conditioning equipment, electrical equipment, and precast concrete.

K. Field Tests: Tests or analyses made at, or in the vicinity of, the job site in connection with the actual construction.

L. Person: The term "person" means associations, companies, corporations, educational institutions, firms, government agencies at the Federal, State, and local level, partnerships, and societies, as well as divisions thereof, and individuals.

M. Product: The term "product" includes the plural thereof and means a type or a category of manufactured goods, constructions, installations, and natural and processed materials or those associated services whose characterization, classification, or functional performance determination is specified by standards.

N. Contractor funded testing Agency: The term "Contractor funded testing laboratory" means any "person", as defined above, whose functions include Contractor funded testing, analyzing, or inspecting "products", as defined above, evaluating the designs or specifications of such "products" according to the requirements of applicable standards.

O. Installer/Applicator/Erector: Contractor or another entity engaged by Contractor as an employee, Subcontractor, or Sub-subcontractor, to perform a particular construction operation, including installation, erection, application, and similar operations.

1. Use of trade-specific terminology in referring to a trade or entity does not require that certain construction activities be performed by accredited or unionized individuals, or that requirements specified apply exclusively to specific trade or trades.

P. Experienced: When used with an entity or individual, "experienced" means having successfully completed a minimum of five previous projects similar in nature, size, and extent to this Project; being familiar with special requirements indicated; and having complied with requirements of authorities having jurisdiction.

1.4 CONFLICTING REQUIREMENTS

A. Referenced Standards: If compliance with two or more standards is specified and the standards establish different or conflicting requirements for minimum quantities or quality levels, comply with the most stringent requirement. Refer conflicting requirements that are different, but apparently equal, to COR for a decision before proceeding.

B. Minimum Quantity or Quality Levels: The quantity or quality level shown or specified shall be the minimum provided or performed. The actual installation may comply exactly with the minimum quantity or quality specified, or it may exceed the minimum within reasonable limits. To comply with these requirements, indicated numeric values are minimum or maximum, as appropriate, for the context of requirements. Refer uncertainties to COR for a decision before proceeding.

1.5 ACTION SUBMITTALS

A. Shop Drawings: For mockups, provide plans, sections, and elevations, indicating materials and size of mockup construction.

1. Indicate manufacturer and model number of individual components.
2. Provide axonometric drawings for conditions difficult to illustrate in two dimensions.

B. Contractor funded testing Agency Qualifications: For Contractor funded testing agencies specified in "Quality Assurance" Article to demonstrate their capabilities and experience. Include proof of qualifications in the form of a recent report on the inspection of the Contractor funded testing agency by a recognized authority.

C. Schedule of Tests and Inspections: Prepare in tabular form and include the following:

1. Specification Section number and title.
2. Entity responsible for performing tests and inspections.
3. Description of test and inspection.
4. Identification of applicable standards.
5. Identification of test and inspection methods.
6. Number of tests and inspections required.
7. Time schedule or time span for tests and inspections.

8. Requirements for obtaining samples.
9. Unique characteristics of each quality-control service.

1.6 THREE PHASES OF CONTROL

A. The QC Manager shall perform and document the three phases of control to ensure that work complies with Contract requirements. The three phases of control shall adequately cover both onsite and offsite work, and shall include the following for each definable feature of work: a definable feature of work is a task, which is separate and distinct from other tasks and requires separate control requirements.

1. Preparatory Phase: Notify the Contracting Officer at least 48 hours in advance of each preparatory phase. Conduct the preparatory phase with the QC Specialists, the Superintendent, and the Foreman responsible for the definable feature. Document the results of the preparatory phase actions in the daily Contractor Quality Control Report. Perform the following prior to beginning work on each definable feature of work.
   a. Review each paragraph of the applicable specification sections.
   b. Review the Contract drawings.
   c. Verify that appropriate shop drawings and submittals for materials and equipment have been submitted and approved. Verify receipt of approved factory test results, when required.
   d. Review the Contractor funded testing plan and ensure that provisions have been made to provide the required QC Contractor funded testing.
   e. Examine the work area to ensure that the required preliminary work has been completed.
   f. A physical examination of required materials, equipment, and sample work to ensure that they are on hand and conform to the approved shop drawings and submitted data.
   g. Review the safety plan and appropriate activity hazard analysis to ensure that applicable safety requirements are met, and that required Material Safety Data Sheets (MSDS) are submitted.
   h. Discussion of procedures for controlling quality of the work, including repetitive deficiencies. Document construction tolerances and workmanship standards for that feature of work.
   i. A check to ensure that the Contracting Officer has accepted the portion of the plan for the work to be performed.

2. Initial Phase: Notify the Contracting Officer at least 48 hours in advance of each initial phase. When construction crews are ready to start work on a definable feature of work, conduct the initial phase with the QC Specialists, the Superintendent, and the Foreman responsible for that feature of work. Observe the initial segment of the definable feature of work to ensure that the work complies with the Contract requirements. Document the results of the initial phase in the daily Contractor Quality Control Report. Repeat the initial phase for each new crew to work onsite, or when acceptable levels of specified quality are not being met. Perform the following for each definable feature of work.

   a. Establish the quality of workmanship required.
   b. Resolve conflicts.
   c. Review the Safety Plan, and the appropriate activity hazard analysis to ensure that applicable safety requirements are met.
   d. Ensure that Contractor funded testing is performed, by the approved laboratory.
   e. Review minutes of the preparatory meeting.
   f. Verify adequacy of controls to ensure full contract compliance, verify required control inspection, and Contractor funded testing.

g. The initial phase should be repeated for new crew to work onsite, or anytime that acceptable specified quality standards are not being met.

3. Follow-up Phase: Daily checks shall be performed to assure control activities, including control Contractor funded testing, are providing compliance with contract requirements, until completion of the particular feature of work. The checks shall be made a matter of record in the QC documentation. Perform the following for ongoing work daily, or more frequently, as necessary until the completion of each definable feature of work and document in the daily Contractor Quality Control Report.

   a. Ensure the work is in compliance with Contract requirements.
   b. Maintain the quality of workmanship required.
   c. Ensure that Contractor funded testing is performed by the approved laboratory; and ensure that rework items are being corrected.

4. Notification of Three Phases of Control for Offsite Work: Notify the Contracting Officer at least 14 calendar days prior to the start of the preparatory and initial phases.

1.7 CONTRACTOR'S QUALITY-CONTROL PLAN

A. Quality-Control Plan, General: Submit quality-control plan within 10 days of Notice of Award, and not less than five days prior to preconstruction conference. Submit in format acceptable to COR. Identify personnel, procedures, controls, instructions, tests, records, and forms to be used to carry out Contractor's quality-assurance and quality-control responsibilities. Coordinate with Contractor's construction schedule.

B. Quality-Control Personnel Qualifications: Engage qualified full-time personnel trained and experienced in managing and executing quality-assurance and quality-control procedures similar in nature and extent to those required for Project.

   1. Project quality-control manager may also serve as Project superintendent.

C. Submittal Procedure: Describe procedures for ensuring compliance with requirements through review and management of submittal process. Indicate qualifications of personnel responsible for submittal review.

D. Contractor funded testing and Inspection: Include in quality-control plan a comprehensive schedule of Work requiring Contractor funded testing or inspection, including the following:

   1. Contractor-performed tests and inspections including subcontractor-performed tests and inspections. Include required tests and inspections and Contractor-elected tests and inspections.
   2. Special inspections required by authorities having jurisdiction and indicated on the "Statement of Special Inspections."
   3. Contracting Officer-performed tests and inspections indicated in the Contract Documents**,** including tests and inspections indicated to be performed by the Commissioning Authority.

E. Continuous Inspection of Workmanship: Describe process for continuous inspection during construction to identify and correct deficiencies in workmanship in addition to Contractor funded testing and inspection specified. Indicate types of corrective actions to be required to

bring work into compliance with standards of workmanship established by Contract requirements and approved mockups.

F. Monitoring and Documentation: Maintain Contractor funded testing and inspection reports including log of approved and rejected results. Include work COR has indicated as nonconforming or defective. Indicate corrective actions taken to bring nonconforming work into compliance with requirements. Comply with requirements of authorities having jurisdiction.

1.8 REPORTS AND DOCUMENTS

A. Test and Inspection Reports: Prepare and submit certified written reports specified in other Sections. Include the following:

1. Date of issue.
2. Project title and number.
3. Name, address, and telephone number of Contractor funded testing agency.
4. Dates and locations of samples and tests or inspections.
5. Names of individuals making tests and inspections.
6. Description of the Work and test and inspection method.
7. Identification of product and Specification Section.
8. Complete test or inspection data.
9. Test and inspection results and an interpretation of test results.
10. Record of temperature and weather conditions at time of sample taking and Contractor funded testing and inspecting.
11. Comments or professional opinion on whether tested or inspected Work complies with the Contract Document requirements.
12. Name and signature of laboratory inspector.
13. Recommendations on Contractor funded testing and reinspecting.

B. Manufacturer's Technical Representative's Field Reports: Prepare written information documenting manufacturer's technical representative's tests and inspections specified in other Sections. Include the following:

1. Name, address, and telephone number of technical representative making report.
2. Statement on condition of substrates and their acceptability for installation of product.
3. Statement that products at Project site comply with requirements.
4. Summary of installation procedures being followed, whether they comply with requirements and, if not, what corrective action was taken.
5. Results of operational and other tests and a statement of whether observed performance complies with requirements.
6. Statement whether conditions, products, and installation will affect warranty.
7. Other required items indicated in individual Specification Sections.

C. Factory-Authorized Service Representative's Reports: Prepare written information documenting manufacturer's factory-authorized service representative's tests and inspections specified in other Sections. Include the following:

1. Name, address, and telephone number of factory-authorized service representative making report.
2. Statement that equipment complies with requirements.

3. Results of operational and other tests and a statement of whether observed performance complies with requirements.
4. Statement whether conditions, products, and installation will affect warranty.
5. Other required items indicated in individual Specification Sections.

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

1.9 QUALITY ASSURANCE

A. General: Qualifications paragraphs in this article establish the minimum qualification levels required; individual Specification Sections specify additional requirements.

B. Manufacturer Qualifications: A firm experienced in manufacturing products or systems similar to those indicated for this Project and with a record of successful in-service performance, as well as sufficient production capacity to produce required units.

C. Fabricator Qualifications: A firm experienced in producing products similar to those indicated for this Project and with a record of successful in-service performance, as well as sufficient production capacity to produce required units.

D. Installer Qualifications: A firm or individual experienced in installing, erecting, or assembling work similar in material, design, and extent to that indicated for this Project, whose work has resulted in construction with a record of successful in-service performance.

E. Professional Engineer Qualifications: A professional engineer who is legally qualified to practice in jurisdiction where Project is located and who is experienced in providing engineering services of the kind indicated. Engineering services are defined as those performed for installations of the system, assembly, or product that are similar to those indicated for this Project in material, design, and extent.

F. Specialists: Certain Specification Sections require that specific construction activities shall be performed by entities who are recognized experts in those operations. Specialists shall satisfy qualification requirements indicated and shall be engaged for the activities indicated.

1. Requirements of authorities having jurisdiction shall supersede requirements for specialists.

G. Contractor funded testing Agency Qualifications: An NRTL, an NVLAP, or an independent agency with the experience and capability to conduct Contractor funded testing and inspecting indicated, as documented according to ASTM E 329; and with additional qualifications specified in individual Sections; and where required by authorities having jurisdiction, that is acceptable to authorities.

1. NRTL: A nationally recognized Contractor funded testing laboratory according to 29 CFR 1910.7.
2. NVLAP: A Contractor funded testing agency accredited according to NIST's National Voluntary Laboratory Accreditation Program.

H. Manufacturer's Technical Representative Qualifications: An authorized representative of manufacturer who is trained and approved by manufacturer to observe and inspect installation of manufacturer's products that are similar in material, design, and extent to those indicated for this Project.

I. Factory-Authorized Service Representative Qualifications: An authorized representative of manufacturer who is trained and approved by manufacturer to inspect installation of manufacturer's products that are similar in material, design, and extent to those indicated for this Project.

J. Preconstruction Contractor funded testing: Where Contractor funded testing agency is indicated to perform preconstruction testing for compliance with specified requirements for performance and test methods, comply with the following:

1. Contractor responsibilities include the following:

a. Provide test specimens representative of proposed products and construction.
b. Submit specimens in a timely manner with sufficient time for Contractor funded testing and analyzing results to prevent delaying the Work.
c. Provide sizes and configurations of test assemblies, mockups, and laboratory mockups to adequately demonstrate capability of products to comply with performance requirements.
d. Build site-assembled test assemblies and mockups using installers who will perform same tasks for Project.
e. Build laboratory mockups at Contractor funded testing facility using personnel, products, and methods of construction indicated for the completed Work.
f. When Contractor funded testing is complete, remove test specimens, assemblies, mockups; do not reuse products on Project.

2. Contractor funded testing Agency Responsibilities: Submit a certified written report of each test, inspection, and similar quality-assurance service to COR, with copy to Contractor. Interpret tests and inspections and state in each report whether tested and inspected work complies with or deviates from the Contract Documents.

1.10 QUALITY CONTROL

A. Contractor Responsibilities: Tests and inspections not explicitly assigned to Contracting Officer are Contractor's responsibility. Perform additional quality-control activities required to verify that the Work complies with requirements, whether specified or not.

1. Unless otherwise indicated, provide quality-control services specified and those required by authorities having jurisdiction. Perform quality-control services required of Contractor by authorities having jurisdiction, whether specified or not.
2. Where services are indicated as Contractor's responsibility, engage a qualified Contractor funded testing agency to perform these quality-control services.

a. Contractor shall not employ same entity engaged by Contracting Officer, unless agreed to in writing by Contracting Officer.

3. Notify Contractor funded testing agencies at least 24 hours in advance of time when Work that requires Contractor funded testing or inspecting will be performed.
4. Where quality-control services are indicated as Contractor's responsibility, submit a certified written report, in duplicate, of each quality-control service.
5. Contractor funded testing and inspecting requested by Contractor and not required by the Contract Documents are Contractor's responsibility.
6. Submit additional copies of each written report directly to authorities having jurisdiction, when they so direct.

B. Manufacturer's Field Services: Where indicated, engage a factory-authorized service representative to inspect field-assembled components and equipment installation, including service connections. Report results in writing as specified in Division 01 Section "Submittal Procedures."

C. Manufacturer's Technical Services: Where indicated, engage a manufacturer's technical representative to observe and inspect the Work. Manufacturer's technical representative's services include participation in preinstallation conferences, examination of substrates and conditions, verification of materials, observation of Installer activities, inspection of completed portions of the Work, and submittal of written reports.

D. Contractor funded testing/Reinspecting: Regardless of whether original tests or inspections were Contractor's responsibility, provide quality-control services, including Contractor funded testing and reinspecting, for construction that replaced Work that failed to comply with the Contract Documents.

E. Contractor funded testing Agency Responsibilities: Cooperate with COR and Contractor in performance of duties. Provide qualified personnel to perform required tests and inspections.

1. Notify COR and Contractor promptly of irregularities or deficiencies observed in the Work during performance of its services.
2. Determine the location from which test samples will be taken and in which in-situ tests are conducted.
3. Conduct and interpret tests and inspections and state in each report whether tested and inspected work complies with or deviates from requirements.
4. Submit a certified written report, in duplicate, of each test, inspection, and similar quality-control service through Contractor.
5. Do not release, revoke, alter, or increase the Contract Document requirements or approve or accept any portion of the Work.
6. Do not perform any duties of Contractor.

F. Associated Services: Cooperate with agencies performing required tests, inspections, and similar quality-control services, and provide reasonable auxiliary services as requested. Notify agency sufficiently in advance of operations to permit assignment of personnel. Provide the following:

1. Access to the Work.
2. Incidental labor and facilities necessary to facilitate tests and inspections.
3. Adequate quantities of representative samples of materials that require Contractor funded testing and inspecting. Assist agency in obtaining samples.
4. Facilities for storage and field curing of test samples.
5. Delivery of samples to Contractor funded testing agencies.

6. Preliminary design mix proposed for use for material mixes that require control by Contractor funded testing agency.
7. Security and protection for samples and for Contractor funded testing and inspecting equipment at Project site.

G. Coordination: Coordinate sequence of activities to accommodate required quality-assurance and -control services with a minimum of delay and to avoid necessity of removing and replacing construction to accommodate Contractor funded testing and inspecting.

1. Schedule times for tests, inspections, obtaining samples, and similar activities.

H. Schedule of Tests and Inspections: Prepare a schedule of tests, inspections, and similar quality-control services required by the Contract Documents. Coordinate and submit concurrently with Contractor's construction schedule. Update as the Work progresses.

1. Distribution: Distribute schedule to Contracting Officer, COR Contractor funded testing agencies, and each party involved in performance of portions of the Work where tests and inspections are required.

1.11 SPECIAL TESTS AND INSPECTIONS

A. Special Tests and Inspections: Engage a qualified Contractor funded testing agency to conduct special tests and inspections required by authorities having jurisdiction as the responsibility of Contracting Officer, and as follows:

B. Special Tests and Inspections: Conducted by a qualified Contractor funded testing agency as required by authorities having jurisdiction, as indicated in individual Specification Sections, and as follows:

1. Verifying that manufacturer maintains detailed fabrication and quality-control procedures and reviewing the completeness and adequacy of those procedures to perform the Work.
2. Notifying COR and Contractor promptly of irregularities and deficiencies observed in the Work during performance of its services.
3. Submitting a certified written report of each test, inspection, and similar quality-control service to COR with copy to Contractor and to authorities having jurisdiction.
4. Submitting a final report of special tests and inspections at Substantial Completion, which includes a list of unresolved deficiencies.
5. Interpreting tests and inspections and stating in each report whether tested and inspected work complies with or deviates from the Contract Documents.
6. Contractor funded testing and reinspecting corrected work.

PART 2 - PRODUCTS (Not Used)

PART 3 - EXECUTION

3.1 TEST AND INSPECTION LOG

A. Prepare a record of tests and inspections. Include the following:

1. Date test or inspection was conducted.
2. Description of the Work tested or inspected.
3. Date test or inspection results were transmitted to COR.
4. Identification of Contractor funded testing agency or special inspector conducting test or inspection.

B. Maintain log at Project site. Post changes and modifications as they occur. Provide access to test and inspection log for COR's reference during normal working hours.

3.2 QUALITY CONTROL REQUIREMENTS

1. The Contractor shall inspect and test all work under the contract and maintain records of the inspections and tests. Approvals, except those required for field installation, field applications, and field tests, shall be obtained before delivery of materials and equipment to the project site. Surveillance of the inspection system will be performed by the Contracting Officer.
   a. Factory Tests: Unless otherwise specified, the Contractor shall arrange for factory tests when they are required under the contract.
   b. Factory Inspections by the Contractor: Unless otherwise specified, the Contractor shall arrange and perform all factory inspections specifically required in the technical specifications. These inspections shall be reported in the Contractor's Daily Report.
   c. Field Inspections and Tests by the Contractor: The Contractor shall furnish all equipment, instruments, qualified personnel, and facilities necessary to inspect all work and perform all tests required by the contract. All inspections and tests performed and test results received each day shall be included in the Contract's Daily Report.
   d. Field Inspections and Tests by the Government: If deemed necessary by the Contracting Officer, field inspections and tests will be made in accordance with the clause entitled "Scheduling of Inspections".
   e. Approval of Contractor funded testing Laboratories: All laboratory work under this contract shall be performed by a laboratory approved by the Government. The basis of approval includes the following:
      1) Contractor funded testing laboratories performing work in connection with concrete, steel, and bituminous materials shall comply with ASTM E329 and ASTM D3666, respectively.
      2) Contractor funded testing laboratories engaged in the Contractor funded testing and inspection of soils and rock or performing non-destructive Contractor funded testing shall comply with ASTM D3740 and ASTM E543, respectively.

3) Contractor funded testing laboratories performing work not in connection with concrete, steel, bituminous materials, soils and non-destructive Contractor funded testing shall comply with ASTM E548.

f. Laboratory Inspection: Prior to approval, the laboratory shall submit in writing the following:
   1) Functional description of the laboratory's organizational structure, operational departments, and support departments and services.
   2) A list and resumes of the personnel assigned to the proposed Contractor funded testing, including the person charged with engineering managerial responsibility.
   3) Affidavit of compliance with the applicable ASTM publication and certification that the laboratory performs work in accordance with technical requirements as required by the contract specifications.
   4) A list of test and inspection equipment for each of the proposed test procedures and certification that the equipment is calibrated at prescribed intervals to ensure the validity of the test and inspection data.
   5) A copy of the latest Laboratory Inspection Report by an independent agency with laboratory certification that deficiencies (if any) have been corrected.

g. Repeated Tests and Inspections: The Contractor shall repeat tests and inspections after each correction made to nonconforming materials and workmanship until tests and inspections indicate the materials, equipment, and workmanship conform to the contract requirements. The Contractor funded testing and reinspections shall be performed at no additional cost to the Government.

3.3 INTERRUPTION TO OPERATIONS AND SERVICES

A. The Contractor shall schedule his work as to cause the least amount of interference with site operations. Work schedules shall be subject to the approval of the COR. Permission to interrupt any site road and/or utility service shall be requested in writing a minimum of fourteen (14) calendar days prior to the desired date of interruption.

B. The Contractor shall ensure that new utility lines are complete, except for the connection, before interrupting existing service.

C. Outages and Closures: The Contractor shall not close or partially block any roads or cause utility outages (electrical, steam, chilled water, water, compressed air, gas, sewer, telephone, fire alarm, and signal systems) without the written authorization from the COR. Authorization shall be requested not less than 14 days in advance and not before all material necessary for the work to be done during the road blockage or utility outage is on the site. The request for authorization shall include in writing the following information: Contractor's name, contract number, project title, description and drawings of roads and utilities to be shut down, times, dates and reasons for shut downs, and any pertinent suggestions or comments. All outages and closures shall be limited to the minimum time and shall not exceed the authorized time. The Contractor shall provide cautionary and directional signs as needed. Work which necessitates an outage affecting the areas beyond the work site shall be performed on Saturday, Sunday or after the normal working day.

3.4 MEASUREMENTS

A. Actual dimensions and physical obstructions shall be obtained by the Contractor from on-site investigation. The Contractor shall furnish and install, at no cost to the Government, all necessary fittings, off-sets, supports, accessories, etc., as required, whether shown or not, to prevent conflict with new or existing work and to provide a complete and usable facility.

3.5 REPAIR AND PROTECTION

A. General: On completion of Contractor funded testing, inspecting, sample taking, and similar services, repair damaged construction and restore substrates and finishes.

1. Provide materials and comply with installation requirements specified in other Specification Sections or matching existing substrates and finishes. Restore patched areas and extend restoration into adjoining areas with durable seams that are as invisible as possible. Comply with the Contract Document requirements for cutting and patching in Division 01 Section "Execution."

B. Protect construction exposed by or for quality-control service activities.

C. Repair and protection are Contractor's responsibility, regardless of the assignment of responsibility for quality-control services.

END OF SECTION 014000

SECTION 014200

REFERENCES

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 DEFINITIONS

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

B. "Approved": The term “approved,” where used in conjunction with the COR’s action on the Contractor’s submittals, applications, and requests, is limited to the duties and responsibilities of the COR as stated in General and Supplementary Conditions. Such approval shall not release the Contractor from responsibility to fulfill Contract requirements unless otherwise provided in the Contract Documents.

C. "Directed": Terms such as “directed”, “requested”, “authorized”, “selected”, “approved”, “required”, and “permitted” mean “directed by the COR”, “requested by the COR”, and similar phrases. However, no implied meaning shall be interpreted to extend the COR’s responsibility into the Contractor’s area of construction supervision."

D. "Indicated": Refers to graphic representations, notes or schedules on the Drawings, or other Paragraphs or Schedules in Specifications, and similar requirements in Contract Documents. Where terms such as “shown,” “noted,” “scheduled,” and “specified” are used, it is to help locate the reference; no limitation on location is intended except as specifically noted."

E. "Regulations": Laws, ordinances, statutes, and lawful orders issued by authorities having jurisdiction, and rules, conventions, and agreements within the construction industry that control performance of the Work.

F. "Furnish": The term “furnish” is used to mean “supply and deliver to the Project site, ready for unloading, unpacking, assembly, installation, and similar operations.

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

H. “Installer”: An “Installer” is the Contractor or an entity engaged by the Contractor, either as an employee, subcontractor, or sub-subcontractor for performance of a particular construction activity, including installation, erection, application, and similar operations. Installers are required to be experienced in the operations they are engaged to perform.

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

I. "Provide": The term “provide” means “to furnish and install, complete and ready for the intended use.

J. "Project Site": Project Site is the space available to the Contractor for performance of construction activities, either exclusively or in conjunction with others performing other construction activities as part of the Project.

K. “Recycled Content Materials”: Building materials that contain, in aggregate, a minimum weighted average of post-consumer or post-industrial recycled content material.

L. “Regulation”: The term “Regulations” includes laws, ordinances, statutes, and lawful orders issued by authorities having jurisdiction, as well as rules, conventions, and agreements within the construction industry that control performance of the Work, whether lawfully imposed by authorities having jurisdiction or not

M. “Post-Consumer Recycled Content”: Building material generated by collection after use by consumers, installed in a project. LEED gives a higher value to post-consumer RCM.

N. “Manufacturing”: Refers to the final assembly of components into the building product.

O. “Salvage or Re-used Materials”: Materials recovered from existing buildings and reprocessed for reuse in other buildings.

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

Q. “Volatile Organic Compounds (VOC)”: Carbon compounds that [participate in atmospheric photochemical reactions and contribute to smog and air pollution.

R. “Ozone Depleting Substances”: Materials and chemical compounds that are destructive to the ozone layer. CFCs and HCHCs, aerosol sprays and other similar substances are considered ‘ozone depleting’.

1.3 INDUSTRY STANDARDS

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

B. Publication Dates: Comply with standards in effect as of date of the Contract Documents unless otherwise indicated.

C. Copies of Standards: Each entity engaged in construction on Project should be familiar with industry standards applicable to its construction activity. Copies of applicable standards are not bound with the Contract Documents.

1. Where copies of standards are needed to perform a required construction activity, obtain copies directly from publication source.

1.4 SPECIFICATION FORMAT AND CONTENT EXPLANATION

A. Specification Format: These Specifications are organized into Divisions and Sections based on the Construction Specifications Institute's 16-Division format and numbering system.

B. Specification Content: This Specification uses certain conventions in the use of language and the intended meaning of certain terms, words, and phrases when used in particular situations or circumstances. These conventions are explained as follows:

1. Abbreviated Language: Language used in the Specifications and other Contract Documents is the abbreviated type. Implied words and meanings will be appropriately interpreted. Singular words will be interpreted as plural and plural words interpreted as singular where applicable and where the full context of the Contract Documents so indicates.
2. Abbreviated Language: Language used in the Specifications and other Contract Documents is the abbreviated type. Implied words and meanings will be appropriately interpreted. Singular words will be interpreted as plural and plural words interpreted as singular where applicable and where the full context of the Contract Documents so indicates.
   a. The words "shall be" shall be included by inference wherever a colon (:) is used within a sentence or phrase.
3. Assignment of Specialists: The Specification requires that certain specific construction activities shall be performed by specialists who are recognized experts in the operations to be performed. The specialists must be engaged for those activities, and assignments are requirements over which the Contractor has no choice or option. Nevertheless, the ultimate responsibility for fulfilling Contract requirements remains with the Contractor.
   a. This requirement shall not be interpreted to conflict with enforcement of building codes and similar regulations governing the Work. It is also not intended to interfere with local trade union jurisdictional settlements and similar conventions.
   b. Trades: Use of titles such as "carpentry" is not intended to imply that certain construction activities must be performed by accredited or unionized individuals of a corresponding generic name, such as "carpenter." It also does not imply that requirements specified apply exclusively to trade persons of the corresponding generic name.

C. Drawing Symbols:

1. Graphic symbols: Where not otherwise noted, symbols are defined by "Architectural Graphic Standards," published by John Wiley & Sons, Inc., eighth edition.
2. Mechanical/Electrical Drawings: Graphic symbols used on mechanical and electrical Drawings are generally aligned with symbols recommended by ASHRAE. Where appropriate, they are supplemented by more specific symbols recommended by technical associations including ASME, ASPE, IEEE, and similar organizations. The Contractor shall refer instances of uncertainty to the COR for clarification before proceeding.

3. Fire Safety Symbols: The contractor shall use the NFPA 170 Standard for Fire Safety Symbols.

D. Industry Standards:

1. Applicability of Standards: Except where the Contract Documents include more stringent requirements, applicable construction industry standards have the same force and effect as if bound or copied directly into the Contract Documents. Such standards are made a part of the Contract Documents by reference. Individual Sections indicate which codes and standards the Contractor must keep available at the Project Site for reference.
2. Publication Dates: Where the date of issue of a referenced standard is not specified, the Contractor shall comply with the standard in effect as of date of Contract Documents.
   a. Updated Standards: At the request of the COR, Contractor, or authority having jurisdiction, the Contractor shall submit a Change Order proposal where an applicable code or standard has been revised and reissued after the date of the Contract Documents and before performance of Work affected. The COR will decide whether to issue a Change Order to proceed with the updated standard.
3. Conflicting Requirements: Where compliance with two or more standards is specified, and they establish different or conflicting requirements for minimum quantities or quality levels, the most stringent requirement will be enforced, unless the Contract Documents indicate otherwise. The Contractor shall refer requirements that are different, but apparently equal, and uncertainties as to which quality level is more stringent to the COR for a decision before proceeding.
   a. Minimum Quantity or Quality Levels: In every instance the quantity or quality level shown or specified shall be the minimum to be provided or performed. The actual installation may comply exactly, within specified tolerances, with the minimum quantity or quality specified, or it may exceed that minimum within reasonable limits. In complying with these requirements, indicated numeric values are minimum or maximum values, as noted, or appropriate for the context of the requirements. The Contractor shall refer instances of uncertainty to the COR for a decision before proceeding.
4. Copies of Standards: Each entity engaged in construction on the Project is required to be familiar with industry standards applicable to that entity's construction activity. Copies of applicable standards are not bound with the Contract Documents.
   a. Where copies of standards are needed for performance of a required construction activity, the Contractor shall obtain copies directly from the publication source.

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

1.5 ABBREVIATIONS AND ACRONYMS

A. Industry Organizations: Where abbreviations and acronyms are used in Specifications or other Contract Documents, they shall mean the recognized name of the entities indicated in Gale's "Encyclopedia of Associations" or in Columbia Books' "National Trade & Professional Associations of the United States."

B. Industry Organizations: Where abbreviations and acronyms are used in Specifications or other Contract Documents, they shall mean the recognized name of the entities in the following list. Names, telephone numbers, and Web sites are subject to change and are believed to be accurate and up-to-date as of the date of the Contract Documents. Also, the Contractor shall refer to the "*Encyclopedia of Associations*," published by Gale Research Co., available in most libraries if abbreviations and acronyms must be verified.

AA	Aluminum Association, Inc. (The) www.aluminum.org	(703) 358-2960
AAADM	American Association of Automatic Door Manufacturers www.aaadm.com	(216) 241-7333
AABC	Associated Air Balance Council www.aabchq.com	(202) 737-0202
AAMA	American Architectural Manufacturers Association www.aamanet.org	(847) 303-5664
AASHTO	American Association of State Highway and Transportation Officials www.transportation.org	(202) 624-5800
AATCC	American Association of Textile Chemists and Colorists www.aatcc.org	(919) 549-8141
ABAA	Air Barrier Association of America www.airbarrier.org	(866) 956-5888
ABMA	American Bearing Manufacturers Association www.abma-dc.org	(202) 367-1155
ACI	American Concrete Institute www.concrete.org	(248) 848-3700
ACPA	American Concrete Pipe Association www.concrete-pipe.org	(972) 506-7216
AEIC	Association of Edison Illuminating Companies, Inc. (The) www.aeic.org	(205) 257-2530
AF&PA	American Forest & Paper Association www.afandpa.org	(800) 878-8878 (202) 463-2700
AGA	American Gas Association www.aga.org	(202) 824-7000
AGC	Associated General Contractors of America (The) www.agc.org	(703) 548-3118
AHAM	Association of Home Appliance Manufacturers	(202) 872-5955

	www.aham.org	
AHRI	Air-Conditioning, Heating, and Refrigeration Institute www.ahrinet.org	(703) 524-8800
AI	Asphalt Institute www.asphaltinstitute.org	(859) 288-4960
AIA	American Institute of Architects (The) www.aia.org	(800) 242-3837 (202) 626-7300
AISC	American Institute of Steel Construction www.aisc.org	(800) 644-2400 (312) 670-2400
AISI	American Iron and Steel Institute www.steel.org	(202) 452-7100
AITC	American Institute of Timber Construction www.aitc-glulam.org	(303) 792-9559
ALSC	American Lumber Standard Committee, Incorporated www.alsc.org	(301) 972-1700
AMCA	Air Movement and Control Association International, Inc. www.amca.org	(847) 394-0150
ANSI	American National Standards Institute www.ansi.org	(202) 293-8020
AOSA	Association of Official Seed Analysts, Inc. www.aosaseed.com	(405) 780-7372
APA	Architectural Precast Association www.archprecast.org	(239) 454-6989
APA	APA - The Engineered Wood Association www.apawood.org	(253) 565-6600
API	American Petroleum Institute www.api.org	(202) 682-8000
ARI	Air-Conditioning & Refrigeration Institute (Now AHRI)	
ARMA	Asphalt Roofing Manufacturers Association www.asphaltroofing.org	(202) 207-0917
ASCE	American Society of Civil Engineers www.asce.org	(800) 548-2723 (703) 295-6300
ASCE/SEI	American Society of Civil Engineers/Structural Engineering	

	Institute (See ASCE)	
ASHRAE	American Society of Heating, Refrigerating and Air-Conditioning Engineers www.ashrae.org	(800) 527-4723 (404) 636-8400
ASHRAE/IESNA 90.1-2004	Energy Standard for Buildings www.ashrae.org	(404) 636-8400
ASME	ASME International (American Society of Mechanical Engineers International) www.asme.org	(800) 843-2763 (973) 882-1170
ASSE	American Society of Safety Engineers www.asse.org	(847) 699-2929
ASSE	American Society of Sanitary Engineering www.asse-plumbing.org	(440) 835-3040
ASTM	ASTM International (American Society for Testing and Materials International) www.astm.org	(610) 832-9500
ATIS	Alliance for Telecommunications Industry Solutions www.atis.org	(202) 628-6380
AWCI	Association of the Wall and Ceiling Industry www.awci.org	(703) 534-8300
AWCMA	American Window Covering Manufacturers Association (Now WCMA)	
AWI	Architectural Woodwork Institute www.awinet.org	(571) 323-3636
AWPA	American Wood Protection Association (Formerly: American Wood Preservers' Association) www.awpa.com	(205) 733-4077
AWS	American Welding Society www.aws.org	(800) 443-9353 (305) 443-9353
AWWA	American Water Works Association www.awwa.org	(800) 926-7337 (303) 794-7711
BHMA	Builders Hardware Manufacturers Association www.buildershardware.com	(212) 297-2122
BIA	Brick Industry Association (The) www.bia.org	(703) 620-0010
BICSI	BICSI, Inc.	(800) 242-7405

	www.bicsi.org	(813) 979-1991
BIFMA	BIFMA International (Business and Institutional Furniture Manufacturer's Association International) www.bifma.com	(616) 285-3963
BISSC	Baking Industry Sanitation Standards Committee www.bissc.org	(866) 342-4772
BWF	Badminton World Federation (Formerly: IBF - International Badminton Federation) www.internationalbadminton.org	6-03-9283 7155
CCC	Carpet Cushion Council www.carpetcushion.org	(610) 527-3880
CDA	Copper Development Association www.copper.org	(212) 251-7200
CEA	Canadian Electricity Association www.canelect.ca	(613) 230-9263
CEA	Consumer Electronics Association www.ce.org	(866) 858-1555 (703) 907-7600
CFFA	Chemical Fabrics & Film Association, Inc. www.chemicalfabricsandfilm.com	(216) 241-7333
CGA	Compressed Gas Association www.cganet.com	(703) 788-2700
CIMA	Cellulose Insulation Manufacturers Association www.cellulose.org	(888) 881-2462 (937) 222-2462
CISCA	Ceilings & Interior Systems Construction Association www.cisca.org	(630) 584-1919
CISPI	Cast Iron Soil Pipe Institute www.cispi.org	(423) 892-0137
CLFMI	Chain Link Fence Manufacturers Institute www.chainlinkinfo.org	(301) 596-2583
CRRC	Cool Roof Rating Council www.coolroofs.org	(866) 465-2523 (510) 485-7175
CPA	Composite Panel Association www.pbmdf.com	(703) 724-1128
CPPA	Corrugated Polyethylene Pipe Association	(800) 510-2772

	www.plasticpipe.org	(202) 462-9607
CRI	Carpet and Rug Institute (The) www.carpet-rug.com	(706) 278-3176
CRSI	Concrete Reinforcing Steel Institute www.crsi.org	(847) 517-1200
CSA	Canadian Standards Association	(800) 463-6727 (416) 747-4000
CSA	CSA International (Formerly: IAS - International Approval Services) www.csa-international.org	(866) 797-4272 (416) 747-4000
CSI	Cast Stone Institute www.caststone.org	(717) 272-3744
CSI	Construction Specifications Institute (The) www.csinet.org	(800) 689-2900 (703) 684-0300
CSSB	Cedar Shake & Shingle Bureau www.cedarbureau.org	(604) 820-7700
CTI	Cooling Technology Institute (Formerly: Cooling Tower Institute) www.cti.org	(281) 583-4087
DHI	Door and Hardware Institute www.dhi.org	(703) 222-2010
ECA	Electronic Components Association www.ec-central.org	(703) 907-8024
EIA	Electronic Industries Alliance www.eia.org	(703) 907-7500
EIMA	EIFS Industry Members Association www.eima.com	(800) 294-3462 (770) 968-7945
EJCDC	Engineers Joint Contract Documents Committee www.ejdc.org	(703) 295-5000
EJMA	Expansion Joint Manufacturers Association, Inc. www.ejma.org	(914) 332-0040
ESD	ESD Association (Electrostatic Discharge Association) www.esda.org	(315) 339-6937
ETL SEMCO	Intertek ETL SEMCO	(800) 967-5352

	(Formerly: ITS - Intertek Testing Service NA) www.intertek-etlsemko.com	
FIBA	Federation Internationale de Basketball (The International Basketball Federation) www.fiba.com	41 22 545 00 00
FIVB	Federation Internationale de Volleyball (The International Volleyball Federation) www.fivb.org	41 21 345 35 35
FM Approvals	FM Approvals LLC www.fmglobal.com	(781) 762-4300
FM Global	FM Global (Formerly: FMG - FM Global) www.fmglobal.com	(401) 275-3000
FRSA	Florida Roofing, Sheet Metal & Air Conditioning Contractors Association, Inc. www.floridaroof.com	(407) 671-3772
FSA	Fluid Sealing Association www.fluidsealing.com	(610) 971-4850
FSC	Forest Stewardship Council www.fsc.org	49 228 367 66 0
GA	Gypsum Association www.gypsum.org	(202) 289-5440
GANA	Glass Association of North America www.glasswebsite.com	(785) 271-0208
GRI	(Part of GSI)	
GS	Green Seal www.greenseal.org	(202) 872-6400
GSI	Geosynthetic Institute www.geosynthetic-institute.org	(610) 522-8440
HI	Hydraulic Institute www.pumps.org	(973) 267-9700
HI	Hydronics Institute www.gamanet.org	(908) 464-8200
HMMA	Hollow Metal Manufacturers Association (Part of NAAMM)	

HPVA	Hardwood Plywood & Veneer Association www.hpva.org	(703) 435-2900
HPW	H. P. White Laboratory, Inc. www.hpwhite.com	(410) 838-6550
IAS	International Approval Services (Now CSA International)	
IBF	International Badminton Federation (Now BWF)	
ICEA	Insulated Cable Engineers Association, Inc. www.icea.net	(770) 830-0369
ICRI	International Concrete Repair Institute, Inc. www.icri.org	(847) 827-0830
IEC	International Electrotechnical Commission www.iec.ch	41 22 919 02 11
IEEE	Institute of Electrical and Electronics Engineers, Inc. (The) www.ieee.org	(212) 419-7900
IES	Illuminating Engineering Society www.ies.org	(212) 248-5000
IESNA	Illuminating Engineering Society of North America (Now IES)	
IEST	Institute of Environmental Sciences and Technology www.iest.org	(847) 981-0100
IGCC	Insulating Glass Certification Council www.igcc.org	(315) 646-2234
IGMA	Insulating Glass Manufacturers Alliance www.igmaonline.org	(613) 233-1510
ILI	Indiana Limestone Institute of America, Inc. www.iliai.com	(812) 275-4426
ISO	International Organization for Standardization www.iso.ch	41 22 749 01 11
	Available from ANSI www.ansi.org	(202) 293-8020
ISSFA	International Solid Surface Fabricators Association www.issfa.net	(877) 464-7732 (702) 567-8150

ITS	Intertek Testing Service NA (Now ETL SEMCO)	
ITU	International Telecommunication Union www.itu.int/home	41 22 730 51 11
KCMA	Kitchen Cabinet Manufacturers Association www.kcma.org	(703) 264-1690
LPI	Lightning Protection Institute www.lightning.org	(800) 488-6864
MBMA	Metal Building Manufacturers Association www.mbma.com	(216) 241-7333
MFMA	Maple Flooring Manufacturers Association, Inc. www.maplefloor.org	(888) 480-9138
MFMA	Metal Framing Manufacturers Association, Inc. www.metalframingmfg.org	(312) 644-6610
MH	Material Handling (Now MHIA)	
MHIA	Material Handling Industry of America www.mhia.org	(800) 345-1815 (704) 676-1190
MIA	Marble Institute of America www.marble-institute.com	(440) 250-9222
MPI	Master Painters Institute www.paintinfo.com	(888) 674-8937 (604) 298-7578
MSS	Manufacturers Standardization Society of The Valve and Fittings Industry Inc. www.mss-hq.com	(703) 281-6613
NAAMM	National Association of Architectural Metal Manufacturers www.naamm.org	(630) 942-6591
NACE	NACE International (National Association of Corrosion Engineers International) www.nace.org	(800) 797-6623 (281) 228-6200
NADCA	National Air Duct Cleaners Association www.nadca.com	(202) 737-2926
NAGWS	National Association for Girls and Women in Sport www.aahperd.org/nagws/	(800) 213-7193, ext. 453 (703) 476-3400

NAIMA	North American Insulation Manufacturers Association www.naima.org	(703) 684-0084
NBGQA	National Building Granite Quarries Association, Inc. www.nbgqa.com	(800) 557-2848
NCAA	National Collegiate Athletic Association (The) www.ncaa.org	(317) 917-6222
NCMA	National Concrete Masonry Association www.ncma.org	(703) 713-1900
NCPI	National Clay Pipe Institute www.ncpi.org	(262) 248-9094
NCTA	National Cable & Telecommunications Association www.ncta.com	(202) 775-2300
NEBB	National Environmental Balancing Bureau www.nebb.org	(301) 977-3698
NECA	National Electrical Contractors Association www.necanet.org	(301) 657-3110
NeLMA	Northeastern Lumber Manufacturers' Association www.nelma.org	(207) 829-6901
NEMA	National Electrical Manufacturers Association www.nema.org	(703) 841-3200
NETA	InterNational Electrical Testing Association www.netaworld.org	(888) 300-6382 (269) 488-6382
NFHS	National Federation of State High School Associations www.nfhs.org	(317) 972-6900
NFPA	NFPA (National Fire Protection Association) www.nfpa.org	(800) 344-3555 (617) 770-3000
NFRC	National Fenestration Rating Council www.nfrc.org	(301) 589-1776
NGA	National Glass Association www.glass.org	(866) 342-5642 (703) 442-4890
NHLA	National Hardwood Lumber Association www.natlhardwood.org	(800) 933-0318 (901) 377-1818
NLGA	National Lumber Grades Authority www.nlga.org	(604) 524-2393

NOFMA	NOFMA: The Wood Flooring Manufacturers Association (Formerly: National Oak Flooring Manufacturers Association) www.nofma.com	(901) 526-5016
NOMMA	National Ornamental & Miscellaneous Metals Association www.nomma.org	(888) 516-8585
NRCA	National Roofing Contractors Association www.nrca.net	(800) 323-9545 (847) 299-9070
NRMCA	National Ready Mixed Concrete Association www.nrmca.org	(888) 846-7622 (301) 587-1400
NSF	NSF International (National Sanitation Foundation International) www.nsf.org	(800) 673-6275 (734) 769-8010
NSSGA	National Stone, Sand & Gravel Association www.nssga.org	(800) 342-1415 (703) 525-8788
NTMA	National Terrazzo & Mosaic Association, Inc. (The) www.ntma.com	(800) 323-9736 (540) 751-0930
NTRMA	National Tile Roofing Manufacturers Association (Now TRI)	
NWFA	National Wood Flooring Association www.woodfloors.org	(800) 422-4556 (636) 519-9663
NWWDA	National Wood Window and Door Association (Now WDMA)	
PCI	Precast/Prestressed Concrete Institute www.pci.org	(312) 786-0300
PDCA	Painting & Decorating Contractors of America www.pdca.com	(800) 332-7322 (314) 514-7322
PDI	Plumbing & Drainage Institute www.pdionline.org	(800) 589-8956 (978) 557-0720
PGI	PVC Geomembrane Institute http://pgi-tp.cee.uiuc.edu	(217) 333-3929
PLANET	Professional Landcare Network www.landcarenetwork.org	(800) 395-2522 (703) 736-9666
PTI	Post-Tensioning Institute www.post-tensioning.org	(602) 870-7540

RCSC	Research Council on Structural Connections www.boltcouncil.org	
RFCI	Resilient Floor Covering Institute www.rfci.com	(301) 340-8580
RIS	Redwood Inspection Service www.redwoodinspection.com	(925) 935-1499
SAE	SAE International www.sae.org	(877) 606-7323 (724) 776-4841
SCTE	Society of Cable Telecommunications Engineers www.scte.org	(800) 542-5040 (610) 363-6888
SDI	Steel Deck Institute www.sdi.org	(847) 458-4647
SDI	Steel Door Institute www.steeldoor.org	(440) 899-0010
SEFA	Scientific Equipment and Furniture Association www.sefalabs.com	(877) 294-5424 (516) 294-5424
SEI/ASCE	Structural Engineering Institute/American Society of Civil Engineers (See ASCE)	
SGCC	Safety Glazing Certification Council www.sgcc.org	(315) 646-2234
SIA	Security Industry Association www.siaonline.org	(866) 817-8888 (703) 683-2075
SJI	Steel Joist Institute www.steeljoist.org	(843) 626-1995
SMA	Screen Manufacturers Association www.smainfo.org	(561) 533-0991
SMACNA	Sheet Metal and Air Conditioning Contractors' National Association www.smacna.org	(703) 803-2980
SMPTE	Society of Motion Picture and Television Engineers www.smpte.org	(914) 761-1100
SPFA	Spray Polyurethane Foam Alliance www.sprayfoam.org	(800) 523-6154
SPIB	Southern Pine Inspection Bureau	(850) 434-2611

	www.spib.org	
SPRI	Single Ply Roofing Industry www.spri.org	(781) 647-7026
SSINA	Specialty Steel Industry of North America www.ssina.com	(800) 982-0355 (202) 342-8630
SSPC	SSPC: The Society for Protective Coatings www.sspc.org	(877) 281-7772 (412) 281-2331
STI	Steel Tank Institute www.steeltank.com	(847) 438-8265
SWI	Steel Window Institute www.steelwindows.com	(216) 241-7333
SWRI	Sealant, Waterproofing, & Restoration Institute www.swrionline.org	(816) 472-7974
TCNA	Tile Council of North America, Inc. www.tileusa.com	(864) 646-8453
TIA/EIA	Telecommunications Industry Association/Electronic Industries Alliance www.tiaonline.org	(703) 907-7700
TMS	The Masonry Society www.masonrysociety.org	(303) 939-9700
TPI	Truss Plate Institute, Inc. www.tpinst.org	(703) 683-1010
TPI	Turfgrass Producers International www.turfgrasssod.org	(800) 405-8873 (847) 649-5555
TRI	Tile Roofing Institute www.tileroofing.org	(312) 670-4177
UL	Underwriters Laboratories Inc. www.ul.com	(877) 854-3577 (847) 272-8800
UNI	Uni-Bell PVC Pipe Association www.uni-bell.org	(972) 243-3902
USAV	USA Volleyball www.usavolleyball.org	(888) 786-5539 (719) 228-6800
USGBC	U.S. Green Building Council www.usgbc.org	(800) 795-1747

USITT	United States Institute for Theatre Technology, Inc. www.usitt.org	(800) 938-7488 (315) 463-6463
WASTEC	Waste Equipment Technology Association www.wastec.org	(800) 424-2869 (202) 244-4700
WCLIB	West Coast Lumber Inspection Bureau www.wclib.org	(800) 283-1486 (503) 639-0651
WCMA	Window Covering Manufacturers Association www.wcmanet.org	(212) 297-2122
WCSC	Window Covering Safety Council www.windowcoverings.org	(800) 506-4636 (212) 297-2109
WDMA	Window & Door Manufacturers Association www.wdma.com	(800) 223-2301 (847) 299-5200
WI	Woodwork Institute (Formerly: WIC - Woodwork Institute of California) www.wicnet.org	(916) 372-9943
WIC	Woodwork Institute of California (Now WI)	
WMMPA	Wood Moulding & Millwork Producers Association www.wmmpa.com	(800) 550-7889 (530) 661-9591
WSRCA	Western States Roofing Contractors Association www.wsrca.com	(800) 725-0333 (650) 570-5441
WWPA	Western Wood Products Association www.wwpa.org	(503) 224-3930

C. Code Agencies: Where abbreviations and acronyms are used in Specifications or other Contract Documents, they shall mean the recognized name of the entities in the following list. Names, telephone numbers, and Web sites are subject to change and are believed to be accurate and up-to-date as of the date of the Contract Documents.

IAPMO	International Association of Plumbing and Mechanical Officials www.iapmo.org	(909) 472-4100
ICC	International Code Council www.iccsafe.org	(888) 422-7233
ICC-ES	ICC Evaluation Service, Inc. www.icc-es.org	(800) 423-6587 (562) 699-0543
UBC	Uniform Building Code (See ICC)	

D. Federal Government Agencies: Where abbreviations and acronyms are used in Specifications or other Contract Documents, they shall mean the recognized name of the entities in the following list. Names, telephone numbers, and Web sites are subject to change and are believed to be accurate and up-to-date as of the date of the Contract Documents.

CE	Army Corps of Engineers www.usace.army.mil	(202) 761-0011
CPSC	Consumer Product Safety Commission www.cpsc.gov	(800) 638-2772 (301) 504-7923
DOC	Department of Commerce www.commerce.gov	(202) 482-2000
DOD	Department of Defense http://.dodssp.daps.dla.mil	(215) 697-6257
DOE	Department of Energy www.energy.gov	(202) 586-9220
EPA	Environmental Protection Agency www.epa.gov	(202) 272-0167
FAA	Federal Aviation Administration www.faa.gov	(866) 835-5322
FCC	Federal Communications Commission www.fcc.gov	(888) 225-5322
FDA	Food and Drug Administration www.fda.gov	(888) 463-6332
GSA	General Services Administration www.gsa.gov	(800) 488-3111
HUD	Department of Housing and Urban Development www.hud.gov	(202) 708-1112
LBL	Lawrence Berkeley National Laboratory www.lbl.gov	(510) 486-4000
NCHRP	National Cooperative Highway Research Program (See TRB)	
NIST	National Institute of Standards and Technology www.nist.gov	(301) 975-6478
OSHA	Occupational Safety & Health Administration www.osha.gov	(800) 321-6742 (202) 693-1999
PBS	Public Buildings Service	

	(See GSA)	
PHS	Office of Public Health and Science www.hhs.gov/ophs	(202) 690-7694
RUS	Rural Utilities Service (See USDA)	(202) 720-9540
SD	State Department www.state.gov	(202) 647-4000
TRB	Transportation Research Board http://gulliver.trb.org	(202) 334-2934
USDA	Department of Agriculture www.usda.gov	(202) 720-2791
USPS	Postal Service www.usps.com	(202) 268-2000

E. Standards and Regulations: Where abbreviations and acronyms are used in Specifications or other Contract Documents, they shall mean the recognized name of the standards and regulations in the following list. Names, telephone numbers, and Web sites are subject to change and are believed to be accurate and up-to-date as of the date of the Contract Documents.

ADAAG	Americans with Disabilities Act (ADA)	(800) 872-2253
	Architectural Barriers Act (ABA)	(202) 272-0080
	Accessibility Guidelines for Buildings and Facilities Available from U.S. Access Board www.access-board.gov	
CFR	Code of Federal Regulations	(866) 512-1800
	Available from Government Printing Office	(202) 512-1800
	www.gpoaccess.gov/cfr/index.html	
DOD	Department of Defense Military Specifications and Standards	(215) 697-2664
	Available from Department of Defense Single Stock Point http://dodssp.daps.dla.mil	
DSCC	Defense Supply Center Columbus (See FS)	
FED-STD	Federal Standard (See FS)	
FS	Federal Specification	(215) 697-

		2664
	Available from Department of Defense Single Stock Point http://dodssp.daps.dla.mil	
	Available from Defense Standardization Program www.dps.dla.mil	
	Available from General Services Administration	(202) 619-8925
	www.gsa.gov	
	Available from National Institute of Building Sciences	(202) 289-7800
	www.wbdg.org/ccb	
FTMS	Federal Test Method Standard (See FS)	
MIL	(See MILSPEC)	
MIL-STD	(See MILSPEC)	
MILSPEC	Military Specification and Standards	(215) 697-2664
	Available from Department of Defense Single Stock Point http://dodssp.daps.dla.mil	
UFAS	Uniform Federal Accessibility Standards	(800) 872-2253
	Available from Access Board	(202) 272-0080
	www.access-board.gov	

F. State Government Agencies: Where abbreviations and acronyms are used in Specifications or other Contract Documents, they shall mean the recognized name of the entities in the following list. Names, telephone numbers, and Web sites are subject to change and are believed to be accurate and up-to-date as of the date of the Contract Documents.

CBHF	State of California, Department of Consumer Affairs Bureau of Home Furnishings and Thermal Insulation www.dca.ca.gov/bhfti	(800) 952-5210 (916) 574-2041
CCR	California Code of Regulations	(916) 323-6815
	www.calregs.com	
CDHS	California Department of Health Services (See CDPH)	
CDPH	California Department of Public Health, Indoor Air Quality Section	(510) 620-

		2802
	www.cal-iaq.org	
CPUC	California Public Utilities Commission	(415) 703-2782
	www.cpuc.ca.gov	
TFS	Texas Forest Service	(979) 458-6650
	Forest Resource Development http://txforestservice.tamu.edu	

PART 2 - PRODUCTS (Not Used)

PART 3 - EXECUTION (Not Used)

END OF SECTION 014200

SECTION 015000

TEMPORARY FACILITIES AND CONTROLS

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 requirements for temporary utilities, support facilities, and security and protection facilities.

B. Related Sections:

1. Division 01 Section "Summary" for work restrictions and limitations on utility interruptions.

1.3 USE CHARGES

A. General: Installation and removal of and use charges for temporary facilities shall be included in the Contract Sum unless otherwise indicated. Allow other entities to use temporary services and facilities without cost, including, but not limited to, COR, contractor funded testing agencies, and authorities having jurisdiction.

B. Electric Power Service from Existing System: Electric power from Contracting Officer's existing system is available for use without metering and without payment of use charges. Provide connections and extensions of services as required for construction operations.

C. Communications Systems: Contractor shall provide and pay for all phone and data services. All communication services shall be through outside phone lines.

1. The Contractor shall arrange with the local phone service provider to have telephone lines installed in the Contractor’s General Foreman’s Office trailer when a trailer is required by the contract.

1.4 INFORMATIONAL SUBMITTALS

A. Disposal of Refuse: The Contractor is totally responsible for the removal of all refuse associated with this project. The Contractor shall remove all refuse associated with the construction operations from the site and dispose of it in accordance with the requirements of the local jurisdiction.

B. Disposal of Hazardous Wastes: Any hazardous wastes generated by the Contractor shall be properly controlled and disposed by the Contractor in accordance with applicable RCRA (40CFR) and COMAR (Title 26) regulations.

C. Moisture-Protection Plan: Describe procedures and controls for protecting materials and construction from water absorption and damage, including delivery, handling, and storage provisions for materials subject to water absorption or water damage, discarding water-damaged materials, protocols for mitigating water intrusion into completed Work, and replacing water damaged Work.

1. Indicate sequencing of work that requires water, such as sprayed fire-resistive materials, plastering, and terrazzo grinding, and describe plans for dealing with water from these operations. Show procedures for verifying that wet construction has dried sufficiently to permit installation of finish materials.

D. Dust-Control and HVAC-Control Plan: Submit coordination drawing and narrative that indicates the dust-control and HVAC-control measures proposed for use, proposed locations, and proposed time frame for their operation. Identify further options if proposed measures are later determined to be inadequate. Include the following:

1. Locations of dust-control partitions at each phase of the work.
2. HVAC system isolation schematic drawing.
3. Location of proposed air filtration system discharge.
4. Other dust-control measures.
5. Waste management plan.

1.5 ACTION SUBMITTALS

A. Temporary Construction Trailers

1.6 QUALITY ASSURANCE

A. Electric Service: Comply with NECA, NEMA, and UL standards and regulations for temporary electric service. Install service to comply with NFPA 70.

B. Tests and Inspections: Arrange for authorities having jurisdiction to test and inspect each temporary utility before use. Obtain required certifications and permits.

C. Accessible Temporary Egress: Comply with applicable provisions in the U.S. Architectural & Transportation Barriers Compliance Board's ADA-ABA Accessibility Guidelines.

1.7 PROJECT CONDITIONS

A. Temporary Use of Permanent Facilities: Engage installer of each permanent service to assume responsibility for operation, maintenance, and protection of each permanent service during its use as a construction facility before Contracting Officer's acceptance, regardless of previously assigned responsibilities.

PART 2 - PRODUCTS

2.1 MATERIALS

A. Dust Control Adhesive-Surface Walk-off Mats: Provide mats minimum 36 by 60 inches.

2.2 EQUIPMENT

A. Fire Extinguishers: Portable, UL rated; with class and extinguishing agent as required by locations and classes of fire exposures.

B. HVAC Equipment: Unless Contracting Officer authorizes use of permanent HVAC system, provide vented, self-contained, liquid-propane-gas or fuel-oil heaters with individual space thermostatic control.

1. Use of gasoline-burning space heaters, open-flame heaters, or salamander-type heating units is prohibited.
2. Heating Units: Listed and labeled for type of fuel being consumed, by a contractor funded testing agency acceptable to authorities having jurisdiction, and marked for intended use.
3. Permanent HVAC System: If Contracting Officer authorizes use of permanent HVAC system for temporary use during construction, provide filter with MERV of **8** at each return air grille in system and remove at end of construction.

C. Air Filtration Units: Primary filter and secondary HEPA filter-equipped portable units with four-stage filtration. Provide single switch for emergency shutoff. Configure to run continuously.

D. Construction Site Maintenance:

1. The Contractor shall store all supplies and equipment on project site so as to preclude mechanical and climatic damage. Maintain site in a neat and orderly manner.
2. Contractor shall be responsible for maintaining any temporary structures in good repair and visually pleasant.

E. Noise Control:
1. The Contractor shall comply with all applicable local laws, ordinances, and regulations relative to noise control. Equipment to be employed on this site shall not produce a noise level exceeding the following limits in dB(A) at a distance of 50 feet from the equipment under test.
   a. Equipment:
      1) Stationary
         a) pumps 76
         b) generators 78
         c) compressors 81
      2) Impact
         a) jack hammers 88
         b) pneumatic tools 86
      3) Other

a) saws 78
b) vibrators 76

PART 3 - EXECUTION

3.1 INSTALLATION, GENERAL

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

1. Locate facilities to limit site disturbance as specified in Division 01 Section "Summary."

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

3.2 SUPPORT FACILITIES INSTALLATION

A. General: Comply with the following:

1. Provide construction for temporary offices, shops, and sheds located within construction area or within 30 feet of building lines that is noncombustible according to ASTM E 136. Comply with NFPA 241.
2. Maintain support facilities until COR schedules Substantial Completion inspection. Remove before Substantial Completion. Personnel remaining after Substantial Completion will be permitted to use permanent facilities, under conditions acceptable to Contracting Officer.

B. Traffic Controls: Comply with requirements of authorities having jurisdiction.

1. Protect existing site improvements to remain including curbs, pavement, and utilities.
2. Maintain access for fire-fighting equipment and access to fire hydrants.
3. Provide personnel “flagger(s)” to control and direct construction vehicular traffic.

C. Parking: Refer to Contract Documents for location of temporary parking.

D. Project Signs: Provide Project signs as indicated. Unauthorized signs are not permitted.

1. Identification Signs: Provide Project identification signs as indicated on Drawings.

a. If required by the contract, within fifteen (15) days after commencement of work, the Contractor shall provide one sign no larger than four (4) square feet at the construction site indicating the name of the Contractor, the name of the Contractors representative and his telephone number, the title and contract number of the project, and any other specific information and format provided by the COR. The construction sign must be approved prior to installation. The COR will select the location for the sign

2. Temporary Signs: Provide other signs as indicated and as required to inform public and individuals seeking entrance to Project.

   a. Provide temporary, directional signs for construction personnel and visitors.

3. Maintain and touchup signs so they are legible at all times.

3.3 SECURITY AND PROTECTION FACILITIES INSTALLATION

A. Environmental Protection: Provide protection, operate temporary facilities, and conduct construction as required to comply with environmental regulations and that minimize possible air, waterway, and subsoil contamination or pollution or other undesirable effects.

   1. Comply with work restrictions specified in Division 01 Section "Summary."

B. Temporary Fire Protection: Install and maintain temporary fire-protection facilities of types needed to protect against reasonably predictable and controllable fire losses. Comply with NFPA 241.

   1. Prohibit smoking in construction areas.
   2. Supervise welding operations, combustion-type temporary heating units, and similar sources of fire ignition according to requirements of authorities having jurisdiction.
   3. Develop and supervise an overall fire-prevention and -protection program for personnel at Project site. Review needs with local fire department and establish procedures to be followed. Instruct personnel in methods and procedures. Post warnings and information.
   4. Provide temporary standpipes and hoses for fire protection. Hang hoses with a warning sign stating that hoses are for fire-protection purposes only and are not to be removed. Match hose size with outlet size and equip with suitable nozzles.

3.4 MOISTURE AND MOLD CONTROL

A. Contractor's Moisture-Protection Plan: Avoid trapping water in finished work. Document visible signs of mold that may appear during construction.

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

   1. Protect porous materials from water damage.
   2. Protect stored and installed material from flowing or standing water.
   3. Keep porous and organic materials from coming into prolonged contact with concrete.
   4. Remove standing water from decks.
   5. Keep deck openings covered or dammed.

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

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

2. Keep interior spaces reasonably clean and protected from water damage.
3. Periodically collect and remove waste containing cellulose or other organic matter.
4. Discard or replace water-damaged material.
5. Do not install material that is wet.
6. Discard, replace or clean stored or installed material that begins to grow mold.
7. Perform work in a sequence that allows any wet materials adequate time to dry before enclosing the material in drywall or other interior finishes.

D. Controlled Construction Phase of Construction: After completing and sealing of the building enclosure but prior to the full operation of permanent HVAC systems, maintain as follows:

1. Control moisture and humidity inside building by maintaining effective dry-in conditions.
2. Use permanent HVAC system to control humidity.
3. Comply with manufacturer's written instructions for temperature, relative humidity, and exposure to water limits.

   a. Hygroscopic materials that may support mold growth, including wood and gypsum-based products, that become wet during the course of construction and remain wet for 48 hours are considered defective.
   b. Measure moisture content of materials that have been exposed to moisture during construction operations or after installation. Record daily readings over a forty-eight hour period. Identify materials containing moisture levels higher than allowed. Report findings in writing to COR.
   c. Remove materials that cannot be completely restored to their manufactured moisture level within 48 hours.

3.5 OPERATION, TERMINATION, AND REMOVAL

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

B. Maintenance: Maintain facilities in good operating condition until removal.

1. Maintain operation of temporary enclosures, heating, cooling, humidity control, ventilation, and similar facilities on a 24-hour basis where required to achieve indicated results and to avoid possibility of damage.

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

1. Materials and facilities that constitute temporary facilities are property of Contractor. Contracting Officer reserves right to take possession of Project identification signs.
2. Remove temporary roads and paved areas not intended for or acceptable for integration into permanent construction. Where area is intended for landscape development, remove soil and aggregate fill that do not comply with requirements for fill or subsoil. Remove materials contaminated with road oil, asphalt and other petrochemical compounds, and other substances that might impair growth of plant materials or lawns. Repair or replace

street paving, curbs, and sidewalks at temporary entrances, as required by authorities having jurisdiction.

3. At Substantial Completion, repair, renovate, and clean permanent facilities used during construction period. Comply with final cleaning requirements specified in Division 01 Section "Closeout Procedures."

END OF SECTION 015000

SECTION 015100

PROJECT CONSTRUCTION SIGNAGE

PART 1 – GENERAL

1.1 SECTION INCLUDES:

A. National Institute of Standards and Technology Project Information Signs.

B. Provide signs and maintain

1.2 SUBMITTAL:

A. Submit layout of signs (see the signs at the end of this section).

PART 2 – PRODUCTS

2.1 MATERIALS:

A. Sign substrate – 24H”x 24L” x 3/4-inch exterior type high density overlaid plywood type AC or equal.

B. Sign material – 24H” x 24L” x 1/8” Dibond aluminum composite panel with polyethylene core. Front and back sides, platinum white or black lacquered with digital print. Secure aluminum panel sign to plywood substrate.

C. Boundary Strips-1-inch by 4-inch fir or equal

D. Sign vertical supports-pressure treated 4-inch by 4-inch pine

E. Support bracing-pressure treated pine or fir.

PART 3 – EXECUTION

A. The Contractor shall display no signs or advertisements except as noted herein.

B. The Contractor shall furnish, erect and maintain for his own people, such signs as may be required by safety regulations, as necessary to safeguard life and property, or as required by local authorities or the Construction Manager and the Owner.

C. Erect signs at a location as ordered by the Project COR. Coordinate mounting height above grade with Project COR.

E. Adequately support signs as site conditions may require.

F. Extend vertical support a minimum of 3 feet into the ground

G. Bound edge of plywood with a 1-inch by 4-inch wood furring strip fastened flat to the edge of the sign at middle of the width of the strip.

END OF SECTION 015100

SECTION 016000

PRODUCT REQUIREMENTS

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 selection of products for use in Project; product delivery, storage, and handling; manufacturers' standard warranties on products; special warranties; and comparable products.

B. Related Sections:

1. Division 01 Section “Submittal Procedures” for products selected as specified.
2. Division 01 Section "Substitutions Prior to Offering”. Division 01 Section "References" for applicable industry standards for products specified.

1.3 DEFINITIONS

A. Products: Items obtained for incorporating into the Work, whether purchased for Project or taken from previously purchased stock. The term "product" includes the terms "material," "equipment," "system," and terms of similar intent.

1. Named Products: Items identified by manufacturer's product name, including make or model number or other designation shown or listed in manufacturer's published product literature, that is current as of date of the Contract Documents.
2. New Products: Items that have not previously been incorporated into another project or facility. Products salvaged or recycled from other projects are not considered new products.
3. Comparable Product: Product that is demonstrated and approved through submittal process to have the indicated qualities related to type, function, dimension, in-service performance, physical properties, appearance, and other characteristics that equal or exceed those of specified product.

B. Basis-of-Design Product Specification: A specification in which a specific manufacturer's product is named and accompanied by the words "basis-of-design product," including make or model number or other designation, to establish the significant qualities related to type, function, dimension, in-service performance, physical properties, appearance, and other

characteristics for purposes of evaluating comparable products of additional manufacturers named in the specification.

1.4 ACTION SUBMITTALS

A. Comparable Product Requests: Submit request for consideration of each comparable product. Identify product or fabrication or installation method to be replaced. Include Specification Section number and title and Drawing numbers and titles.

1. Include data to indicate compliance with the requirements specified in "Comparable Products" Article.
2. COR's Action: If necessary, COR will request additional information or documentation for evaluation within one week of receipt of a comparable product request. COR will notify Contractor of approval or rejection of proposed comparable product request within 15 days of receipt of request, or seven days of receipt of additional information or documentation, whichever is later.

    a. Form of Approval: As specified in Division 01 Section "Submittal Procedures."
    b. Use product specified if COR does not issue a decision on use of a comparable product request within time allocated.

B. Basis-of-Design Product Specification Submittal: Comply with requirements in Division 01 Section "Submittal Procedures." Show compliance with requirements.

1.5 QUALITY ASSURANCE

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

1.6 PRODUCT DELIVERY, STORAGE, AND HANDLING

A. Deliver, store, and handle products using means and methods that will prevent damage, deterioration, and loss, including theft and vandalism. Comply with manufacturer's written instructions.

B. Delivery and Handling:

1. Schedule delivery to minimize long-term storage at Project site and to prevent overcrowding of construction spaces.
2. Coordinate delivery with installation time to ensure minimum holding time for items that are flammable, hazardous, easily damaged, or sensitive to deterioration, theft, and other losses.
3. Deliver products to Project site in an undamaged condition in manufacturer's original sealed container or other packaging system, complete with labels and instructions for handling, storing, unpacking, protecting, and installing.

4. Inspect products on delivery to determine compliance with the Contract Documents and to determine that products are undamaged and properly protected.

C. Storage:

1. Store products to allow for inspection and measurement of quantity or counting of units.
2. Store materials in a manner that will not endanger Project structure.
3. Store products that are subject to damage by the elements, under cover in a weathertight enclosure above ground, with ventilation adequate to prevent condensation.
4. Store foam plastic from exposure to sunlight, except to extent necessary for period of installation and concealment.
5. Comply with product manufacturer's written instructions for temperature, humidity, ventilation, and weather-protection requirements for storage.
6. Protect stored products from damage and liquids from freezing.

1.7 PRODUCT WARRANTIES

A. Warranties specified in other Sections shall be in addition to, and run concurrent with, other warranties required by the Contract Documents. Manufacturer's disclaimers and limitations on product warranties do not relieve Contractor of obligations under requirements of the Contract Documents. Warranty period shall begin after acceptance by the government.

1. Manufacturer's Warranty: Written warranty furnished by individual manufacturer for a particular product and specifically endorsed by manufacturer to Contracting Officer.
2. Special Warranty: Written warranty required by the Contract Documents to provide specific rights for Contracting Officer.

B. Special Warranties: Prepare a written document that contains appropriate terms and identification, ready for execution.

1. Manufacturer's Standard Form: Modified to include Project-specific information and properly executed.
2. Specified Form: When specified forms are included with the Specifications, prepare a written document using indicated form properly executed.
3. Refer to Divisions 02 through 49. Sections for specific content requirements and particular requirements for submitting special warranties.

C. Submittal Time: Comply with requirements in Division 01 Section "Closeout Procedures."

PART 2 - PRODUCTS

2.1 PRODUCT SELECTION PROCEDURES

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

1. Provide products complete with accessories, trim, finish, fasteners, and other items needed for a complete installation and indicated use and effect.
2. Standard Products: If available, and unless custom products or nonstandard options are specified, provide standard products of types that have been produced and used successfully in similar situations on other projects.
3. Contracting Officer reserves the right to limit selection to products with warranties not in conflict with requirements of the Contract Documents.
4. Where products are accompanied by the term "as selected," COR will make selection.
5. Descriptive, performance, and reference standard requirements in the Specifications establish salient characteristics of products.
6. Or Equal: For products specified by name and accompanied by the term "or equal," or "or approved equal," or "or approved," comply with requirements in "Comparable Products" Article to obtain approval for use of an unnamed product.

B. Product Selection Procedures:

1. Product: Where Specifications name a single manufacturer and product, provide the named product that complies with requirements. Comparable products or substitutions for Contractor's convenience will not be considered.
2. Manufacturer/Source: Where Specifications name a single manufacturer or source, provide a product by the named manufacturer or source that complies with requirements. Comparable products or substitutions for Contractor's convenience will not be considered.
3. Products:

    a. Restricted List: Where Specifications include a list of names of both manufacturers and products, provide one of the products listed that complies with requirements. Comparable products or substitutions for Contractor's convenience will be considered.
    b. Non-restricted List: Where Specifications include a list of names of both available manufacturers and products, provide one of the products listed, or an unnamed product, that complies with requirements. Comply with requirements in "Substitutions Prior to Offering" Article for consideration of an unnamed product.

4. Manufacturers:

    a. Restricted List: Where Specifications include a list of manufacturers' names, provide a product by one of the manufacturers listed that complies with requirements. Comparable products or substitutions for Contractor's convenience will be considered.
    b. Non-restricted List: Where Specifications include a list of available manufacturers, provide a product by one of the manufacturers listed, or a product by an unnamed manufacturer, that complies with requirements. Comply with requirements in "Substitutions Prior to Offering" Article for consideration of an unnamed manufacturer's product.

5. Basis-of-Design Product: Where Specifications name a product, or refer to a product indicated on Drawings, and include a list of manufacturers, provide the specified or indicated product or a comparable product by one of the other named manufacturers. Drawings and Specifications indicate sizes, profiles, dimensions, and other characteristics

that are based on the product named. Comply with requirements in "Comparable Products" Article for consideration of an unnamed product by one of the other named manufacturers.

C. Visual Matching Specification: Where Specifications require "match COR's sample", provide a product that complies with requirements and matches COR's sample. COR's decision will be final on whether a proposed product matches.

1. If no product available within specified category matches and complies with other specified requirements, comply with requirements in Division 01 Section "Substitution Procedures" for proposal of product.

D. Visual Selection Specification: Where Specifications include the phrase "as selected by COR from manufacturer's full range" or similar phrase, select a product that complies with requirements. COR will select color, gloss, pattern, density, or texture from manufacturer's product line that includes both standard and premium items.

2.2 COMPARABLE PRODUCTS

A. Conditions for Consideration: COR will consider Contractor's request for comparable product when the following conditions are satisfied. If the following conditions are not satisfied, COR may return requests without action, except to record noncompliance with these requirements:

1. Evidence that the proposed product does not require revisions to the Contract Documents, that it is consistent with the Contract Documents and will produce the indicated results, and that it is compatible with other portions of the Work.
2. Detailed comparison of significant qualities of proposed product with those named in the Specifications. Significant qualities include attributes such as performance, weight, size, durability, visual effect, and specific features and requirements indicated.
3. Evidence that proposed product provides specified warranty.
4. List of similar installations for completed projects with project names and addresses and names and addresses of CORs and Contracting Officers, if requested.
5. Samples, if requested.

PART 3 - EXECUTION (Not Used)

END OF SECTION 016000

SECTION 017300

EXECUTION

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 general administrative and procedural requirements governing execution of the Work including, but not limited to, the following:

1. Construction layout.
2. Field engineering and surveying.
3. Installation of the Work.
4. Coordination of Contracting Officer-installed products.
5. Progress cleaning.
6. Starting and adjusting.
7. Protection of installed construction.
8. Correction of the Work.

B. Related Sections:

1. Division 01 Section "Submittal Procedures" for submitting surveys.
2. Division 01 Section "Closeout Procedures" for submitting final property survey with Project Record Documents, recording of Contracting Officer-accepted deviations from indicated lines and levels, and final cleaning.
3. Division 07 Section "Penetration Firestopping" for patching penetrations in fire-rated construction.

1.3 DEFINITIONS

A. Cutting: Removal of in-place construction necessary to permit installation or performance of other work.

B. Patching: Fitting and repair work required to restore construction to original conditions after installation of other work.

1.4 INFORMATIONAL SUBMITTALS

A. Qualification Data: For land surveyor.

B. Certificates: Submit certificate signed by land surveyor certifying that location and elevation of improvements comply with requirements.

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

D. Certified Surveys: Submit two copies signed by land surveyor.

1.5 QUALITY ASSURANCE

A. Land Surveyor Qualifications: A professional land surveyor who is legally qualified to practice in jurisdiction where Project is located and who is experienced in providing land-surveying services of the kind indicated.

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

PART 2 - PRODUCTS

2.1 MATERIALS

A. General: Comply with requirements specified in other Sections.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Existing Conditions: The existence and location of underground and other utilities and construction indicated as existing are not guaranteed. Before beginning site work, investigate and verify the existence and location of underground utilities, mechanical and electrical systems, and other construction affecting the Work.

1. Before construction, verify the location and invert elevation at points of connection of sanitary sewer, storm sewer, water-service piping, underground electrical services, and other utilities.
2. Furnish location data for work related to Project that must be performed by public utilities serving Project site.

B. Examination and Acceptance of Conditions: Before proceeding with each component of the Work, examine substrates, areas, and conditions, with Installer or Applicator present where indicated, for compliance with requirements for installation tolerances and other conditions affecting performance. Record observations.

1. Written Report: Where a written report listing conditions detrimental to performance of the Work is required by other Sections, include the following:

a. Description of the Work.
b. List of detrimental conditions, including substrates.
c. List of unacceptable installation tolerances.
d. Recommended corrections.

2. Verify compatibility with and suitability of substrates, including compatibility with existing finishes or primers.
3. Examine roughing-in for mechanical and electrical systems to verify actual locations of connections before equipment and fixture installation.
4. Examine walls, floors, and roofs for suitable conditions where products and systems are to be installed.
5. Proceed with installation only after unsatisfactory conditions have been corrected. Proceeding with the Work indicates acceptance of surfaces and conditions.

3.2 PREPARATION

A. Existing Utility Information: Furnish information to Contracting Officer that is necessary to adjust, move, or relocate existing utility structures, utility poles, lines, services, or other utility appurtenances located in or affected by construction. Coordinate with authorities having jurisdiction.

B. Field Measurements: Take field measurements as required to fit the Work properly. Recheck measurements before installing each product. Where portions of the Work are indicated to fit to other construction, verify dimensions of other construction by field measurements before fabrication. Coordinate fabrication schedule with construction progress to avoid delaying the Work.

C. Space Requirements: Verify space requirements and dimensions of items shown diagrammatically on Drawings.

D. Review of Contract Documents and Field Conditions: Immediately on discovery of the need for clarification of the Contract Documents caused by differing field conditions outside the control of the Contractor, submit a request for information to COR according to requirements in Division 01 Section "Project Management and Coordination."

3.3 CONSTRUCTION LAYOUT

A. Verification: Before proceeding to lay out the Work, verify layout information shown on Drawings, in relation to the property survey and existing benchmarks. If discrepancies are discovered, notify COR promptly.

B. General: Engage a land surveyor to lay out the Work using accepted surveying practices.

1. Establish benchmarks and control points to set lines and levels at each story of construction and elsewhere as needed to locate each element of Project.
2. Establish dimensions within tolerances indicated. Do not scale Drawings to obtain required dimensions.
3. Inform installers of lines and levels to which they must comply.
4. Check the location, level and plumb, of every major element as the Work progresses.

5. Notify COR when deviations from required lines and levels exceed allowable tolerances.
6. Close site surveys with an error of closure equal to or less than the standard established by authorities having jurisdiction.

C. Site Improvements: Locate and lay out site improvements, including pavements, grading, fill and topsoil placement, utility slopes, and rim and invert elevations.

D. Building Lines and Levels: Locate and lay out control lines and levels for structures, building foundations, column grids, and floor levels, including those required for mechanical and electrical work. Transfer survey markings and elevations for use with control lines and levels. Level foundations and piers from two or more locations.

E. Record Log: Maintain a log of layout control work. Record deviations from required lines and levels. Include beginning and ending dates and times of surveys, weather conditions, name and duty of each survey party member, and types of instruments and tapes used. Make the log available for reference by COR.

3.4 FIELD ENGINEERING

A. Identification: Contracting Officer will identify existing benchmarks, control points, and property corners.

B. Reference Points: Locate existing permanent benchmarks, control points, and similar reference points before beginning the Work. Preserve and protect permanent benchmarks and control points during construction operations.

1. Do not change or relocate existing benchmarks or control points without prior written approval of COR. Report lost or destroyed permanent benchmarks or control points promptly. Report the need to relocate permanent benchmarks or control points to COR before proceeding.
2. Replace lost or destroyed permanent benchmarks and control points promptly. Base replacements on the original survey control points.

C. Benchmarks: Establish and maintain a minimum of two permanent benchmarks on Project site, referenced to data established by survey control points. Comply with authorities having jurisdiction for type and size of benchmark.

1. Record benchmark locations, with horizontal and vertical data, on Project Record Documents.
2. Where the actual location or elevation of layout points cannot be marked, provide temporary reference points sufficient to locate the Work.
3. Remove temporary reference points when no longer needed. Restore marked construction to its original condition.

D. Certified Survey: On completion of foundation walls, major site improvements, and other work requiring field-engineering services, prepare a certified survey showing dimensions, locations, angles, and elevations of construction and site work.

3.5 FIRE PREVENTION AND PROTECTION

1. The Contractor shall comply with all fire prevention recommendations of the National Fire Protection Association (NFPA) Regulations which are incorporated herein by reference. A written fire permit shall be obtained from the FPE for use of open flame devices, such as blow torches, portable furnaces, tar kettles or gas and electric welding and cutting equipment in or within fifteen feet of buildings. The Contractor shall be liable for any fire loss to Government property attributable to negligence on the part of the Contractor or sub-Contractor, included in part, failure to comply with fire prevention measures prescribed by terms of this Contract. Gasoline-driven equipment will not be allowed within the building.
2. Fire hydrant service shall be maintained during all construction activities, in accordance with National Fire Protection Association Standard No. 241 (NFPA 241), standard for Safeguarding Construction Alteration, and Demolition Operations. Should the relocation of hydrants or the use of temporary hydrants be required during major renovation or construction activities, the location of such hydrants shall be suitable to the Fire Protection Services Division, as directed by the Contracting Officer. Installation shall be in accordance with Division 21 of the Technical Specifications.

3.6 INSTALLATION

A. General: Locate the Work and components of the Work accurately, in correct alignment and elevation, as indicated.

1. Make vertical work plumb and make horizontal work level.
2. Where space is limited, install components to maximize space available for maintenance and ease of removal for replacement.
3. Conceal pipes, ducts, and wiring in finished areas, unless otherwise indicated.
4. Maintain minimum headroom clearance of 96 inches in occupied spaces and 90 inches in unoccupied spaces.

B. Comply with manufacturer's written instructions and recommendations for installing products in applications indicated.

C. Install products at the time and under conditions that will ensure the best possible results. Maintain conditions required for product performance until Substantial Completion.

D. Conduct construction operations so no part of the Work is subjected to damaging operations or loading in excess of that expected during normal conditions of occupancy.

E. Tools and Equipment: Do not use tools or equipment that produces harmful noise levels.

F. Templates: Obtain and distribute to the parties involved templates for work specified to be factory prepared and field installed. Check Shop Drawings of other work to confirm that adequate provisions are made for locating and installing products to comply with indicated requirements.

G. Attachment: Provide blocking and attachment plates and anchors and fasteners of adequate size and number to securely anchor each component in place, accurately located and aligned with

other portions of the Work. Where size and type of attachments are not indicated, verify size and type required for load conditions.

1. Mounting Heights: Where mounting heights are not indicated, mount components at heights directed by COR.
2. Allow for building movement, including thermal expansion and contraction.
3. Coordinate installation of anchorages. Furnish setting drawings, templates, and directions for installing anchorages, including sleeves, concrete inserts, anchor bolts, and items with integral anchors, that are to be embedded in concrete or masonry. Deliver such items to Project site in time for installation.

H. Joints: Make joints of uniform width. Where joint locations in exposed work are not indicated, arrange joints for the best visual effect. Fit exposed connections together to form hairline joints.

I. Hazardous Materials: Use products, cleaners, and installation materials that are not considered hazardous.

3.7 CONTRACTING OFFICER-INSTALLED PRODUCTS

A. Site Access: Provide access to Project site for Contracting Officer's construction personnel.

B. Coordination: Coordinate construction and operations of the Work with work performed by Contracting Officer's construction personnel.

1. Construction Schedule: Inform Contracting Officer of Contractor's preferred construction schedule for Contracting Officer's portion of the Work. Adjust construction schedule based on a mutually agreeable timetable. Notify Contracting Officer if changes to schedule are required due to differences in actual construction progress.
2. Preinstallation Conferences: Include Contracting Officer's construction personnel at preinstallation conferences covering portions of the Work that are to receive Contracting Officer's work. Attend preinstallation conferences conducted by Contracting Officer's construction personnel if portions of the Work depend on Contracting Officer's construction.

3.8 PROGRESS CLEANING

A. General: Clean Project site and work areas daily, including common areas. Enforce requirements strictly. Dispose of materials lawfully.

1. Comply with requirements in NFPA 241 for removal of combustible waste materials and debris.
2. Do not hold waste materials more than seven days during normal weather or three days if the temperature is expected to rise above 80 deg F.
3. Containerize hazardous and unsanitary waste materials separately from other waste. Mark containers appropriately and dispose of legally, according to regulations.

    a. Utilize containers intended for holding waste materials of type to be stored.

4. Coordinate progress cleaning for joint-use areas where more than one installer has worked.

B. Site: Maintain Project site free of waste materials and debris.

C. Work Areas: Clean areas where work is in progress to the level of cleanliness necessary for proper execution of the Work.

1. Remove liquid spills promptly.
2. Where dust would impair proper execution of the Work, broom-clean or vacuum the entire work area, as appropriate.

D. Installed Work: Keep installed work clean. Clean installed surfaces according to written instructions of manufacturer or fabricator of product installed, using only cleaning materials specifically recommended. If specific cleaning materials are not recommended, use cleaning materials that are not hazardous to health or property and that will not damage exposed surfaces.

E. Concealed Spaces: Remove debris from concealed spaces before enclosing the space.

F. Exposed Surfaces in Finished Areas: Clean exposed surfaces and protect as necessary to ensure freedom from damage and deterioration at time of Substantial Completion.

G. Waste Disposal: Do not bury or burn waste materials on-site. Do not wash waste materials down sewers or into waterways.

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

I. Clean and provide maintenance on completed construction as frequently as necessary through the remainder of the construction period. Adjust and lubricate operable components to ensure operability without damaging effects.

J. Limiting Exposures: Supervise construction operations to assure that no part of the construction completed or in progress, is subject to harmful, dangerous, damaging, or otherwise deleterious exposure during the construction period.

3.9 STARTING AND ADJUSTING

A. Start equipment and operating components to confirm proper operation. Remove malfunctioning units, replace with new units, and retest.

B. Adjust equipment for proper operation. Adjust operating components for proper operation without binding.

C. Test each piece of equipment to verify proper operation. Test and adjust controls and safeties. Replace damaged and malfunctioning controls and equipment.

D. Manufacturer's Field Service: Comply with qualification requirements in Division 01 Section "Quality Requirements."

3.10 PROTECTION OF INSTALLED CONSTRUCTION

A. Provide final protection and maintain conditions that ensure installed Work is without damage or deterioration at time of Substantial Completion.

B. Comply with manufacturer's written instructions for temperature and relative humidity.

3.11 CORRECTION OF THE WORK

A. Repair or remove and replace defective construction. Restore damaged substrates and finishes.

1. Repairing includes replacing defective parts, refinishing damaged surfaces, touching up with matching materials, and properly adjusting operating equipment.

B. Restore permanent facilities used during construction to their specified condition.

C. Remove and replace damaged surfaces that are exposed to view if surfaces cannot be repaired without visible evidence of repair.

D. Repair components that do not operate properly. Remove and replace operating components that cannot be repaired.

E. Remove and replace chipped, scratched, and broken glass or reflective surfaces.

END OF SECTION 017300

SECTION 017310

CUTTING AND PATCHING

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

A. This section includes procedural requirements for cutting and patching.

B. Definition: Cutting and patching includes cutting into existing construction to provide for the installation or performance of other work and subsequent fitting and repair required to restore surfaces to their original condition.

C. Refer to other sections for other requirements and limitations applicable to cutting and patching individual parts of the work.

D. Related Sections: This specification section is related to any and all specification sections with explicit or implicit reference to cutting and patching. Specific submittal requirements of these related specification sections are not included in this section. Related sections include but are not limited to the following specification sections:
1. Division 1 Section "Summary"
2. Division 1 Section "Project Management and Coordination"
3. Division 1 Section "Construction Progress Documentation"
4. Division 1 Section "Submittal Procedures"
5. Division 1 Section "Quality Requirements"
6. Division 1 Section "References"
7. Division 1 Section "Temporary Facilities and Controls"
8. Division 1 Section "Product Requirements"
9. Division 1 Section "Execution"
10. Division 1 Section "Closeout Procedures"

1.3 SUBMITTALS

A. Cutting and Patching Plan: Submit a written plan to the Contracting Officer Representative (COR) through the Quality Control manager describing procedures at least 21 calendar days in advance of the time cutting and patching will initially be performed.
1. Include the following information, as applicable:
   a. Description of the extent of cutting and patching required. Show how it will be performed and indicate why it cannot be avoided.
   b. Description of the anticipated results in terms of changes to existing construction. Include changes to structural elements and operating components as well as changes in appearance and other significant visual elements.
   c. List of products to be used and entities that will perform work.
   d. Dates and hours of operation when cutting and patching will be performed.

e. List of utilities that cutting and patching procedures will disturb or affect. List utilities that will be relocated and those that will be temporarily out-of-service. Indicate how long service will be disrupted.
f. Compatibility and cohesion characteristics of patching compounds with adjacent materials.
g. Details and engineering calculations showing integration of reinforcement with the original structure, where cutting and patching involves adding reinforcement to structural elements.

2. Approval by the Contracting Officer Representative (COR) to proceed with cutting and patching does not waive the right to later require complete removal and replacement of unsatisfactory work.
3. Samples: Provide cutting and patching samples for the following items within 14 calendar days after notice to proceed in order that special reviews and coordination can be arranged with approval authorities.
   a. Where cutting and patching samples are indicated as a requirement on Drawings.

1.4 QUALITY REQUIREMENTS

A. Requirements for Structural Work: Do not cut and patch structural elements in a manner that would change their load-carrying capacity or load-deflection ratio.
   1. The cutting and patching plan shall include but not be necessarily limited to work required at the following structural elements:
      a. Foundation construction.
      b. Bearing and retaining walls.
      c. Structural concrete.
      d. Structural steel.
      e. Lintels.
      f. Timber and primary wood framing.
      g. Structural decking.
      h. Stair systems.
      i. Miscellaneous structural metals.
      j. Exterior curtain-wall construction.
      k. Equipment supports.
      l. Piping, ductwork, vessels, and equipment.
      m. Structural systems of other construction.

B. Operational Limitations: Do not cut and patch operating elements, safety related systems, or related components in a manner that would result in reducing their capacity to perform as intended. Do not cut and patch operating elements, safety related systems or related components in a manner that would result in increased maintenance or decreased operational life or safety. Operating elements or safety related systems include but are not limited to the following:
   1. Primary operational systems and equipment.
   2. Air or smoke barriers.
   3. Water, moisture, or vapor barriers.
   4. Membranes and flashings.
   5. Fire protection systems.
   6. Noise and vibration control elements and systems.
   7. Control systems.
   8. Communication systems.
   9. Conveying systems.

10. Electrical wiring systems.
11. Operating systems of other construction.

C. Visual Requirements: Do not cut and patch construction exposed on the exterior or in occupied spaces in a manner that would, in the Contracting Officer Representative (COR)'s opinion, reduce the building's aesthetic qualities. Do not cut and patch construction in a manner that would result in visual evidence of cutting and patching. Remove and replace construction that was previously cut and patched in a visually unsatisfactorily manner. When requested by the Contracting Officer, engage a Specialist who is specifically experienced in the work. Visual elements include but are not limited to the following:
1. Processed concrete finishes.
2. Stonework and stone masonry.
3. Ornamental metal.
4. Matched-veneer woodwork.
5. Preformed metal panels.
6. Firestopping.
7. Window wall system.
8. Stucco and ornamental plaster.
9. Acoustical ceilings.
10. Terrazzo.
11. Finished wood flooring.
12. Fluid-applied flooring.
13. Carpeting.
14. Aggregate wall coating.
15. Wall covering.
16. Mechanical system enclosures, cabinets, or covers.

1.5 EXISTING WARRANTIES

A. Remove, replace, patch, and repair material and surfaces cut or damaged during cutting and patching operations by methods and with materials in such a manner as not to void any existing warranties.

PART 2 - PRODUCTS

2.1 MATERIALS

A. Comply with requirements specified in other Sections of these Specifications.

B. Use materials identical to existing materials. For exposed surfaces, use materials that visually match existing adjacent surfaces to the fullest extent possible.
1. If identical materials are unavailable or cannot be used, use materials that, when installed, will match the visual and functional performance of existing materials.

PART 3 - EXECUTION

3.1 INSPECTION

A. Before cutting, examine surfaces to be cut and patched and conditions under which cutting and patching is to be performed. If unsafe or unsatisfactory conditions are encountered, take corrective action before proceeding.

B. Before proceeding with cutting and patching involving two or more trades, meet at the project site with the Contracting Officer Representative (COR) and the entities providing or affected by the cutting and patching. Site meeting should be incorporated into the Three Phases of Quality Control process managed by the Contractor's Quality Control Manager. Review areas of potential interference and conflict. Coordinate procedures and resolve potential conflicts before proceeding.

C. Compatibility: Before patching, verify compatibility with and suitability of substrates, including compatibility with existing finishes or primers.

3.2 PREPARATION

A. Provide temporary support for work to be cut.

B. Protect existing conditions during cutting and patching to prevent damage. Provide protection from adverse weather conditions for portions of the Project that might be exposed during cutting and patching operations.

C. Avoid interference with use of adjoining areas or interruption of free passage to adjoining areas.

D. Where existing services are required to be removed, relocated, abandoned, bypass such services before cutting to avoid interruption of services to occupied areas.

3.3 PERFORMANCE

A. Employ skilled workmen to perform cutting and patching. Proceed with cutting and patching at the earliest feasible time and complete without delay.

B. Cutting: Cut existing construction using methods least likely to damage elements retained and adjoining construction. Where possible, review proposed procedures with the original installer and comply with the original installer's recommendations.
   1. In general, use hand or small power tools designed for sawing or grinding, not for hammering and chopping.
   2. Cut holes and slots as small as possible, neatly to size required, and with minimum disturbance of adjacent surfaces. Temporarily cover openings when not in use.
   3. To avoid marring existing finished surfaces, cut or drill from the exposed or finished side into concealed surfaces.
   4. Cut through concrete and masonry using a cutting machine, such as a Carborundum saw or a diamond-core drill.
   5. Comply with requirements of applicable Division 2 sections where cutting and patching requires excavating and backfilling.
   6. After utility services are bypassed, cut-off pipe or conduit in walls or partitions to be removed. Cap, valve or plug and seal the remaining portion of pipe or conduit to prevent entrance of moisture or other foreign matter after by-passing and cutting.

C. Patching: Patch construction by filling, repairing, refinishing, closing up, and similar operations following performance of other work. Patch with durable seams that are as invisible as possible. Provide materials and comply with installation requirements specified in other Sections of these Specifications.
   1. Where feasible, inspect and test patched areas to demonstrate integrity of the installation.

2. Restore exposed finishes of patched areas and extend finish restoration into adjoining construction in a manner that will eliminate evidence of patching and refinishing.
3. Where removed walls or partitions extends one finished area into another finished area, patch and repair floor and wall surfaces to provide an even surface of uniform color, finish, texture, and appearance. Remove existing floor and wall coverings and replace with new materials, if necessary, to achieve uniform color and appearance.
4. Where patching occurs in a smooth painted surface, extend final paint coat over entire unbroken surface that contains the patch after the area has received primer and other undercoats.
5. Patch, repair or rehang existing ceilings as necessary to provide an even-plane surface of uniform appearance.
6. Maintain integrity of fire barriers, vapor barriers and insulation.

3.4 CLEANING

A. Clean areas and spaces where cutting and patching are performed. Completely remove paint, mortar, oils, putty, and similar items.

B. Thoroughly clean piping, conduit, and similar features before applying paint, restored pipe coverings, or other finishing materials.

END OF SECTION 017310

SECTION 017700

CLOSEOUT PROCEDURES

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 contract closeout, including, but not limited to, the following:

1. Substantial Completion procedures.
2. Final completion procedures.
3. Warranties.
4. Final cleaning.

B. Related Sections:
1. Division 01 Section "Execution" for progress cleaning of Project site.
2. Division 01 Section "Operation and Maintenance Data" for operation and maintenance manual requirements.
3. Division 01 Section "Project Record Documents" for submitting Record Drawings, Record Specifications, and Record Product Data.
4. Divisions 02 through 49 Sections for specific closeout and special cleaning requirements for the Work in those Sections.

1.3 SUBSTANTIAL COMPLETION

A. Preliminary Procedures: Before requesting inspection for determining date of Substantial Completion, complete the following. List items below that are incomplete with request.

1. Prepare a list of items to be completed and corrected (punch list), the value of items on the list, and reasons why the Work is not complete.
2. Advise Contracting Officer of pending insurance changeover requirements.
3. Submit specific warranties, workmanship bonds, maintenance service agreements, final certifications, and similar documents.
4. Obtain and submit releases permitting Contracting Officer unrestricted use of the Work and access to services and utilities. Include occupancy permits, operating certificates, and similar releases.
5. Prepare and submit Project Record Documents, operation and maintenance manuals, final completion construction photographic documentation, damage or settlement surveys, property surveys, and similar final record information.

6. Deliver tools, spare parts, extra materials, and similar items to location designated by Contracting Officer. Label with manufacturer's name and model number where applicable.
7. Make final changeover of permanent locks and deliver keys to Contracting Officer. Advise Contracting Officer's personnel of changeover in security provisions.
8. Complete startup testing of systems.
9. Submit test/adjust/balance records.
10. Terminate and remove temporary facilities from Project site, along with mockups, construction tools, and similar elements.
11. Advise Contracting Officer of changeover in heat and other utilities.
12. Submit changeover information related to Contracting Officer's occupancy, use, operation, and maintenance.
13. Complete final cleaning requirements, including touchup painting.
14. Touch up and otherwise repair and restore marred exposed finishes to eliminate visual defects.

B. Request for Inspection: Submit a written request for inspection for Substantial Completion to the Contracting Officer at least 14 calendar days prior to the requested date of inspection. On receipt of request and verifying that all required testing has been completed, COR will either proceed with inspection or notify Contractor of unfulfilled requirements. COR will prepare the Certificate of Substantial Completion after inspection or will notify Contractor of items, either on Contractor's list or additional items identified by COR that must be completed or corrected before certificate will be issued.

1. Reinspection: Request reinspection when the Work identified in previous inspections as incomplete is completed or corrected.
2. Results of completed inspection will form the basis of requirements for final completion.

1.4 FINAL COMPLETION

A. Preliminary Procedures: Before requesting final inspection for determining final completion, complete the following:

1. Submit certified copy of COR's Substantial Completion inspection list of items to be completed or corrected (punch list), endorsed and dated by COR. The certified copy of the list shall state that each item has been completed or otherwise resolved for acceptance.
2. Submit evidence of final, continuing insurance coverage complying with insurance requirements.
3. Instruct Contracting Officer's personnel in operation, adjustment, and maintenance of products, equipment, and systems.
4. Prior to completion of the contract, the Contractor shall furnish an “as-built” record of materials used in the construction. Submission of this data is a condition for final payment under the contract. Where several manufacturers’ brands, types, or classes of the item listed have been used in the project, the specific areas where each item was used shall be designated. Designations shall be keyed to the areas and spaces depicted on the contract drawings.

B. Inspection: Submit a written request for final inspection for acceptance. On receipt of request, COR will either proceed with inspection or notify Contractor of unfulfilled requirements. COR

will prepare a final Certificate for Payment after inspection or will notify Contractor of construction that must be completed or corrected before certificate will be issued.

1. Reinspection: Request reinspection when the Work identified in previous inspections as incomplete is completed or corrected.

1.5 LIST OF INCOMPLETE ITEMS (PUNCH LIST)

A. Organization of List: Include name and identification of each space and area affected by construction operations for incomplete items and items needing correction including, if necessary, areas disturbed by Contractor that are outside the limits of construction.

1. Organize list of spaces in sequential order, starting with exterior areas first.
2. Organize items applying to each space by major element, including categories for ceiling, individual walls, floors, equipment, and building systems.
3. Include the following information at the top of each page:

    a. Project name.
    b. Date.
    c. Name of COR.
    d. Name of Contractor.
    e. Page number.

4. Submit list of incomplete items in the following format:

    a. PDF electronic file.
    b. Six (6) paper copies of product schedule or list, unless otherwise indicated. COR will return two copies.

1.6 WARRANTIES

A. Submittal Time: Submit written warranties on request of COR for designated portions of the Work where commencement of warranties other than date of Substantial Completion is indicated.

B. Partial Occupancy: Submit properly executed warranties within 15 days of completion of designated portions of the Work that are completed and occupied or used by Contracting Officer during construction period by separate agreement with Contractor.

C. Organize warranty documents into an orderly sequence based on the table of contents of the Project Manual.

1. Bind warranties and bonds in heavy-duty, three-ring, vinyl-covered, loose-leaf binders, thickness as necessary to accommodate contents, and sized to receive 8-1/2-by-11-inch paper.
2. Provide heavy paper dividers with plastic-covered tabs for each separate warranty. Mark tab to identify the product or installation. Provide a typed description of the product or installation, including the name of the product and the name, address, and telephone number of Installer.

3. Identify each binder on the front and spine with the typed or printed title "WARRANTIES," Project name, and name of Contractor.
4. Scan warranties and bonds and assemble complete warranty and bond submittal package into a single indexed electronic PDF file with links enabling navigation to each item. Provide table of contents at beginning of document.

D. Provide additional copies of each warranty to include in operation and maintenance manuals.

PART 2 - PRODUCTS

2.1 MATERIALS

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

1. Use cleaning products that meet Green Seal GS-37, or if GS-37 is not applicable, use products that comply with the California Code of Regulations maximum allowable VOC levels.

PART 3 - EXECUTION

3.1 FINAL CLEANING

A. General: Perform final cleaning. Conduct cleaning and waste-removal operations to comply with local laws and ordinances and Federal and local environmental and antipollution regulations.

B. Cleaning: Employ experienced workers or professional cleaners for final cleaning. Clean each surface or unit to condition expected in an average commercial building cleaning and maintenance program. Comply with manufacturer's written instructions.

1. Complete the following cleaning operations before requesting inspection for certification of Substantial Completion for entire Project or for a portion of Project:

a. Clean Project site, yard, and grounds, in areas disturbed by construction activities, including landscape development areas, of rubbish, waste material, litter, and other foreign substances.
b. Sweep paved areas broom clean. Remove petrochemical spills, stains, and other foreign deposits.
c. Rake grounds that are neither planted nor paved to a smooth, even-textured surface.
d. Remove tools, construction equipment, machinery, and surplus material from Project site.
e. Remove snow and ice to provide safe access to building.
f. Clean exposed exterior and interior hard-surfaced finishes to a dirt-free condition, free of stains, films, and similar foreign substances. Avoid disturbing natural

weathering of exterior surfaces. Restore reflective surfaces to their original condition.

g. Remove debris and surface dust from limited access spaces, including roofs, plenums, shafts, trenches, equipment vaults, manholes, attics, and similar spaces.

h. Sweep concrete floors broom clean in unoccupied spaces.

i. Vacuum carpet and similar soft surfaces, removing debris and excess nap; shampoo if visible soil or stains remain.

j. Clean transparent materials, including mirrors and glass in doors and windows. Remove glazing compounds and other noticeable, vision-obscuring materials. Replace chipped or broken glass and other damaged transparent materials. Polish mirrors and glass, taking care not to scratch surfaces.

k. Remove labels that are not permanent.

l. Touch up and otherwise repair and restore marred, exposed finishes and surfaces. Replace finishes and surfaces that cannot be satisfactorily repaired or restored or that already show evidence of repair or restoration.

    1) Do not paint over "UL" and other required labels and identification, including mechanical and electrical nameplates.

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

n. Replace parts subject to operating conditions during construction that may impede operation or reduce longevity.

o. Clean plumbing fixtures to a sanitary condition, free of stains, including stains resulting from water exposure.

p. Replace disposable air filters and clean permanent air filters. Clean exposed surfaces of diffusers, registers, and grills.

q. Clean ducts, blowers, and coils if units were operated without filters during construction or that display contamination with particulate matter upon inspection.

    1) Clean HVAC system in compliance with NADCA Standard 1992-01. Provide written report upon completion of cleaning.

r. Clean light fixtures, lamps, globes, and reflectors to function with full efficiency. Replace burned-out bulbs, and those noticeably dimmed by hours of use, and defective and noisy starters in fluorescent and mercury vapor fixtures to comply with requirements for new fixtures.

s. Leave Project clean and ready for occupancy.

3.2 USE OF EQUIPMENT BY GOVERNMENT

A. The Government may take over and operate, with Government employees, such equipment as is necessary for heating or cooling such areas of the building as require the service, as soon as the installation is sufficiently complete.

B. The Contracting Officer will advise the Contractor by letter, prior to the use of equipment, which items of equipment will be operated, and the date and time such operation will begin.

C. Government operation of equipment will not relieve the Contractor of the guarantee on materials and workmanship elsewhere provided for in this contract.

END OF SECTION 017700

SECTION 017823

OPERATION AND MAINTENANCE DATA

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 preparing operation and maintenance manuals, including the following:

1. Operation and maintenance documentation directory.
2. Emergency manuals.
3. Operation manuals for systems, subsystems, and equipment.
4. Product maintenance manuals.
5. Systems and equipment maintenance manuals.

B. Related Sections:

1. Division 01 Section "Submittal Procedures" for submitting copies of submittals for operation and maintenance manuals.
2. Divisions 02 through 49 Sections for specific operation and maintenance manual requirements for the Work in those Sections.

1.3 DEFINITIONS

A. System: An organized collection of parts, equipment, or subsystems united by regular interaction.

B. Subsystem: A portion of a system with characteristics similar to a system.

1.4 CLOSEOUT SUBMITTALS

A. Manual Content: Operations and maintenance manual content is specified in individual specification sections to be reviewed at the time of Section submittals. Submit reviewed manual content formatted and organized as required by this Section.

1. Where applicable, clarify and update reviewed manual content to correspond to modifications and field conditions.

B. Format: Submit operations and maintenance manuals in the following format:

1. PDF electronic file. Assemble each manual into a composite electronically-indexed file. Submit on digital media acceptable to COR.

   a. Name each indexed document file in composite electronic index with applicable item name. Include a complete electronically-linked operation and maintenance directory.
   b. Enable inserted reviewer comments on draft submittals.

2. Six (6) paper copies. Include a complete operation and maintenance directory. Enclose title pages and directories in clear plastic sleeves. COR will return two copies.

C. Initial Manual Submittal: Submit draft copy of each manual at least 30 days before commencing demonstration and training. COR will comment on whether general scope and content of manual are acceptable.

D. Final Manual Submittal: Submit each manual in final form prior to requesting inspection for Substantial Completion and at least 15 days before commencing demonstration and training. COR will return copy with comments.

1. Correct or modify each manual to comply with COR's comments. Submit copies of each corrected manual within 15 days of receipt of COR's comments and prior to commencing demonstration and training.

PART 2 - PRODUCTS

2.1 OPERATION AND MAINTENANCE DOCUMENTATION DIRECTORY

A. Organization: Include a section in the directory for each of the following:

1. List of documents.
2. List of systems.
3. List of equipment.
4. Table of contents.

B. The Contractor shall furnish four (4) complete sets of manuals and/or instruction booklets and spare parts catalogs with each piece of equipment furnished under this contract.

C. List of Systems and Subsystems: List systems alphabetically. Include references to operation and maintenance manuals that contain information about each system.

D. List of Equipment: List equipment for each system, organized alphabetically by system. For pieces of equipment not part of system, list alphabetically in separate list.

1. Within (10) ten calendar days after Award of Contract, and prior to the commitment for purchase of any materials and/or equipment to be utilized on this Contract, the Contractor shall submit for review and for tentative approval only, four (4) copies of a complete listing of such materials and/or equipment. The listing shall include sufficient data to identify the materials and equipment as to type, quality, sizes when applicable, and

manufacturer or source. Tentative approval of the items in the materials and equipment list will be given, however all items will be subject to final review and approval by the COR upon submittal of samples and/or shop drawings when specified. Materials and/or equipment shall not be fabricated or installed without prior approval.

E. Tables of Contents: Include a table of contents for each emergency, operation, and maintenance manual.

F. Identification: In the documentation directory and in each operation and maintenance manual, identify each system, subsystem, and piece of equipment with same designation used in the Contract Documents. If no designation exists, assign a designation according to ASHRAE Guideline 4, "Preparation of Operating and Maintenance Documentation for Building Systems."

2.2 REQUIREMENTS FOR EMERGENCY, OPERATION, AND MAINTENANCE MANUALS

A. Organization: Unless otherwise indicated, organize each manual into a separate section for each system and subsystem, and a separate section for each piece of equipment not part of a system. Each manual shall contain the following materials, in the order listed:

1. Title page.
2. Table of contents.
3. Manual contents.

B. Title Page: Include the following information:

1. Subject matter included in manual.
2. Name and address of Project.
3. Name and address of Contracting Officer.
4. Date of submittal.
5. Name and contact information for Contractor.
6. Name and contact information for COR.
7. Name and contact information for Commissioning Agent.
8. Names and contact information for major consultants to the COR that designed the systems contained in the manuals.
9. Cross-reference to related systems in other operation and maintenance manuals.

C. Table of Contents: List each product included in manual, identified by product name, indexed to the content of the volume, and cross-referenced to Specification Section number in Project Manual.

1. If operation or maintenance documentation requires more than one volume to accommodate data, include comprehensive table of contents for all volumes in each volume of the set.

D. Manual Contents: Organize into sets of manageable size. Arrange contents alphabetically by system, subsystem, and equipment. If possible, assemble instructions for subsystems, equipment, and components of one system into a single binder.

E. Manuals, Electronic Files: Submit manuals in the form of a multiple file composite electronic PDF file for each manual type required.

1. Electronic Files: Use electronic files prepared by manufacturer where available. Where scanning of paper documents is required, configure scanned file for minimum readable file size.
2. File Names and Bookmarks: Enable bookmarking of individual documents based upon file names. Name document files to correspond to system, subsystem, and equipment names used in manual directory and table of contents. Group documents for each system and subsystem into individual composite bookmarked files, then create composite manual, so that resulting bookmarks reflect the system, subsystem, and equipment names in a readily navigated file tree. Configure electronic manual to display bookmark panel upon opening file.

F. Manuals, Paper Copy: Submit manuals in the form of hard copy, bound and labeled volumes.

1. Binders: Heavy-duty, three-ring, vinyl-covered, loose-leaf binders, in thickness necessary to accommodate contents, sized to hold 8-1/2-by-11-inch paper; with clear plastic sleeve on spine to hold label describing contents and with pockets inside covers to hold folded oversize sheets.

    a. If two or more binders are necessary to accommodate data of a system, organize data in each binder into groupings by subsystem and related components. Cross-reference other binders if necessary to provide essential information for proper operation or maintenance of equipment or system.
    b. Identify each binder on front and spine, with printed title "OPERATION AND MAINTENANCE MANUAL," Project title or name, and subject matter of contents, and indicate Specification Section number on bottom of spine. Indicate volume number for multiple-volume sets.

2. Dividers: Heavy-paper dividers with plastic-covered tabs for each section of the manual. Mark each tab to indicate contents. Include typed list of products and major components of equipment included in the section on each divider, cross-referenced to Specification Section number and title of Project Manual.
3. Protective Plastic Sleeves: Transparent plastic sleeves designed to enclose diagnostic software storage media for computerized electronic equipment.
4. Supplementary Text: Prepared on 8-1/2-by-11-inch white bond paper.
5. Drawings: Attach reinforced, punched binder tabs on drawings and bind with text.

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

2.3 EMERGENCY MANUALS

A. Content: Organize manual into a separate section for each of the following:

1. Type of emergency.
2. Emergency instructions.
3. Emergency procedures.

B. Type of Emergency: Where applicable for each type of emergency indicated below, include instructions and procedures for each system, subsystem, piece of equipment, and component:

1. Fire.
2. Flood.
3. Gas leak.
4. Water leak.
5. Power failure.
6. Water outage.
7. System, subsystem, or equipment failure.
8. Chemical release or spill.

C. Emergency Instructions: Describe and explain warnings, trouble indications, error messages, and similar codes and signals. Include responsibilities of Contracting Officer's operating personnel for notification of Installer, supplier, and manufacturer to maintain warranties.

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

1. Instructions on stopping.
2. Shutdown instructions for each type of emergency.
3. Operating instructions for conditions outside normal operating limits.
4. Required sequences for electric or electronic systems.
5. Special operating instructions and procedures.

2.4 OPERATION MANUALS

A. Content: In addition to requirements in this Section, include operation data required in individual Specification Sections and the following information:

1. System, subsystem, and equipment descriptions. Use designations for systems and equipment indicated on Contract Documents.
2. Performance and design criteria if Contractor is delegated design responsibility.
3. Operating standards.
4. Operating procedures.
5. Operating logs.
6. Wiring diagrams.
7. Control diagrams.
8. Piped system diagrams.
9. Precautions against improper use.
10. License requirements including inspection and renewal dates.

B. Descriptions: Include the following:

1. Product name and model number. Use designations for products indicated on Contract Documents.
2. Manufacturer's name.

3. Equipment identification with serial number of each component.
4. Equipment function.
5. Operating characteristics.
6. Limiting conditions.
7. Performance curves.
8. Engineering data and tests.
9. Complete nomenclature and number of replacement parts.

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

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

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

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

2.5 PRODUCT MAINTENANCE MANUALS

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

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

C. Product Information: Include the following, as applicable:

1. Product name and model number.
2. Manufacturer's name.
3. Color, pattern, and texture.
4. Material and chemical composition.
5. Reordering information for specially manufactured products.

D. Maintenance Procedures: Include manufacturer's written recommendations and the following:

1. Inspection procedures.
2. Types of cleaning agents to be used and methods of cleaning.

3. List of cleaning agents and methods of cleaning detrimental to product.
4. Schedule for routine cleaning and maintenance.
5. Repair instructions.

E. Repair Materials and Sources: Include lists of materials and local sources of materials and related services.

F. Warranties and Bonds: Include copies of warranties and bonds and lists of circumstances and conditions that would affect validity of warranties or bonds.

1. Include procedures to follow and required notifications for warranty claims.

2.6 SYSTEMS AND EQUIPMENT MAINTENANCE MANUALS

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

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

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

1. Standard maintenance instructions and bulletins.
2. Drawings, diagrams, and instructions required for maintenance, including disassembly and component removal, replacement, and assembly.
3. Identification and nomenclature of parts and components.
4. List of items recommended to be stocked as spare parts.

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

1. Test and inspection instructions.
2. Troubleshooting guide.
3. Precautions against improper maintenance.
4. Disassembly; component removal, repair, and replacement; and reassembly instructions.
5. Aligning, adjusting, and checking instructions.
6. Demonstration and training video recording, if available.

E. Maintenance and Service Schedules: Include service and lubrication requirements, list of required lubricants for equipment, and separate schedules for preventive and routine maintenance and service with standard time allotment.

1. Scheduled Maintenance and Service: Tabulate actions for daily, weekly, monthly, quarterly, semiannual, and annual frequencies.

2. Maintenance and Service Record: Include manufacturers' forms for recording maintenance.

F. Spare Parts List and Source Information: Include lists of replacement and repair parts, with parts identified and cross-referenced to manufacturers' maintenance documentation and local sources of maintenance materials and related services.

G. Maintenance Service Contracts: Include copies of maintenance agreements with name and telephone number of service agent.

H. Warranties and Bonds: Include copies of warranties and bonds and lists of circumstances and conditions that would affect validity of warranties or bonds.

1. Include procedures to follow and required notifications for warranty claims.

PART 3 - EXECUTION

3.1 MANUAL PREPARATION

A. Operation and Maintenance Documentation Directory: Prepare a separate manual that provides an organized reference to emergency, operation, and maintenance manuals.

B. Emergency Manual: Assemble a complete set of emergency information indicating procedures for use by emergency personnel and by Contracting Officer's operating personnel for types of emergencies indicated.

C. Product Maintenance Manual: Assemble a complete set of maintenance data indicating care and maintenance of each product, material, and finish incorporated into the Work.

D. Operation and Maintenance Manuals: Assemble a complete set of operation and maintenance data indicating operation and maintenance of each system, subsystem, and piece of equipment not part of a system.

1. Engage a factory-authorized service representative to assemble and prepare information for each system, subsystem, and piece of equipment not part of a system.
2. Prepare a separate manual for each system and subsystem, in the form of an instructional manual for use by Contracting Officer's operating personnel.

E. Manufacturers' Data: Where manuals contain manufacturers' standard printed data, include only sheets pertinent to product or component installed. Mark each sheet to identify each product or component incorporated into the Work. If data include more than one item in a tabular format, identify each item using appropriate references from the Contract Documents. Identify data applicable to the Work and delete references to information not applicable.

1. Prepare supplementary text if manufacturers' standard printed data are not available and where the information is necessary for proper operation and maintenance of equipment or systems.

F. Drawings: Prepare drawings supplementing manufacturers' printed data to illustrate the relationship of component parts of equipment and systems and to illustrate control sequence and flow diagrams. Coordinate these drawings with information contained in record Drawings to ensure correct illustration of completed installation.

1. Do not use original project record documents as part of operation and maintenance manuals.
2. Comply with requirements of newly prepared record Drawings in Division 01 Section "Project Record Documents."

G. Comply with Division 01 Section "Closeout Procedures" for schedule for submitting operation and maintenance documentation.

END OF SECTION 017823

SECTION 017839

PROJECT RECORD DOCUMENTS

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 project record documents, including the following:

1. Record Drawings.
2. Record Specifications.
3. Record Product Data.
4. Miscellaneous record submittals.

B. Related Sections:

1. Division 01 Section "Execution" for final property survey.
2. Division 01 Section "Closeout Procedures" for general closeout procedures.
3. Division 01 Section "Operation and Maintenance Data" for operation and maintenance manual requirements.
4. Divisions 02 through 49 Sections for specific requirements for project record documents of the Work in those Sections.

1.3 CLOSEOUT SUBMITTALS

A. Record Drawings: Comply with the following:

1. Number of Copies: Submit one set(s) of marked-up record prints.
2. Number of Copies: Submit copies of record Drawings as follows:

a. Initial Submittal: Submit one paper copy set of marked-up record prints and one set(s) of plots from corrected record digital data files. COR will indicate whether general scope of changes, additional information recorded, and quality of drafting are acceptable.
b. Final Submittal: Submit one paper copy set of marked-up record prints, and one set(s) of record digital data file plots.

B. Record Specifications: Submit one paper copy of Project's Specifications, including addenda and contract modifications.

C. Record Product Data: Submit one paper copy of each submittal.

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

D. Miscellaneous Record Submittals: Refer to other Specification Sections for miscellaneous record-keeping requirements and submittals in connection with various construction activities. Submit one paper copy of each submittal.

E. Reports: Submit written report indicating items incorporated in Project record documents concurrent with progress of the Work, including modifications, concealed conditions, field changes, product selections, and other notations incorporated.

PART 2 - PRODUCTS

2.1 RECORD DRAWINGS

A. Record Prints: Maintain one set of marked-up paper copies of the Contract Drawings and Shop Drawings.

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

a. Give particular attention to information on concealed elements that would be difficult to identify or measure and record later.
b. Accurately record information in an acceptable drawing technique.
c. Record data as soon as possible after obtaining it.
d. Record and check the markup before enclosing concealed installations.
e. Cross-reference record prints to corresponding archive photographic documentation.

2. Content: Types of items requiring marking include, but are not limited to, the following:

a. Dimensional changes to Drawings.
b. Revisions to details shown on Drawings.
c. Depths of foundations below first floor.
d. Locations and depths of underground utilities.
e. Revisions to routing of piping and conduits.
f. Revisions to electrical circuitry.
g. Actual equipment locations.
h. Duct size and routing.
i. Locations of concealed internal utilities.
j. Changes made by Change Order or Construction Change Directive.
k. Changes made following COR's written orders.
l. Details not on the original Contract Drawings.
m. Field records for variable and concealed conditions.
n. Record information on the Work that is shown only schematically.

3. Mark the Contract Drawings and Shop Drawings completely and accurately. Utilize personnel proficient at recording graphic information in production of marked-up record prints.
4. Mark record sets with erasable, red-colored pencil. Use other colors to distinguish between changes for different categories of the Work at same location.
5. Mark important additional information that was either shown schematically or omitted from original Drawings.
6. Note Construction Change Directive numbers, alternate numbers, Change Order numbers, and similar identification, where applicable.

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

1. Format: Same digital data software program, version, and operating system as the original Contract Drawings.
2. Format: Annotated PDF electronic file with comment function enabled.
3. Incorporate changes and additional information previously marked on record prints. Delete, redraw, and add details and notations where applicable.
4. Refer instances of uncertainty to COR for resolution.
5. COR will furnish Contractor one set of digital data files of the Contract Drawings for use in recording information.

    a. Refer to Division 01 Section "Submittal Procedures" for requirements related to use of COR's digital data files.
    b. COR will provide data file layer information. Record markups in separate layers.

2.2 RECORD SPECIFICATIONS

A. Preparation: Mark Specifications to indicate the actual product installation where installation varies from that indicated in Specifications, addenda, and contract modifications.

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

B. Format: Submit record Specifications as annotated PDF electronic file, paper copy, and scanned PDF electronic file(s) of marked up paper copy of Specifications.

2.3 MISCELLANEOUS RECORD SUBMITTALS

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

B. Format: Submit miscellaneous record submittals as PDF electronic file, paper copy, and scanned PDF electronic file(s) of marked up miscellaneous record submittals.

1. Include miscellaneous record submittals directory organized by specification section number and title, electronically linked to each item of miscellaneous record submittals.

PART 3 - EXECUTION

3.1 RECORDING AND MAINTENANCE

A. Recording: Maintain one copy of each submittal during the construction period for project record document purposes. Post changes and modifications to project record documents as they occur; do not wait until the end of Project.

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

END OF SECTION 017839

SECTION 018200

DEMONSTRATION AND TRAINING

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

A. This Section includes administrative and procedural requirements for instructing NIST operation and maintenance personnel, including the following:
   1. Demonstration of operation of systems, subsystems, and equipment.
   2. Training in operation and maintenance of systems, subsystems, and equipment.

B. This specification section is related to any and all specification sections with explicit or implicit reference to demonstration and training including but not limited to the following Division 1 specification sections:
   1. Division 1 Section "Summary"
   2. Division 1 Section "Project Management and Coordination"
   3. Division 1 Section "Construction Progress Documentation"
   4. Division 1 Section "Quality Requirements"
   5. Division 1 Section "Closeout Procedures"
   6. Division 1 Section "Project Record Documents"
   7. Division 1 Section "Operation and Maintenance Documents"

1.3 SUBMITTALS

A. Instruction Program: Prior to the Pre-final Inspection, submit 2 copies of the outline of the proposed instructional program for demonstration and training to the CORr. Including training modules to be included, a schedule of proposed dates, times, length of instruction time, instructors' names for each training module, and learning objective and outline for each training module.
   1. At completion of training, submit 2 complete training manuals for NIST use.

B. Training Modules. Submit 2 draft copies to the CORr of training modules as described in this section 14 calendar days prior to the start of training.
   1. NIST will provide review comments within 7 calendar days of receipt of the draft module.
   2. All draft modules are to be submitted to the CORr prior to Final Inspection.

C. Qualification Data: For facilitator and instructors, to demonstrate their capabilities and experience, include lists of completed projects with project names and addresses, names and addresses of architects and owners, and other information specified.

D. Attendance Record: For each training module, submit list of participants and length of instruction time.

E. Evaluations: For each participant and for each training module, submit results and documentation of performance-based test.

1.4 QUALIFICATIONS

A. Facilitator Qualifications: A firm or individual experienced in training or educating maintenance personnel in a training program similar in content and extent to that required for this project, and whose work has resulted in training or education with a record of successful learning performance.

B. Instructor Qualifications: A factory-authorized service representative, experienced in operation and maintenance procedures and training.
   1. Instructor shall meet or exceed any specific qualifications or experience requirements indicated in the Division 2-16 technical specification sections for the specific system, subsystem, or equipment that is the subject of the training or demonstration.

1.5 PREINSTRUCTION CONFERENCE

A. The Contractor, facilitator, and instructors shall conduct a conference at the project site to review methods and procedures related to demonstration and training including, but not limited to, the following:
   1. Inspect and discuss locations and other facilities required for instruction.
   2. Review and finalize instruction schedule and verify availability of educational materials, instructors' personnel, audiovisual equipment, and other facilities.
   3. Review required content of instruction.
   4. For instruction that must occur outside, review weather and forecasted weather conditions and procedures to follow if conditions are unfavorable.

1.6 COORDINATION

A. Coordinate instruction schedule with the CORr. Be prepared to adjust schedule as required to minimize disrupting NIST operations.

B. Coordinate instructors, including providing notification of dates, times, length of instruction time, and course content.

C. Coordinate content of training modules with content of approved emergency, operation, and maintenance manuals. Do not submit instruction program module until operation and maintenance data or manual(s) as required for the equipment in the module have been reviewed and approved by the Contracting Officer.

PART 2 - PRODUCTS

2.1 INSTRUCTION PROGRAM

A. Program Structure: Develop an instruction program that includes individual training modules for each system and for equipment not part of a system, as required by individual Division 2-16 technical specification sections:

B. Training Modules: Develop and submit written learning objective and teaching outlines for each module. Include a description of specific skills and knowledge that participant is expected to master. For each module, include instruction for the following:
   1. Basis of System Design, Operational Requirements, and Criteria: Include the following:
      a. System, subsystem, and equipment descriptions.
      b. Performance and design criteria if Contractor is delegated design responsibility.
      c. Operating standards.
      d. Regulatory requirements.
      e. Equipment function.
      f. Operating characteristics.
      g. Limiting conditions.
      h. Performance curves.
   2. Documentation: Review the following items in detail:
      a. Emergency manuals.
      b. Operations manuals.
      c. Maintenance manuals.
      d. Project Record Documents.
      e. Identification systems.
      f. Warranties and bonds.
      g. Maintenance service agreements and similar continuing commitments.
   3. Emergencies: Include the following, as applicable:
      a. Instructions on meaning of warnings, trouble indications, and error messages.
      b. Instructions on stopping.
      c. Shutdown instructions for each type of emergency.
      d. Operating instructions for conditions outside of normal operating limits.
      e. Sequences for electric or electronic systems.
      f. Special operating instructions and procedures.
   4. Operations: Include the following, as applicable:
      a. Startup procedures.
      b. Equipment or system break-in procedures.
      c. Routine and normal operating instructions.
      d. Regulation and control procedures.
      e. Control sequences.
      f. Safety procedures.
      g. Instructions on stopping.
      h. Normal shutdown instructions.
      i. Operating procedures for emergencies.
      j. Operating procedures for system, subsystem, or equipment failure.
      k. Seasonal and weekend operating instructions.
      l. Required sequences for electric or electronic systems.
      m. Special operating instructions and procedures.
   5. Adjustments: Include the following:
      a. Alignments.
      b. Checking adjustments.
      c. Noise and vibration adjustments.
      d. Economy and efficiency adjustments.
   6. Troubleshooting: Include the following:
      a. Diagnostic instructions.
      b. Test and inspection procedures.
   7. Maintenance: Include the following:
      a. Inspection procedures.

b. Types of cleaning agents to be used and methods of cleaning.
c. List of cleaning agents and methods of cleaning detrimental to product.
d. Procedures for routine cleaning
e. Procedures for preventive maintenance.
f. Procedures for routine maintenance.
g. Instruction on use of special tools.

8. Repairs: Include the following:
   a. Diagnosis instructions.
   b. Repair instructions.
   c. Disassembly; component removal, repair, and replacement; and reassembly instructions.
   d. Instructions for identifying parts and components.
   e. Review of spare parts needed for operation and maintenance.

C. Training modules can be developed and submitted separately however they must be designed to be compiled into a comprehensive training program. The training program submission will not be complete until the final module has been submitted, reviewed, and approved.

PART 3 - EXECUTION

3.1 PREPARATION

A. Assemble educational materials necessary for instruction, including documentation and training. Assemble training modules into a combined training manual.

B. Set up instructional equipment at instruction location.

3.2 INSTRUCTION

A. Engage a qualified facilitator to prepare instruction program and training modules, to coordinate instructors, and to coordinate between Contractor and NIST for number of participants, instruction times, and location.

B. Contractor provided Instruction: Engage qualified instructors to instruct NIST personnel to adjust, operate, and maintain systems, subsystems, and equipment not part of a system.

C. The Contracting Officer will furnish the Contractor with the names and positions of NIST participants.

D. Scheduling: Provide instruction at mutually agreed on times. For equipment that requires seasonal operation, provide similar instruction at start of each season.
   1. Schedule training with the CORr at least 7 days' in advance.

E. Evaluation: At conclusion of each training module, assess and document each participant's mastery of the module by use of an written or demonstration performance-based test.

F. Cleanup: Collect and remove used and leftover educational materials. Remove instructional equipment. Restore systems and equipment to condition existing before initial training use.

END OF SECTION 018200

SECTION 230500

COMMON WORK RESULTS FOR HVAC

PART 1 - GENERAL

1.1 SUMMARY

A. This Section includes the following:

1. HVAC demolition.
2. Equipment installation requirements common to equipment sections.

1.2 DEFINITIONS

A. Finished Spaces: Spaces other than mechanical and electrical equipment rooms, furred spaces, pipe and duct chases, unheated spaces immediately below roof, spaces above ceilings, unexcavated spaces, crawlspaces, and tunnels.

B. Exposed, Interior Installations: Exposed to view indoors. Examples include finished occupied spaces and mechanical equipment rooms.

C. Exposed, Exterior Installations: Exposed to view outdoors or subject to outdoor ambient temperatures and weather conditions. Examples include rooftop locations.

D. Concealed, Interior Installations: Concealed from view and protected from physical contact by building occupants. Examples include above ceilings and chases.

E. Concealed, Exterior Installations: Concealed from view and protected from weather conditions and physical contact by building occupants but subject to outdoor ambient temperatures. Examples include installations within unheated shelters.

1.3 QUALITY ASSURANCE

A. Electrical Characteristics for HVAC Equipment: Equipment of higher electrical characteristics may be furnished provided such proposed equipment is approved in writing and connecting electrical services, circuit breakers, and conduit sizes are appropriately modified. If minimum energy ratings or efficiencies are specified, equipment shall comply with requirements.

PART 2 - PRODUCTS

PART 3 - EXECUTION

3.1 HVAC DEMOLITION

A. Refer to Division 01 Section "Cutting and Patching" and Division 02 Section "Selective Structure Demolition" for general demolition requirements and procedures.

B. Disconnect, demolish, and remove HVAC systems, equipment, and components indicated to be removed.

1. Piping to Be Removed: Remove portion of piping indicated to be removed and cap or plug remaining piping with same or compatible piping material.
2. Piping to Be Abandoned in Place: Drain piping and cap or plug piping with same or compatible piping material.
3. Ducts to Be Removed: Remove portion of ducts indicated to be removed and plug remaining ducts with same or compatible ductwork material.
4. Ducts to Be Abandoned in Place: Cap or plug ducts with same or compatible ductwork material.
5. Equipment to Be Removed: Disconnect and cap services and remove equipment.
6. Equipment to Be Removed and Reinstalled: Disconnect and cap services and remove, clean, and store equipment; when appropriate, reinstall, reconnect, and make equipment operational.
7. Equipment to Be Removed and Salvaged: Disconnect and cap services and remove equipment and deliver to Owner.

C. If pipe, insulation, or equipment to remain is damaged in appearance or is unserviceable, remove damaged or unserviceable portions and replace with new products of equal capacity and quality.

3.2 EQUIPMENT INSTALLATION - COMMON REQUIREMENTS

A. Install equipment to allow maximum possible headroom unless specific mounting heights are not indicated.

B. Install equipment level and plumb, parallel and perpendicular to other building systems and components in exposed interior spaces, unless otherwise indicated.

C. Install HVAC equipment to facilitate service, maintenance, and repair or replacement of components. Connect equipment for ease of disconnecting, with minimum interference to other installations. Extend grease fittings to accessible locations.

D. Install equipment to allow right of way for piping installed at required slope.

END OF SECTION 230500

SECTION 230923

NIST DIRECT DIGITAL CONTROL SYSTEMS SPECIFICATION

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1.0 PART 1 GENERAL

1.1 REFERENCES

The publications listed below form a part of this specification to the extent referenced. The publications are referred to in the text by the basic designation only.

AMERICAN NATIONAL STANDARDS INSTITUTE (ANSI)

ANSI C12.10	(1997) Electromechanical Watt-hour Meters
ANSI C57.13	(1993) IEEE Standard Requirements for Instrument Transformers

AMERICAN SOCIETY OF HEATING, REFRIGERATING, AND AIR-CONDITIONING ENGINEERS (ASHRAE)

ANSI/ASHRAE 135	(2001) BACnet
ANSI/ASHRAE 135.1	(2003) Method of Test for Conformace to BACnet

AMERICAN SOCIETY OF MECHANICAL ENGINEERS (ASME)

ASME B16.5	(1996) Pipe Flanges and Flanged Fitting NPS 1/2 Through NPS 24
ASME B16.18	(2002) Cast Copper Alloy Solder Joint Pressure Fittings
ASME B16.22	(2002) Wrought Copper and Copper Alloy Solder Joint Pressure Fittings
ASME B16.26	(1988) Cast Copper Alloy Fittings for Flared Copper Tubes
ASME B16.34	(1996) Valves - Flanged, Threaded, and Welding End
ASME B31.1	(2001) Power Piping
ASME B40.1	(1991; Special Notice 1992) Gauges -Pressure Indicating Dial Type - Elastic Element
ASME BPVC SEC VIII	(1995; Addenda 1995) Boiler and Pressure Vessel Codes: Section VIII Pressure Vessels

AMERICAN SOCIETY FOR TESTING AND MATERIALS (ASTM)

ASTM A 126	(1995; R 2001) Gray Iron Castings for Valves, Flanges, and Pipe Fittings
ASTM B 32	(2000e1) Solder Metal
ASTM B 75	(2002) Seamless Copper Tube
ASTM B 88	(2002) Seamless Copper Water Tube
ASTM D 635	(1998) Rate of Burning and/or Extent and Time of Burning of Self-Supporting Plastics in a Horizontal Position
ASTM D 638	(2002) Tensile Properties of Plastics
ASTM D 792	(2000) Density and Specific Gravity (Relative Density) of Plastics by Displacement
ASTM D 1238	(2001e1) Melt Flow Rates of Thermoplastics by Extrusion Plastometer
ASTM D 1693	(2001) Environmental Stress-Cracking of Ethylene Plastics

INSTITUTE OF ELECTRICAL AND ELECTRONICS ENGINEERS (IEEE)

IEEE C62.41	(1991) Surge Voltages in Low-Voltage AC Power Circuits
IEEE C62.45	(1992) Surge Testing for Equipment Connected to Low-Voltage AC Power Circuits

NATIONAL FIRE PROTECTION ASSOCIATION (NFPA)

NFPA 70	(2013) National Electrical Code
NFPA 90A	(1999) Installation of Air Conditioning and Ventilating Systems

SHEET METAL & AIR CONDITIONING CONTRACTORS' NATIONAL ASSOCIATION (SMACNA)

SMACNA HVAC Duct Const Stds	(1995; Addendum Nov 1997; 6th Printing 2001) HVAC Duct Construction Standards - Metal and Flexible
SMACNA HVACTAB	(1993; 3rd Printing 1999) HVAC Systems Testing, Adjusting and Balancing

UNDERWRITERS LABORATORIES (UL)

UL 506 (2000) Specialty Transformers

UL 508A (2001; R 2003) Industrial Control Panels

UL 916 (1998) Energy Management Equipment

UL 1449 (1996; Rev thru Nov 2001) Transient Voltage Surge Suppressors

1.2 DEFINITIONS

1.2.1 ANSI/ASHRAE Standard 135-2001

ANSI/ASHRAE Standard 135-2001: BACnet - A Data Communication Protocol for Building Automation and Control Networks, as amended, and hereinafter referred to as "BACnet". American Society of Heating, Refrigerating and Air-Conditioning Engineers, Inc. 2001. BACnet was developed by an ASHRAE sponsored committee to provide a universal means by which diverse building automation devices from various manufacturers can communicate and share data within the same internetwork. While BACnet enables multi-vendor interoperability, it in no way requires it. BACnet was designed to provide a single, uniform standard for building control systems.

1.2.2 BACnet Device

Any device, real or virtual, that supports digital communications using the BACnet protocol. A BACnet control system can contain up to 4,194,305 devices. This constraint is because each device must have a unique value for the Object Identifier property of the Device object. This uniqueness is the basis for BACnet services that permit dynamic location of information and binding of addresses (the process of determining how to address a message to communicate with a particular device).

1.2.3 BACnet Objects

BACnet objects form a means to exchange data information stored in BACnet devices, regardless of vendor, by making this information "network-visible" in a standardized way. Currently, there are 21 standard object types.

1.2.4 BAS

Building Automation Systems for purposes of this specification is limited to DDC used for HVAC.

1.2.5 BAS Owner

The BAS Owner is the agent responsible for managing the operation of the BAS system including coordination of BAS network connections; managing the workstation, web-server and notebook computer hardware and software; managing interface tools; maintaining passwords; providing technical support for maintenance personnel; assisting with the review of submittals; and participating in the Performance Verification Testing. The BAS Owner is National Institute of Standards and Technology.

1.2.6 Baud Rate

Baud rate refers to the speed (measured in bits per second) at which serial information is transmitted or received. 9600 baud means 9600 bits per second while 10 M baud (mega baud) means 10,000,000 bits per second.

1.2.7 BBMD

BACnet Broadcast Management Device

1.2.8 BIBB

BACnet Interoperability Building Blocks. A collection of one or more BACnet services defined for the purpose of describing communication functionality in an unambiguous way. These are prescribed in terms of an "A" and a "B" device. Both of these devices are nodes on a BACnet internetwork. In most cases, the “A” device will act as the user of data and the “B” device will be the provider of this data. In addition, certain BIBBs may also be predicated on the support of certain, otherwise optional, BACnet objects or properties and may place constraints on the allowable values of specific properties or service parameters.

1.2.9 BMA

BACnet Manufacturers Association. The BMA can be reached on the internet at http://www.bacnetassociation.org.

1.2.10 BTL

The BACnet Testing Laboratories of the BMA. The organization responsible for testing products to assure they conform to the BACnet standard. Listings of tested products are available on the internet at http://www.bacnetassociation.org.

1.2.11 Bridge

A device that connects two or more segments at the physical and data link areas. This device may also perform message filtering based upon MAC layer address.

1.2.12 COR

Contracting Officer Representative is a Government employee assigned by the Contracting Officer to monitor the contract and to provide technical assistance.

1.2.13 Device Profile

A collection of BIBB's that describes the minimum BACnet capabilities of a device for reliable communication in one of five specified "interoperability areas." Devices include BACnet Building Controllers B-BC), BACnet Advanced Application Controllers (B-AAC), BACnet Application Specific Controllers (B-ASC), BACnet Smart Actuator (B-SA), and BACnet Smart Sensor (B-SS).

1.2.14 Digital Controller

A control module which is microprocessor based, programmable by the user, has integral input/output within the module or on network connected modules, and performs stand-alone operations.

1.2.15 Direct Digital Control

Direct digital control, or DDC, as defined in this specification, performs control logic through modulating control of an output device by means of a digital computer. The controller directly senses building environment and makes control decisions based on user defined, controller resident programs. The controller outputs control signals that directly operate valves, dampers, and motor controllers. No conventional control devices, pneumatic or electronic, such as receiver-controllers, thermostats, and logic units are present within or interface with a direct digital control loop. Actuators are electric or pneumatic, and the controller output is converted to the appropriate

type of signal.

1.2.16 DDC System

A system made up of one or more digital controllers communicating on a network.

1.2.17 Distributed Control

In distributed control, stand-alone controllers are installed near their respective controlled equipment. The controllers can perform the required climate control and most energy management functions without connection to another digital controller, central panel, or DDC workstation. See definition for stand-alone control.

1.2.18 Ethernet

A LAN carrier sensing multiple access with collision detection network technology defined by ISO/IEC 8802-3.

1.2.19 Firmware

Firmware is software programmed into read only memory (ROM) and erasable programmable read only memory (EPROM) chips. Software may not be changed without physically altering the chip.

1.2.20 Gateway

A gateway is a single device that translates between BACnet and non-BACnet communication protocols, permitting the exchange of information. Gateway for the purposes of this specification section is synonymous with "BACnet Gateway (B-GW). NIST will not permit the use of “Gateway’s”.

1.2.21 Half Router

A device or node that can participate as one partner in a PTP connection. The two half-router partners that form an active PTP connection make up a single router.

1.2.22 HVAC

Heating, Ventilation, and Air Conditioning

1.2.23 Internetwork

A set of two or more BACnet networks interconnected by routers.

1.2.24 Interoperability Areas

A communications domain in which cooperation is desired. These areas are currently: 1) data sharing; 2) alarm and event management; 3) trending; 4) scheduling; and 5) device and network management.

1.2.25 Input/Output or I/O Objects

I/O objects refer to analog inputs (AI), binary inputs (BI), analog outputs (AO), and binary outputs (BO) in a digital controller. Another term for binary inputs and outputs is digital input

and output points. Inputs are from analog sensors (temperature, pressure, humidity, flow) and digital sensors (motor status, flow switches, switch position, and pulse output devices). Outputs operate modulating and on/off control devices.

1.2.26 I/O Expansion Unit

An I/O expansion unit provides additional point capacity to a digital controller and communicates with the stand-alone digital controller on a LAN. An I/O expansion unit is not stand-alone because the control program does not reside in the I/O expansion unit; however, an I/O expansion unit which connects directly to a stand-alone controller through a multi-line microprocessor bus and resides within 3 feet of the stand-alone controller is considered part of the stand-alone controller.

1.2.27 IP

(Internet Protocol) A networking protocol originally developed by the Federal Defense Advanced Research Projects Agency. BACnet messages can traverse the campus network when encapsulated in routable IP packets.

1.2.28 LAN

(Local Area Network) LAN's permit sharing global information. This allows building and site wide control strategies such as operating schedules, peak demand limiting, dynamic control strategies, coordinated response to alarm conditions, and remote monitoring and programming of digital controllers including OEM digital interfaces to HVAC equipment that are connected to the DDC system.

1.2.29 MAC Address

(Medium Access Control Address) A numeric value used to uniquely identify a computer node on a LAN or other network.

1.2.30 Microprocessor

A microprocessor refers to the central processing unit (CPU) that contains all registers and logic circuitry that allow digital controllers to function.

1.2.31 MS/TP

Master-Slave/Token-Passing Network. One of the approved BACnet LANs.

1.2.32 Network

One of the communication technologies for data communications specified in BACnet. Approved network technologies are Ethernet and MS/TP.

1.2.33 Output Signal Conversion

Output signal conversion refers to changing one kind of control output into a proportionally related signal appropriate for direct actuation of the controlled device. An example is converting a 4 to 20 mA or 0 to 10 VDC signal to a proportional 3 to 15 psig signal to operate a pneumatic actuator.

1.2.34 Optimum Start

Optimum start is a method of starting HVAC equipment prior to scheduled occupancy in order to have the building at setpoint when the building or spaces first become occupied. Optimum start is based on zone temperatures, zone setpoints, outdoor temperature and the equipment's ability to heat or cool the space. Typically, the control logic determines the best start time based on the prior day's performance and using historical data.

1.2.35 Peer-to-Peer

Peer-to-peer refers to controllers connected on a communications LAN that act independently, as equals, and communicate with each other to pass information.

1.2.36 Performance Verification Tests

The Performance Verification Tests or PVT is the procedure for determining if the installed BAS meets the performance design criteria prior to final acceptance. The PVT is also used to check some aspects of conformance, such as labeling and tagging of controllers. The PVT is performed after installation, testing and balancing of any HVAC mechanical systems. The administering of the PVT is performed by the Contractor and witnessed/approved by the Government. The spreadsheet format for reporting results of the PVT is developed by the Contractor using the criteria provided in the specification. This report is a very technical and detailed summary of the as-installed condition of the control system. The PVT is to be developed and submitted three weeks prior to expected use. Once approved by the COR/DDC Administrator, the PVT may then be used.

1.2.37 PI

PI refers to proportional and integral control; the two types of actions that are used in controlling modulating equipment.

PRAC Tuning is not acceptable.

1.2.38 PICS

Protocol Implementation Conformance Statements or PICS describe the BACnet capabilities of a specific device.

1.2.39 PTP

Point-to-Point protocol or PTP is a method to interconnect individual BACnet devices or networks using serial asynchronous connections such as those provided by dial-up modem-to-modem links. The devices on either end of the PTP connection act as "half-routers" and once the connection is established, appears as routers to devices on their respective networks.

1.2.40 Resolution

Refers to the number of possible states an input value or output value can take and is a function of the digital controller I/O circuitry; the A/D converter for input and the D/A converter for output. Ten bit resolution has 1024 possible states.

1.2.41 Router

A router is a device that joins together two or more networks that use different LAN technologies such as a BACnet Ethernet LAN to a BACnet MS/TP LAN. It may also join networks of the same technology within the BACnet protocol.

1.2.42 Stand-alone Control

Digital controller performing required climate control, and most energy management functions without connection to another digital controller, central panel or DDC workstation. On a loss of communication, the stand-alone controller provides stable and reliable control using default values or other methods for values normally read over the network. The ability for a controller to stand-alone requires careful programming to ensure it can maintain control while not connected to the network. Stand-alone control does not require that shared variables common to all controllers such as outside air temperature, schedules, trending, or load demand strategies reside directly in every field controller as these functions may be managed at the BACnet Building Controller (B-BC) level.

1.2.43 Trending vs. Plotting

Trending is the accumulation of (time, value) data pairs at specified rates for a specified duration. Trends are distinguished from real-time plotting of data by the fact that the data are destined for long-term storage.

1.2.44 UDP

(User Datagram Protocol) One of the IP family of protocols. UDP is used to convey BACnet/IP messages and is characterized by a "port number" for each protocol. BACnet/IP typically uses UDP port X'BAC0' or decimal 47808.

1.2.45 VLAN

(Virtual Local Area Network) A network configuration that allows devices to communicate across multiple physical local area networks or LANs using their hardware or MAC addresses as if they shared a common networking medium. As with a physical LAN, "local" broadcast messages are also propagated to each of the participating LANs. VLAN capability depends on the configuration of the interconnecting data communication equipment.

1.3 DDC SYSTEM DESCRIPTION

a. Modify existing DDC systems including associated equipment and accessories. The DDC system shall use BACnet communications without the use of gateways unless gateways are specifically shown on the drawings. When gateways are incorporated into the design, the system shall be configured to provide complete exposure of all non-BACnet data to the BACnet workstation. The server and any connected BACnet workstation shall be configured and licensed in such a way that permits a minimum of 3 simultaneous users. However, licensing shall be adequate to allow for no less than 15 users. Manufacturer’s products, including design, materials, fabrication, assembly, erection, examination, inspection, and testing shall be in accordance with ANSI/ASHRAE 135, ANSI/ASHRAE 135.1, ASME B31.1 and NFPA 70, except as modified herein or indicated otherwise.

Permitted applications are only Alerton. Only exception for NIST Gaithersburg will be expansion of existing Andover applications, however no new Andover devices will be permitted.

1.3.1 Design Requirements

1.3.1.1 Drawing Requirements

Drawing shall meet the Standards and CADD requirements in “NIST Gaithersburg CADD Standards and Procedures – August 2013”.

1.3.1.2 Control System Schematic

Provide control system schematics that include the following:

a. Indicate physical location of each smoke detector and each piece of related HVAC equipment.

b. Flow diagram of each HVAC component, for instance flow through coils, fans, and dampers.

Mechanical Flow Drawing: Show relative position of all individual HVAC components, controller inputs (temperature sensors, pressure sensors, equipment proofs, override buttons, etc.), controller outputs (actuators, valves, dampers, etc.), and hard-wired safeties (smoke detectors and freeze protection thermostats).

c. Name or symbol for each component.

d. For each system show a detailed points list.

e. Schedule identifying each sensor and controlled device with the following information:

i. LAN and Software point name with send and receive address if applicable.

ii. Point type: AO - Analog Output, AI - Analog Input, BO - Binary Output, BI - Binary Input, AV - Analog Variable, BV - Binary Variable

iii. Point range for AI's and AO's

iv. Digital controller number for each point

1.3.1.3 Electrical Equipment Ladder Diagrams

Electric Elementary/Ladder Diagrams: Show line and control circuitry, motor starters, motor loads, control device actuators, manual and automatic switches, interlocks, and control sensors. Indicate dedicated power sources as required for individual DDC panels.

1.3.1.4 Component Wiring Diagrams

Provide a wiring diagram for each type of input device and each type of output device. Diagram shall show how the device is wired and powered; showing typical connections at the digital controller and each power supply, as well as at the device itself. Show for all field connected devices, including, but not limited to, control relays, motor starters, electric or electronic

actuators, and temperature, pressure, flow, proof, and humidity sensors and transmitters.

1.3.1.5 Communication Architecture Schematic

Submit a schematic showing communication networks path and location used for all DDC system controllers, workstations, network switches, routers, bridges, gateways, UPS equipment, and field interface devices. The contractor is to coordinate the existing site schematic format with NIST COR/DDC Administrator and adopt accordingly.

1.4 SUBMITTALS

Submit manufacturers' specification sheets for each type of equipment to show compliance with the project specification. Highlight each compliance item and reference each item to the relevant specification paragraph number. Submit sufficient manufacturers' information to allow verification of compliance by the reviewing authority. Equipment and software specification compliance data submitted includes, but is not limited to, the following:

1.4.1 Preconstruction Submittals

List of Drawings

List of Symbols and Abbreviations Used on Drawings

List of all Points

Equipment Components List

1.4.2 Shop Drawings

Control system schematics

Ladder diagrams

Component wiring diagrams

Communication architecture schematics

1.4.3 Product Data

Direct Digital Controllers

DDC software

BACnet Operator Workstation

Gateways

BACnet Protocol Analyzer

Input devices

Output devices

Surge and transient protection

Workstation Hardware Manuals

Maintenance Personnel Interface Tools

Pneumatic tubing

1.4.4 Test Reports

Performance Verification Tests

1.4.5 Certificates

Contractors' Qualifications

Manufacturer's Controller Warranty

Training

1.4.6 Operation and Maintenance Data

Control System Operators Manual

DDC Manufacturer's Hardware and Software Manuals

1.4.7 Closeout Submittals

Posted operating instructions:

AC Power Table

Provide administrative and closeout submittals:

Training course documentation

Service organizations

Contractor certification

1.5 OPERATING ENVIRONMENT

Protect components from humidity and temperature variations, dust, and other contaminants, within limits published by the manufacturer.

1.6 QUALITY ASSURANCE

1.6.1 Standard Products

All materials and equipment shall be UL Listed and standard products of a manufacturer regularly engaged in the manufacturing of such products, currently in production. All products furnished shall be supported by a local factory service organization.

1.6.2 Nameplates and Tags

Provide a metal aluminum or brass nameplate with block lettering permanently attached to each

control cabinet, indicating its name, function, and drawing number reference. For each field-installed control system
component, provide a metal aluminum or brass heavy-duty tag for use in industrial environments, permanently attached to each component using link brass chain for attachment, with high visibility engraved or stamped lettering. Each label shall show the associated equipment name and point identifier.

1.6.3 Verification of Dimensions

The contractor shall verify all dimensions in the field, and shall advise the COR of any discrepancy before performing work.

1.6.4 Drawings

Because of the small scale of the drawings, it is not possible to indicate all offsets, fittings, and accessories that may be required. The Contractor shall carefully investigate the mechanical, electrical, and finish conditions that could affect the work, and shall furnish all work necessary to meet such conditions.

1.6.4.1 List of Drawings

Submit a summary list of control system drawings submitted.

1.6.4.2 List of Symbols and Abbreviations Used on Drawings

Submit an index of symbols and abbreviations used on the drawings.

1.6.4.3 List of I/O Points and Memory Points

For each input and output physically connected to a digital controller and memory points provide, on a controller-by-controller basis, provide the following:

a. Point description: for example: mixed air temperature, supply fan start/stop, etc.

b. Point type: AO, AI, AV, BO, BI, BV, etc.

1.6.4.4 Equipment Components List

Submit a listing of controllers and connected devices shown on control system schematic. List the following:

a. Control system schematic name

b. Description

c. Manufacturer of controller

d. Controller's name

e. Equipment part numbers

1.6.4.5 AC Power Table

Submit a table listing each controller and the circuit breaker number, panel box number, and physical location of each controller's source of AC power.

1.6.5 Contractor’s Minimum Qualifications

The contractor responsible for the design and installation on this project shall regularly engage in the design and installation of BACnet building automation systems of a size and scope similar to this project. The contractor shall have been a factory representative of the proposed control system manufacturer for a minimum of 1 year and shall have performed design and installation of automation systems for a minimum of 3 years.

1.6.6 Training Course Documentation

Training course documentation including a manual for each trainee plus two additional copies and one copy of audiovisual training aids, if used. Documentation shall include an agenda, defined objectives for each lesson and detailed description of the subject matter of each lesson. Include all available CD support training media.

1.6.7 Service Organizations

Provide a list of service organizations (including telephone numbers) of organizations qualified to service the HVAC control system.

1.6.8 Contractor Certification

Provide certification that installation of the control system is complete and meets the technical requirements of this section.

1.6.9 Control System Operator’s Manual

Provide three copies and one original reproducible copy of a Control Systems Operator’s Manual in print and two copies in CD format. Provide manuals in 3 ring binders with a minimum of the following 6 sections. Use tabs to divide each section. CD media shall be documented with a professional label maker and stored in a hard plastic case.

a. Description of HVAC Systems: Provide a complete description of the HVAC system and its components. Include all sequences of operation and a complete points list that includes, for each physical or software point, the point name, description, display units, alarm limits and definitions, along with the BACnet object description, object ID, and associated device ID. The list shall also indicate whether Trend Log or Schedule objects have been established for the point. Provide documentation of all non-Standard BACnet Objects, properties, or enumerations utilized in the system detailing their structure, data types, and any associated lists or enumerated values. It is preferred that an Excel format of check list, that includes naming of columns and proper row ID’s be incorporated into the documentation and/or drawings.

b. Control System Drawings: Provide drawings as specified in submittal paragraph.

c. Control Program Listings: Provide listing of all control programs, including controller setup pages if used. Provide complete program descriptions of all control and application software per the system installation. This shall include English narratives of application programs, and/or flowcharts, and/or actual source code files.

d. Current Operating Parameters: Provide printouts of input and output point setup information, such as point addresses, slopes and offsets for all points.

e. Control Equipment Technical Data Sheets: Provide technical data sheets for all controller hardware and accessories including valve schedules, damper schedules, and controller list.

f. Backup of Control Programs, Drawings, and Workstation Graphics: Provide 2 copies on DVD media of the final project control programming, workstation graphics, and final AutoCAD and other control drawings.

1.6.10 DDC Manufacturer's Hardware and Software Manuals

Provide four copies of the following manuals both in print and one copy in CD format for new system projects. “To be provided” information shall be in DVD format in a “.pdf file” format.

a. Installation, operation, and maintenance manuals for all DDC hardware.

b. Installation, operation, programming and maintenance manuals for all digital controllers.

c. Operator and Programming Manuals for DDC workstation software for operating system and application(s).

d. Existing DDC hardware and software that require revisions, and/or upgrades and/or patches shall only require one copy in print and CD format of 1.6.10(a),(b),(c).

1.6.11 Workstation Hardware and Software Manuals

Provide original workstation hardware, software, and operation manuals furnished with all workstation, server, and notebook computers. Include all original installation media (including all software installed), licenses, and warranty.

1.6.12 Modification of References

The advisory provisions in ASME B31.1 and NFPA 70 are mandatory. Substitute the word "shall" for "should" wherever it appears and interpret all references to the "authority having jurisdiction" to mean the COR.

1.7 WARRANTY AND BACNET CERTIFICATION

1.7.1 Manufacturer's System Software and Controller Warranty

For all system software and direct digital controllers installed under this contract, provide a statement of warranty for performing all firmware and system software patches as soon as they become available, and full replacement of any defective controller for a minimum of one year starting from the date of substantial completion. Include with the statement of warranty an itemized list for the system software and for each controller showing nomenclature, part numbers and serial numbers, with the effective beginning and ending warranty dates. Provide an additional statement that manufacturer technical support, including software patches or equivalent shall be provided without cost during the system

warranty.

1.7.1.1 BACnet Compliant Certification

Provide Protocol Implementation Conformance Statements for all workstation software and for all controllers in the BACnet system, to show compliance with ANSI/ASHRAE 135.1.

2.0 PART 2 PRODUCTS

2.1 DDC SYSTEM

a. Provide a DDC system as a distributed control system in compliance with the latest revisions of the ANSI/ASHRAE 135, BACnet standard. The system shall have digital controllers meeting the descriptions and profiles of standardized BACnet devices, a communications internetwork, BACnet workstation computer, and compactable with the manufacturer's BACnet workstation programming and operational software.

   Permitted applications are only Alerton and Siemens for NIST Gaithersburg and only Metasys for NIST Boulder. Only exception for NIST Gaithersburg will be expansion of existing Andover applications, however no new Andover devices will be permitted. All exceptions must be approved by the COR / DDC Administrator.

b. Provide an operator programmable system to perform closed-loop, modulating control of building equipment. Connect all digital controllers through the BACnet communication internetwork to share common data and report to workstation computers. Provide workstation DDC software capable of programming and monitoring the digital controllers. The control system shall be capable of downloading programs and parameters from any workstation whether remote or local to the digital controllers.

c. Provide the quantity of digital controllers indicated on the drawings to perform required climate control, energy management, and alarm functions. The quantity of controllers shall be no less than the number shown on drawings. All material used shall be latest in production.

2.1.1 Direct Digital Controllers

DDC hardware shall be UL 916 rated.

2.1.1.1 I/O Point Limitation

Total number of I/O hardware points used by a single stand-alone digital controller, including I/O expansion units shall not impede the controller's ability to perform proper sequence control, communications, trending and alarm management functions. I/O expansion shall be located inside the same controller cabinet of the digital controller and shall be UPS protected.

2.1.1.2 Stand-alone Control

Provide stand-alone digital controllers in the event of communication failure. All I/O points specified for a piece of equipment shall be integral to its controller. Provide stable and reliable stand-alone control

using default values or other method for values normally communicated over the network.

2.1.1.3 Immunity to Power and Noise

Controllers shall be able to operate at 90% to 110% of nominal voltage rating and shall perform an orderly shutdown below 80% nominal voltage. Operation shall be protected against electrical noise of 5 to 120 Hz and from keyed radios up to 5 watts at 3 ft.

2.1.1.4 Transformer

Controller power supply shall be fused or current limiting and shall be rated at a minimum of 125% of controller power consumption.

2.1.1.5 Wiring Terminations

Wiring terminations shall be screw terminal blocks for all controllers. Field-removable modular terminal strip or a termination card connected by a ribbon cable are required on all controllers other than terminal units such as VAV terminal units, duct-mounted heating coils on terminal units, and terminal zone dampers. Spade type terminals are not permitted for any controllers.

2.1.1.6 Input and Output Interface

Provide hard-wired input and output interface for all controllers as follows:

a. Protection: Shorting an input or output point to itself, to another point, or to ground shall cause no controller damage. Input or output point contact with up to 24 V for any duration shall cause no controller damage.

b. Binary Inputs: Binary inputs shall monitor the on and off signal from a remote device. Binary inputs shall provide a wetting current of at least 12 mA and shall be protected against contact bounce and noise. Binary inputs shall sense dry contact closure without application of power external to the controller.

c. Pulse Accumulation Inputs: Pulse accumulation inputs shall conform to binary input requirements and shall accumulate no less than 10 pulses per second.

d. Analog Inputs: Analog inputs shall monitor low-voltage (0-10 Vdc), current (4-20 mA), or resistance (thermistor or RTD) signals. Analog inputs shall be compatible with and field configurable to commonly available sensing devices.

e. Binary Outputs: Binary outputs shall send a pulsed low-voltage signal for pulse width modulation control or an on-or-off signal for on and off control. Controllers shall use status lights for binary outputs and provide alarm information to the operator workstation when output is in override or forced state. Outputs shall be selectable for normally open or normally closed operation.

f. Analog Outputs: Analog outputs shall send a modulating nominal 0-10 Vdc or 4-20 mA signal as required to properly control output devices. Controllers shall provide alarm information to the operator workstation when placed in override or forced state. Analog outputs shall not drift more than 0.4% of range annually.

g. Tri-State Outputs: Tri-State outputs shall provide three-point floating control of electronic actuators that are used only in terminal unit control applications such as VAV

terminal units, duct-mounted heating coils on terminal units, and terminal zone dampers. This method must be approved by the COR/DDC Administrator.

2.1.1.7 PI Control

Provide controllers with proportional and integral control capability. Pre-approval from the COR/DDC Administrator is required if PI is used.

2.1.1.8 Digital Controller BACnet Internetworking Capabilities

Digital control products, communication media, connectors, repeaters, Network switches, and routers shall comprise a BACnet internetwork. Gateways, when shown on the project drawings, shall connect non-BACnet devices to the BACnet internetwork. Controller and operator interface communication shall conform to ANSI/ASHRAE 135, BACnet. Internetwork operator interface and value passing shall be transparent to internetwork architecture. An operator interface connected to a controller shall allow the operator to interface with each internetwork controller as if directly connected. Controller information such as data, status, control algorithms shall be viewable and editable, and controller program editing and downloadable from each internetwork controller. Inputs, outputs, and control variables used to integrate control strategies across multiple controllers shall be readable by each controller on the internetwork. An authorized operator shall be able to edit cross-controller links by typing a standard object address or by using a point-and-click interface.

2.1.1.9 Communications Ports

a. Controller-to-Controller Network Communications Ports: Controllers shall have controller-to-controller communication ports for all controllers over the internetwork permitting sharing of information between controllers, allowing execution of dynamic control strategies, and coordinated response to alarm conditions.

b. Direct-Connect Interface Ports: Provide a communications port or a portable interface tool at each controller for direct connection of a notebook computer through which each controller may be fully accessed locally.

2.1.1.10 Gateways – General Comment: Gateways are not acceptable on the Gaithersburg site, unless approved by the COTR / DDC Administrator.

Provide gateways to connect to legacy systems or other non-BACnet devices only if gateways are shown on the drawings. The drawings will identify the BACnet to non-BACnet protocol connection point in the communications architecture. When new OEM equipment plant equipment such as boilers, chillers, and variable frequency drives have been specified and the OEM has developed a BACnet gateway for such equipment, the manufacturer shall provide the gateway integral with the equipment. The gateway shall be fully programmed to expose all objects as network visible, with adjustable parameters and as specified in other paragraphs and sections of the contract and this DDC specifications. Devices that use BACnet as their native protocol shall be used if available. Provide gateways with all available setup software, software licenses, and configuration tools. The following minimum capabilities are required by a gateway:

a. Information from both BACnet and non-BACnet devices shall be displayed on any connected operator workstation.

b. The gateway shall provide bi-directional communication.

c. Non-BACnet points shall be readable from the BACnet side of the gateway and BACnet objects are to be readable from the non-BACnet side of the gateway. Non-BACnet points are to be modifiable from the BACnet side of the gateway and BACnet objects shall be modifiable from the non-BACnet side of the gateway.

d. Expansion capacity in the gateway shall be sufficient to accommodate a future increased point capacity of 25 percent.

e. Controller program and configuration database archives shall be created and maintained from the BACnet side of the gateway in the same manner as BACnet archives are maintained.

f. Gateway shall support the detection, notification, and acknowledgment of alarms and other significant events. Gateway shall also support scheduling and collection of trend data.

g. Gateway shall be a single device, not depending on multiple devices for exchanging information from either side of the gateway.

2.1.1.11 The BACnet Protocol Analyzer

NIST will provide a BACnet protocol analyzer. The analyzer will have the following minimum capabilities:

a. Capture and analyze data traffic on BACnet/Ethernet, BACnet/IP, and BACnet/MSTP.

b. Measure bandwidth usage.

c. Filtering options with the ability to ignore or capture data based on ports or other "triggers".

d. Verify that alarm messages are being directed to the proper recipients.

e. Verify that change-of-value notifications are being correctly produced.

f. Verify that time synchronizations are sent at the correct intervals.

2.1.2 DDC Software

2.1.2.1 Sequence of Control

Provide graphic-based programming, menu-based programming, or line-by-line programming software to execute the sequence of control as stand-alone programs in individual field controllers. Provide all programming and commissioning tools accompanied by complete instructions and help files to configure and commission all controllers.

a. Graphic-based programming shall be accomplished using a library of function blocks made from pre-programmed code designed for BAS control. Function blocks shall be assembled with interconnecting lines documenting the control sequence in an orderly flowchart, documented with sufficient comments for clarity, and presented with ample space between logic functions for uncluttered viewing. Graphic programs shall be

viewable in real time displaying the present values and logical results from each function block.

b. Menu-based programming shall be accomplished by entering parameters, definitions, conditions, requirements, and constraints to a pre-programmed field controller.

c. Line-by-line or text-based programming software shall reside in the same field controller with other stand-alone sequences. Where declaration of variable types is required (local, global, real, integer, etc.), these statements shall appear at the beginning of the program. Control of any point or device shall occur in only one program. If a project has unique requirements for a point or device to be controlled by more than one program, it shall be brought to the attention of the COR/DDC Administrator for discussion and approval. Proper documentation shall be made and submitted by responsible parties. Descriptive comments shall be used liberally and adequately within the program to describe the methodology used to accomplish the line-by-line control strategy.

d. Prior to downloading each program, a means for detecting program errors and testing software strategies shall be accomplished during the compile process and through a simulation process.

2.1.2.2 Parameter Modification

Parameters shall be adjustable at all levels of the network regardless of the programming methods used to create the applications.

2.1.2.3 Differential

Where set point is in response to some analog input such as temperature, pressure, or humidity, include a set point differential to prevent short cycling of control devices.

2.1.2.4 Motor and Flow Status Delay

Provide an adjustable delay between when a motor is commanded on or off and when the control program looks to the motor or flow status input for confirmation of successful command execution.

2.1.2.5 Timed Local Override

Provide BAS Owner definable and adjustable run time for each push of a momentary contact timed local override. Pushes shall not be cumulative with each push. Timed local overrides are disabled or ignored during normal occupancy.

2.1.2.6 Time Programs

Provide programs to automatically adjust for leap years, daylight savings time, and operator time adjustments.

2.1.2.7 Scheduling

a. Individual controlled equipment shall conform to the BACnet service for schedules and be based on time of day, day of week, and day of year. Equipment may be associated into groups. Each group may be associated with a different schedule. Changing the schedule of a group shall change the schedule of all equipment in the group. Groups may be modified, created, and deleted by the operator.

b. Provide capability to view and modify schedules in a seven-day week format. When control program does not automatically compute holidays, provide capability to enter holiday schedules one full year at a time.

2.1.2.8 Point Override and Object Property Configuration

I/O and virtual points shall accept software overrides to any possible value. In order to support commissioning and troubleshooting functions, the Out-Of-Service property of all Analog, Binary, Multi-state, Loop, and Program objects shall be writeable using BACnet services.

2.1.2.9 Alarming

I/O points and software points shall conform to the BACnet service for alarms based on prioritization. Alarms shall be able to be enabled and disabled for every point. Alarm delays shall be configurable for each alarm. Alarm limits shall be adjustable. Controllers connected to an external communications device such as a printer, terminal, or computer, shall download alarm and alarm message when an alarm occurs. When a computer workstation is connected to a DDC system with a LAN or modem, alarm conditions shall report to the computer, printer, alphanumeric pager, e-mail, or cell phone as specified by the operator with sufficient privilege. Otherwise, alarms are stored and automatically forwarded when a communications link occurs. Storing of alarms over extended periods shall not degrade the performance of the system. Provide alarms according to the point list table and other system alarms, such as a non-responsive module, to assure the BAS does not function in a degraded manner. The following conditions are typical examples of alarms:

a. Motor is commanded on or off, but motor status input indicates no change.

b. An analog input has a value indicating sensor failure

c. A controller is not communicating on the LAN

d. Controller has lost memory

e. BOs, BIs, AIs, and AVs are in override, forced, or out-of-service

2.1.2.10 Event Notification Messages

Messages shall conform to the BACnet service for events and be operator defined and assigned to alarm or status conditions. Messages shall be displayed on the workstation and printer when these conditions occur and be routed to an alphanumeric pager, email, or cell phone as specified.

2.1.2.11 Trending

DDC system shall conform to the BACnet service for trends and have the capability to trend all physical and software points. Points may be associated into groups. A trend report may be set up for each group. The period between logging consecutive trend values shall range at a minimum from 1 minute to 60 minutes unless specified differently. The minimum number of consecutive trend values stored at one time shall be 250 per variable. When trend memory is full, the most recent data shall overwrite the oldest data. Trend data shall be capable of being uploaded to the BACnet Operator Workstation. Trend data shall be available on a real time basis; trend data shall appear numerically and graphically on a connected computer's screen as the data is processed from the DDC system. Trending shall not degrade network communications and shall be capable of logging all trends marked on the points list using 250 samples

per variable at the minimum-logging rate.

2.1.2.12 Status Display

Present value and object name of every I/O point shall be displayed on command. Objects shall be associated into functional groups, such as all the objects associated with control of a single air handling unit, and displayed as a group, so the status of a single mechanical system can be readily checked. A group shall be selectable from a menu of groups having meaningful names matching the equipment or zone.

2.1.2.13 Diagnostics

Each controller shall have diagnostic LEDs for power, communication, and processor. The DDC system shall be capable of recognizing a non-responsive module. In the event of a non-responsive module, the remaining responsive modules on a LAN shall not operate in a degraded mode.

2.1.2.14 Power Loss

During a power outage, each controller shall assume a disabled status and outputs shall go to a user definable state. Upon restoration of power, DDC system shall perform an orderly restart, with sequencing of outputs.

2.1.2.15 Password Protection

Provide at least five authorization levels of password protection to the DDC system permitting different levels of access to the system. The lowest level allows monitoring only. The highest level allows full administrative rights to control program, all operating systems, applications and functions of system, including setting new passwords. The COR/DDC Administrator shall provide user groups and IDs. Each user name and password combination shall define accessible viewing, editing, adding, and deleting functions in each system application, editor, and object. Automatic log out of each operator is required if no keyboard or mouse activity is detected after 5 minutes. Operators shall be able to adjust automatic log out delay. System security data including operator passwords shall be stored in an encrypted format. (Coordinate with COR and DDC Administrator)

2.2 ELECTRICAL POWER AND DISTRIBUTION

For controller power provide a new, dedicated 120 VAC 60 Hz source, three wires. Run green ground wire to panel ground; conduit grounds are not sufficient. Must also use known earth ground.

2.2.1 Transformers

Transformers shall conform to UL 506. Power digital controllers from dedicated circuit breakers with surge protection specified. Transformers for digital controllers serving terminal equipment may be grouped to have specified surge protection sized for the number of controllers on a single transformer. Provide a fuse or circuit breaker on the transformer primary and secondary sides. No more than 4 devices are to be powered by any one transformer and surge protection in series.

2.2.2 Surge Protection

Surge and transient protection consist of devices installed externally to digital controllers.

2.2.2.1 Power Line Surge Protection

Surge suppressors external to digital controller, shall be installed on all incoming AC power used for all BACnet Building Controllers. Surge suppressor shall be rated by UL 1449, have a fault indicating light, and meet the following requirements: (Control Panel Surge Protection Model HSP121BT-1RU EDCO Surge Suppression shall be permissible)

a. Unit shall be transient voltage surge suppressor 120 VAC/1 phase/2 wire plus ground, hard wire individual equipment protector.

b. Unit shall react within 5 nanoseconds and automatically reset.

c. Voltage protection threshold, line to neutral, starts at no more than 211 volts peak on the 120 VAC line.

d. The transient voltage surge suppressor shall have an independent secondary stage equal to or greater than the primary stage joule rating.

e. The primary suppression system components shall be pure silicon avalanche diodes.

f. Silicon avalanche diodes or metal oxide varistors are acceptable in the independent secondary suppression system.

g. The transient suppression system shall incorporate an indication light which denotes whether the primary and/or secondary transient protection components are functioning.

h. All system functions of the transient suppression system shall be individually fused and not short circuit the AC power line at any time.

i. The transient suppression system shall incorporate an EMI/RFI noise filter with a minimum attenuation of 13 dB at 10 kHz to 300 MHz.

j. The system shall comply with IEEE C62.41, Class "B" requirements and be tested according to IEEE C62.45.

k. The power line surge protector shall have an operating range of -20 degrees C to +50 degrees C.

2.2.3 Wiring

Note: NEC is minimum requirements. This section 2.4.3 may be in addition to the NEC Code.

Provide complete electric wiring for DDC System, including wiring to transformer primaries. Control circuit wiring shall not run in the same conduit as power wiring over 100 volts. Circuits operating at 100 Volts or less shall be defined as low voltage and run in rigid, flexible conduit, metallic tubing, metal raceways, wire trays, or armored cable. Provide circuit and wiring protection as required by NFPA 70. Use conduit or plenum-rated cable in HVAC plenums. HVAC plenums include the space between a suspended ceiling and the structural ceiling, within walls, and within ductwork. Protect exposed wiring from abuse and damage.

2.2.3.1 AC Wiring

a. Control wiring for 24 V circuits shall be insulated copper 18 AWG minimum and rated for 300 VAC service.

b. Wiring for 120 V shall be 12 AWG minimum and rated for 600 V service.

c. All wiring shall be run in EMT conduit and/or liquid tight. All conduit connector shall be compression type. No setscrew type electrical connectors will be allowed for any reason.

d. Electrical power wiring shall follow NIST Electrical standard. (Reference Section 2.2.5 Electrical in the A&E Guide.)

e. Electrical shall comply with the latest National Electrical Code edition.

f. All raceways, fittings, enclosures, and electrical equipment shall be UL listed for the application.

g. All control cables shall be shielded and continue from the field device to the controller output or input.

h. All electrical connection and splices shall be made in a terminal box.

i. All work shall be neat and installed in a professional manor.

j. Use only copper wire, copper buss, and copper windings.

k. Power Circuits with conductors No. 10 AWG and smaller shall be solid copper. Conductors larger than 10 AWG shall be stranded copper.

l. Install wiring with at least 12 inches of slack as space permits at each termination.

m. Power circuit wiring shall use 90 degree C insulation but shall be sized for a maximum temperature of 75 degree C.

n. Minimum raceway size shall be ¾". All circuits shall have a ground wire rather than using the conduit as the ground path. Conductors used for DDC device communications and control shall be shielded and shielding is not considered grounding conductor.

o. Wire insulation shall be type THHN and color code as indicated below.

The following color schedule shall be used for power wiring:

	480/277 Volt System	208/120 Volt System
A Phase	Brown	Black
B Phase	Orange	Red
C Phase	Yellow	Blue
Neutral	Gray	White
Ground	Green	Green

2.2.3.2 Analog Signal Wiring

Analog signal wiring shall be 18 AWG single or multiple twisted pair. Each cable shall be 100 percent shielded, and have 20 AWG drain wire. Each wire shall have insulation rated to 300 V AC. Cables shall have an overall aluminum-polyester or tinned-copper cable-shield tape. Install analog signal wiring in

conduit separate from AC power circuits. Said conductor shall have grounding conductor.

2.3 FIRE PROTECTION DEVICES

Provide smoke detectors in return air ducts on downstream side of filters in accordance with NFPA 90A, except as otherwise indicated. Provide UL listed or FM approved detectors for duct installation. Unless otherwise noted, smoke detectors shall be on return air ductwork located at a distance no closer than 10 times the duct diameter to the humidity supply. Refer to specification 284621.11 Addressable Fire Alarm and Mass Notification Systems for additional information.

2.3.1 Smoke Detectors

Smoke detectors shall be in compliance with the latest version of NFPA 90A, “Standard for the Installation of Air-Conditioning and Ventilating Systems”, NFPA 90B, “Standard for the Installation of Warm Air Heating and Air-Conditioning Systems”, and NFPA 72, “National Fire Alarm and Signaling Code”. All fire alarm devices shall be compatible, interfaced, monitored, and status graphical displaced on NIST’s site wide Simplex Fire Alarm System.

3.0 PART 3 EXECUTION

NOTE: Contract substantial completion will not be issued until the DDC System is complete and operational, and has passed the final performance verification testing as witnessed by the COR and DDC Administrator as described in sections 3.0 through 3.3.4.12.

3.1 INSTALLATION

Perform installation using certified technicians regularly employed in the installation of DDC systems. By “certified”, this means that the technician has successfully completed recognized installation courses of the vendor’s product.

3.1.1 Naming Conventions

The following paragraphs list the requirements for the assignment of names and identifiers for BACnet objects. Prior approval shall be obtained from the COR/DDC Administrator prior to assignment of names and identifiers or device configuration. Coordinate the use of the names and identifiers with the standardized list designated by the BAS Owner.

a. Device Names

The BAS uses a system for naming its control devices based on facility name, location within a facility, the system or systems that the device monitors and/or controls, or the area served. The basic principle to follow in setting up site-wide object (and device) naming conventions is that the names should be as meaningful as possible given the name length available. Thus,"AHU7-2.SMOKE" would be preferable to a more cryptic name like "A1ZXC5". An often used convention is to construct a name from a set of components, each of which relates to the building system installation. In this scheme, the compound name is constructed from the building or facility in which the system is located, the name of the building system itself, and, finally, the name of the desired point. An example of this FACILITY.SYSTEM.POINT (FSP) naming method is "BLDG220.AHU1.MA_TEMP". The facility is Building 220, the system is Air Handler

Unit 1, and the point is the mixed air temperature. The convention may be easily extended to accommodate areas within the facility, and subsystems within a system. For example, "BLDG220.BASEMENT_MER.AHU1.CW.STEMP" would refer to the supply temperature of the chilled water subsystem of the air handler located in the basement mechanical equipment room.

i. Specify a set of abbreviations for common building systems, subsystems, and points that are to be used by all vendors.

ii. Specify that object name properties, in those devices where the object name is configurable, shall be at least 50 characters long and shall, to the extent possible, make use of a system and point nomenclature using the abbreviations specified above.

iii. Specify that BACnet object names used in workstations may be up to 50 characters long and shall consist of a string made up of components indicating, as appropriate, the location, system, subsystem, and point of the object. These object names shall be used in workstation applications such as graphics, reports, and alarms wherever an object name is appropriate in lieu of the object name property in the remote device. Moreover, an operator may display at any time the mapping between the object name used on the Sever/ Workstation and the object name property used in the remote BACnet device.

Coordinate these names with the standardized list for Device Names designated by the BAS Owner. All naming conventions are to be approved by COR/DDC Administrator prior to the start of work.

b. Device Instance Numbers

BACnet allows 4,194,305 device instances per BACnet internetwork; each of which must be unique. Unique device instances are formed as follows: Device Instance = "FFFFNDD" where:

FFFF = Facility Code (see below)

N = 0-9 This allows up to 10 networks per facility or building

DD = 00-99 This allows up to 100 devices per network

Example of Facility Code assignments with Building number and wing is represented below:

101 =1010
101A=1011
101B=1012
101C=1013
101D=1014
101E=1015

Where facilities have a facility code with an alphabetic suffix to denote wings, related structures, etc. The suffix will be converted to a numeric number: A=1, B=2, C=3, D=4, E=5 etc. Coordinate the use of the Device Instance Numbers with the standardized list designated by the BAS Owner.

c. Non-Device Object Names

Objects other than Device objects shall be named in a manner analogous to Device objects. The names shall consist of a site. facility.{sub-facility.}system.{sub-system.}point designation.

d. Non-Device Object Instance Numbers

The instance numbers for objects other than Device objects may be assigned at the Contractor's discretion subject only to the constraint that they be unique for a given object type within a given device.

e. Using Object Descriptions

Each Device object and every object in BACnet Building Controllers shall be configured with a description property. For all object types in all devices that support Description properties, the available string length and whether or not the Description is writeable using BACnet services shall be specified in the device's PICS.

f. Issues Relating to Specific BACnet Object Types

Minimum requirements for specific BACnet object types are:

i. Analog Input, Output, and Value - All Analog Input, Analog Output, and Analog Value objects shall have the capability of using the change of value (COV) reporting mechanism, and the COV Increment property shall be writeable using BACnet services.

ii. Binary Input - The Inactive Text and Active Text properties of Binary Input objects shall be configured with text string values as indicated on the points list. Binary Input objects shall
support COV reporting.

iii. Binary Output - The Inactive Text and Active Text properties of Binary Output objects shall be configured with text string values as indicated on the points list. All Binary Output objects associated with motor on/off status shall track changes of state and runtime. Binary Output objects shall support COV reporting.

iv. Binary Value - The Inactive Text and Active Text properties of Binary Value objects shall be configured with text string values as indicated on the points list. Binary Value objects shall
support COV reporting.

v. Calendar - Devices providing scheduling capability shall also provide at least one Calendar object with a capacity of at least ten entries. Operators shall be able to view the calendar object and make modifications from any BACnet workstation on

the network. If the Calendar's Date List property is writeable using BACnet services, all calendar entry data types shall be supported.

vi. Loop - All control loops using any combination of proportional and/or integral control shall be represented by BACnet Loop objects. Operators with sufficient authority shall be able to adjust at least the Update_Inteval, Set point, Proportional Constant, and Integral Constant using BACnet services. Loop objects shall support COV reporting.

vii. Multi-state Input, Output, and Value - The text to be used for the Multi-state object types shall be determined from the points list. Feedback Value shall be determined by sensing the actual condition or mode of the device. All Multi-state objects shall support COV reporting.

viii. Schedule - All building systems with date and time scheduling requirements shall have schedules represented by BACnet Schedule objects. All operators shall be able to view the entries for a schedule. Operators with sufficient privilege shall be able to modify schedule entries from any BACnet workstation. Required schedules are shown on the drawings as part of the occupied and unoccupied modes.

ix. Dynamic Object Creation - BACnet Building Controllers shall be configured to allow the dynamic creation of Trend Log, Calendar, and Schedule objects by means of the BACnet Create Object service. This shall be possible from any supplied BACnet workstation by operators with appropriate authority.

3.1.2 Use Of BACnet Services

Requirements that are specific to the use of BACnet communication services are as follows:

a. Interoperable Commands

All dampers, valves, fans, or other mechanical equipment that may need to be controlled by more than one application shall be represented as commandable BACnet objects. The application programs interacting with this equipment shall be configured to use the command priorities listed below. If implementing the sequence of operations or other required functionality requires using a command priority not listed, the priority assignment shall be approved by the COR/DDC Administrator. Coordinate the use of the priority level assignment with the standardized list designated by the BAS Owner.

Priority Level	Application
1	Manual-Life Safety
2	Automatic-Life Safety
3	Available
4	Available
5	Critical Equipment Control
6	Minimum On/Off
7	Available
8	Manual Operator
9	Available

10 Available
11 Load Shedding
12 Available
13 Available
14 Available
15 Available
16 Available

b. Alarming

Requirements that are specific to the use of BACnet for alarm processing are as follows:

i. Alarm Priorities - All alarm and event notification priorities shall be configured as indicated. Use the current priority list for alarm priority level assignment designated by the BAS Owner.

ii. Notification Classes - The BAS Owner shall be designated as a recipient for all alarm notifications. The Priority, Ack_Required, and Recipient List properties of Notification Class
objects shall be writeable over the network using BACnet services.

iii. Event Notification Message Texts - Alarm and event processing shall be configured to convey descriptive text messages along with the notification.

c. Operator Authority Levels

Provide DDC workstations with at least five levels of authority as follows:

* DDC Administrator – All privileges including passwords, operating system
* NIST DDC Lead Technician – All privileges including passwords, operating system
* DDC Control Group – According to DDC Administrator/ IT user defined list
* HVAC Shop – Selective configuration/IT user defined list
* Guest User – View graphic pages only

d. Change of Value (COV) Processing

Local DDC workstations shall be able to display property values based on the receipt of confirmed and unconfirmed Change of Value (COV) notifications. Operators shall have the ability from any workstation to subscribe to COV notifications for all objects that support COV subscriptions. After initialization, all graphic display screens shall update the displayed values using COV notifications if COV notification capabilities are available from the data source. The COV increment shall be adjustable by an operator using BACnet services.

3.1.3 Local Area Networks

Requirements that are specific to the integration of multiple BACnet networks, possibly on different LAN types, into a single BACnet "internetwork" shall be approved by the COR and DDC Administrator prior to beginning device configuration. The BAS Owner maintains and approves methods for network configurations.

3.1.4 Wiring Criteria

a. Input/output identification: Permanently label each field wire, cable, or pneumatic tube at each end with unique descriptive identification using a commercial wire marking system consisting of heat shrink or plastic sleeves that fully encircle the wire with pre-printed alpha/numeric labels. Locate the markers within 2 inches of the wire, cable, or tube termination. Point names shall match the naming convention found in the points list along with its I/O number. All power wiring to field devices shall be labeled identifying its associated hardware object. All terminal blocks shall be identified with pre-printed alpha/numeric plastic labels designed to fit the terminal block. All wiring and the wiring methods shall meet the standards of UL 508A.

b. Wiring standards are as follows for NIST Boulder:
Yellow = AI
Orange = BI
Blue = DO
Brown = AO
Black = Common
Red = 24 Vac

c. Wiring for controllers shall be fed separately, protected by a circuit breaker, and not connected to the load side of the disconnect on the HVAC equipment.

d. Rigid or flexible conduit shall be terminated at all sensors, panels, troughs, and output devices.

e. Surge Protection: Install surge protection per manufacturer's instructions. Multiple controllers fed from a common power supply may be protected by a common surge protector when properly sized.

f. Grounding: Ground controllers and cabinets to a good earth ground. Ground controller to a ground in accordance with NEC 2013 Edition. Conduit grounding alone is not sufficient; all grounding shall have a direct path to the building earth ground. Ground sensor drain wire shields at controller end.

g. Contractor is responsible for correcting all associated ground loop problems.

h. Wiring in panel enclosures shall run in covered wire way.

i. Firestop: All through-penetrations of fire rated assemblies (floor-ceilings, roof-ceilings, walls) with openings, pipes, ducts, conduits, cable trays, or cables shall have a U.L. Fire Resistance Directory listed, numbered fire stop system installed in and around the penetrations, conforming to the construction type, penetrate type, annular space requirements and fire rating involved, in accordance to manufacturer’s instructions and capable of maintaining the fire resistance rating of the fire barrier.

3.1.5 Digital Controllers

a. Do not divide control of a single mechanical system such as an air handling unit, boiler, chiller, or terminal equipment between two or more controllers. A single controller shall manage control functions for a single mechanical system using stand-alone processes in the controller. It is permissible, however, to manage more than one mechanical system

with a single controller.

b. Locate digital control cabinets at locations shown on the drawings. If not shown on the drawings, install in the most accessible space as close to the controlled equipment as possible, and approved by the COR.

3.2 PERFORMANCE VERIFICATION TESTING (PVT)

3.2.1 General

The Performance Verification Tests (PVT) determines the integrity of the installed BAS and shall be executed by the Contractor and approved by the COR/DDC Administrator, on behalf of the BAS Owner. If the project is phased, then a separate test plan shall be executed for each phase. Use PVT sample procedures, designated by the BAS Owner, as a guide to creating the test plan spreadsheets.

Prepare to conduct separate simulations during both the Pre-Performance Testing and the Performance Verification Testing to simulate seasonal testing as a result of a change in the outside weather condition. For example, if the testing is conducted in the Summer months, this testing shall also simulate full operational functioning, data collection, and alarm reporting capability when simulated Fall, Winter, and Spring temperatures are imposed, to include very cold (5 degree F) and very hot (100 degree F) outside air temperatures, and very low (0%) and very high (100%) outside air humidity.

a. Obtain written approval of the Performance Verification Tests plan for each phase of testing before beginning that phase of testing. Give the COR written notification of planned testing at least two weeks prior to the test but not before completion of any test and balance (TAB) requirements have been completed. The PVT for testing use is to be submitted for approval 3 weeks prior to the planned testing. Also see Section 1.2.36. Notification shall be accompanied by the proposed test procedure, a verified Pre-performance Testing Checklist, and a written estimated timetable required to perform the test. After the written notification is received, the COR shall convene a meeting with the contractor at least 14 days prior to testing. In no case will the Contractor be allowed to start testing without written COR approval of the Performance Verification Testing plan.

b. Demonstrate compliance of the heating, ventilating, and air conditioning control system with the contract documents including proper labeling of controls and wiring. Furnish personnel, equipment, instrumentation, and supplies necessary to perform calibration and site testing. Ensure that test personnel are regularly employed in the testing and calibration of DDC systems.

c. Performance verification testing will include, but not be limited to, workstation operations, calibration results for input and output devices required by manufacturer, proper tuning of control loops, and ensuring proper execution of the sequence of operation. Use the BACnet protocol analyzer during the performance testing to demonstrate communications reliability.

3.2.2 Pre-performance Testing Checklist

The Pre-performance Testing Checklist shall be used as the Contractor's guide to prepare for the PVT and to guide discussions at the pre-performance test meeting between the Contractor and the COR and DDC Administrator. Every item on the check list shall be validated by the Contractor's QC representative and COR/DDC Administrator prior to the test meeting.

a. Verify all workstations, notebook computers, and maintenance personnel interface tools have been delivered, all system and database software installed, and graphic pages created for each workstation and notebook computers. Notify the COR when network connections are needed at least 7 days prior to installation of the workstation.

b. Verify proper pneumatic pressures, electric voltage and amperages, and verify all circuits are free from grounds or faults.

c. Verify integrity/safety of all electrical and pneumatic connections.

d. Verify proper interface with fire alarm system. Coordinate this activity with the COR and campus Fire Alarm system administrator.

e. Verify proper communications over network segments and between controllers.

f. Verify proper wire and control panel labeling.

g. Coordinate with the TAB contractor to obtain control settings that are determined from balancing procedures.

h. Test, calibrate, and set all digital and analog sensing and actuating devices as required.

i. Check and set zero and span adjustments for all actuating devices as required.

j. Check each digital controller for stand-alone operation by temporarily removing from the network.

k. Check that proper sequences have been installed and tested.

l. Check that all control loops have been properly tuned.

m. Check that all alarms are programmed and routed to their proper destination.

n. Check that all trends are operating for each item marked for trending on the points list, and 21 days of data has been collected and stored. This is to demonstrate that control and tolerance levels are being maintained.

o. Check that all schedules are operating for each item marked for schedules on the points list.

p. Complete all "as-built" record drawings and I/O points list.

3.2.3 Test Reporting for Performance Verification Tests

a. The test procedure reporting documents shall be developed by the Contractor and based specifically on the control system installed in a spread sheet format allowing sufficient space for individual testing of each area of the control system. List the test procedure and the expected response for each piece of equipment and system in each test area specified. Develop a separate row or column for each item that is required to be "demonstrated" within a test area. Allow ample space for comments, pass, fail, and retest lines. Each area of testing shall have four signature lines, one for the Contractor's QC representative, one for the Contractor's PVT administrator, one for the COR, and one for the DDC Administrator to acknowledge successful completion for each test area. Include

references to the paragraph number or drawing number in the contract documents for each item or group of items to be tested. BACnet protocol analyzer test results shall be included with the test reporting. During and after completion of the Performance Verification Tests, identify, determine causes, replace, repair or calibrate equipment that fails to meet the specification, and submit a written report to the COR.

b. Document all tests with detailed test results. Explain in detail the nature of each failure and corrective action taken. Provide a written report containing test documentation after the Performance Verification Tests. Schedule a meeting with the COR and DDC Administrator to present the results to them after all failures have been corrected. Based on the report and test review meeting, the COR/DDC Administrator will determine the successful completion of the testing. If retesting of any portion of the PVT is required, do not retest until after receipt of written notification by the COR. At the conclusion of retest, assessment will be repeated. The COR reserves the right to require retesting of 100 percent of every component in the system when results from sampled areas are found deficient. One copy of the final test results will be submitted in hard copy and electronic format on CD media.

3.2.4 Performance Verification Tests

Using the completed shop drawings, the PVT spreadsheet, and 21 days of data that demonstrate accuracy/ tolerance control (see Section 3.3.2.n), conduct the performance verification test to demonstrate workstations and network communications are operating correctly, control system maintains set points, control loops are tuned, and controllers are programmed for the correct sequence of operation. The test report shall include the required minimal of two authorization signatures for successful completion of each test area. Test areas may have several sub-areas and each shall be fully satisfied in order to receive approval. Partial completion cannot be signed off. When sampling is allowed for testing of typical zones and controllers that are identical, the COR will choose which items to test from the contract drawings. The contractor needs to allow for this when creating the spreadsheet to insert the name and location on-site for random selection.

Specifically the PVT consists of the individual test areas below, but not limited to, and shall demonstrate the following:

3.2.4.1 Controller Capability, Accessibility, and Labeling

a. Memory: Demonstrate that programmed data, parameters, and trend/alarm history collected during normal operation are not lost due to power failures.

b. Direct Connect Interface: Demonstrate the ability to connect directly to each type of digital controller with a notebook computer. Demonstrate that maintenance personnel interface tools perform as specified in the Manufacturer's technical literature.

c. Wiring and AC Power: Demonstrate the ability to disconnect any controller safely from its power source using the AC Power Table.

d. Demonstrate the ability to match wiring labels easily with the control drawings. Demonstrate the ability to locate a controller's location using the riser communications diagram in the control drawings.

e. Nameplates and Tags: Demonstrate the nameplates and tags bearing device unique identifiers are accurate and permanently attached to the HVAC’s control panel doors and

back plates. Demonstrate that metal equipment tags have the correct equipment name and point identifier.

3.2.4.2 Workstation and Software Operation

a. For each server, workstation and notebook computer provided:
Verify that the correct software has been installed and licensed with the latest revisions available, delivery of all associated peripheral components are installed correctly, CD installation media including system restore disks are delivered, and the on-site warranty has been properly registered with the manufacturer. For each existing server, user workstation or notebook computer specified for upgrade, verify that all hardware and software upgrades have been installed and licensed correctly.

b. For NIST Gaithersburg – the contractor will need to submit the notebook computer to the COR, who will then submit it to the DDC Administrator for review and processing.

c. Demonstrate that points lists are generated as specified and conform to the proper naming conventions.

d. Demonstrate that graphics are complete, resolution size fills the workstation or notebook computer screen areas without scrolling and the operator can navigate successfully to every mechanical system and zone.

e. Demonstrate the UPS backup maintains power for the specified time on the workstation during a power failure and can recover automatically after an extended power loss when the UPS battery has drained.

3.2.4.3 BACnet Communications and Interoperability Areas

Demonstrate proper functioning of the five interoperability areas of: data sharing, alarm and event management, trending, scheduling, and device and network management. Use the BACnet protocol analyzer to demonstrate that communications are free from errors and those devices from different manufacturers are interoperable. These requirements shall be met even if there is only one manufacturer's equipment installed.

3.2.4.4 Data Sharing

This test includes the following:

a. Data Presentation - On each web server workstation, demonstrate graphic display capabilities as follows: Each graphic page shall initially display with current data within 5 seconds connection and 15 seconds after a dial-up modem connection is established. Updated information shall occur when a change of value (COV) notification is received or, if COV is not implemented, within 15 seconds. Demonstrate that any data value from any networked device shall be available for plotting at a workstation in real time. Select binary and analog data concurrently and plot multiple instances of each data type on the same screen. Demonstrate the ability to select sampling intervals from 1 minute to 60 minutes. For devices that implement COV reporting, select this as the means to update the plot.

b. Monitoring of Any Property - Demonstrate the ability to display any value of any property of any object from any networked device including all properties required by

BACnet, all supported optional properties, and any proprietary extensions. Compare the difference between properties shown on the operator workstation over the network and the properties shown when directly connected to the controller in the field.

c. Set point and Parameter Modifications - Demonstrate the ability to modify all control loop set points and tuning parameters via BACnet messages initiated through operator interaction with graphics displays. Compare the difference between parameters modified on the operator workstation over the network and the parameters modified when directly connected to the controller in the field.

d. Peer-to-Peer Data Dependencies - Demonstrate all BACnet devices are installed and configured to exchange data values directly, without the need for operator or workstation intervention, to implement the sequence of operations specified in the mechanical system drawings and to share global data values.

3.2.4.5 Alarm and Event Management

This test includes the following:

a. Alarm Lists - Demonstrate that alarms are installed and configured to detect alarms and events for the points indicated in the system drawings and are prioritized according to the standardized list
designated by the BAS Owner. Demonstrate system alarms, such as offline controllers are generated. Demonstrate software logic has been set up to avoid nuisance alarms, e.g., no temperature or status alarms shall be generated when fan systems are not running, or during start-up and shut-down transitions. Demonstrate that delays between the occurrence of an alarm condition and its annunciation are adjustable. Demonstrate alarms appear at any local workstation within 5 seconds connection and 15 seconds on a dial-up modem connection. Demonstrate workstations display an alarm message window that appears on top of any other open windows and alarm message window has a distinctive color and appearance to attract the operator's attention. Demonstrate alarms that require operator acknowledgement and cause the alarm window to remain active until such an acknowledgement is received and when multiple alarms are received, unacknowledged alarms shall be displayed on a first-come first-served basis grouped by priority, with the highest priority alarms displayed first.

b. Alarm Parameter Adjustment - Demonstrate the ability for operators (with sufficient privilege) to change alarm parameters for all standard BACnet event types.

c. Alarm Routing Adjustment - Demonstrate the ability for operators (with sufficient privilege) to change alarm routing (BACnet notification classes) for each alarm including the destination for each type of alarm and alarm priority, the day of week and time of day, and the type of transition involved (TO-OFFNORMAL, TO-NORMAL, etc.).

3.2.4.6 Scheduling

This test includes the following:

a. Schedule Lists - Demonstrate that schedules are installed and configured start/stop, mode change, and night setback schedules as defined in the sequence of operations including holidays. Demonstrate the ability to program alterations to programmed operating schedules based on the priority of events, including the ability to temporarily override the

programmed schedule of equipment. Demonstrate operational override of a programmed schedule shall be for a specific duration following which the schedule shall revert back to the reprogrammed schedule.

b. Display of Start/Stop Times and Actions - Demonstrate the ability to inspect the content of any schedule and determine the specific control actions that will occur at any time, on any date.

c. Modification of Schedules - Demonstrate that all calendar entries and schedules shall be modifiable from any local workstation by an operator with sufficient privilege.

3.2.4.7 Trending

This test includes the following:

a. Archival Storage of Data - Demonstrate that archival storage of data will be handled by the operator workstation/server. Demonstrate that local trend archiving and display can be accomplished through the use of BACnet Trend Log objects. Archival data shall be readily accessible by users, and users shall be able to retrieve said data for up to 3 months history.

b. Modification of Trend Log Parameters - Demonstrate that an operator with sufficient privileges shall be able to change the data points to be logged, the sampling rate, and the duration of a trend log.

3.2.4.8 Device and Network Management

This test includes the following:

a. Display of Device Status Information - Operators shall be able to display at any time the operational status of any device on the network.

b. Display of BACnet Object Information - Operators shall be able to display at any time any property of any BACnet object. Operators shall be able to display property values of objects grouped by object type, object location, and building system.

c. Silencing Devices that are Transmitting Erroneous Data -Operators shall be able to direct a field device to stop transmitting event, alarm, or COV notifications until a subsequent command to resume transmissions is received.

d. Time Synchronization - Operators shall be able to set the time and date in any device on the network that supports time-of-day functionality. The operator shall be able to select to set the time and date for an individual device or all devices on a single local network.

e. Remote Device Re-initialization - Operators shall have the ability to issue re-initialization commands to any device that supports remote re-initialization.

f. Backup and Restore – Operators shall have the ability to backup and restore all BACnet devices on the network that support this capability.

g. Configuration Management of Half-Routers, Routers, and BBMDs – Operators shall have

the ability to display and modify the routing table entries in all supplied BACnet half-routers, routers, and the broadcast distribution and foreign device registration tables in all BBMDs.

3.2.4.9 Execution of Sequence of Operation

Demonstrate the HVAC system operates properly through the complete sequence of operation. Insert the complete sequence of operation into the PVT spreadsheet with spaces between each line to allow for observations and comments.

3.2.4.10 Control Loop Stability and Accuracy

Furnish the Government graphed trends of control loops to demonstrate the control loop is stable and that set point is maintained. Control loop response shall respond to set point changes of 10 percent and stabilize in 3 minutes or less. Control loop trend data shall be in real time and the time between data points shall not greater than one minute.

3.2.4.11 Stand-alone Capability

3.2.4.12 Demonstrate stand-alone controller capability for each central mechanical system, each air handler, and each zone. Zones with identical controllers and identical sequences may be randomly tested one controller per zone. Controllers shall provide stable and reliable stand-alone operation using default values or other method for values normally read over the network. Verify that a system alarm is generated indicating the communications failure for each controller in a stand-alone state.

3.3 TRAINING

Submit syllabus, instructor's qualification statement, and all training materials (O&M and Course DDC manuals for each student) 45 calendar days prior to the start of training. Obtain written approval of the training course and instructor's qualifications before scheduling training. The Contractor shall request a meeting at least 30 calendar days prior to the start of training with the Contracting Officer and the DDC Administer to determining the training dates for course instruction to ensure availability of students and resolve any scheduling conflicts. Furnish a qualified instructor to conduct training courses for designated personnel in the maintenance and operation of the HVAC and DDC system. Instructor's qualifications shall include two years experience in the installation and programming of DDC systems and a minimum of 80 hours of experience providing instruction on the same manufacturer's equipment that is installed under this contract. Provide written documentation showing instructor's qualifications. Orient training to the specific system being installed under this contract. Use the Operation and Maintenance manual as the primary instructional aid. DDC training materials used by the manufacturer at the factory level shall be incorporated into the Operations and Maintenance manuals and provided on CD media. Manuals shall be delivered for each trainee with two additional sets delivered for archiving at the project site. Training manuals shall include an agenda, defined objectives, and a detailed description of the subject matter for each lesson. Furnish audio-visual equipment and all other training materials and supplies. A training day is defined as 8 hours of classroom or lab instruction, including two 15 minute breaks and excluding lunch time, Monday through Friday, during the daytime shift in effect at the training facility. For guidance, the Contractor should assume the attendees will have experience with DDC on other systems but not with the one installed under this contract. Training shall be provided with the goal in mind that each student shall acquire the skills to maintain the DDC system with the same professional skills as the installing manufacturer's representative.

3.3.1 DDC Training Phase I

The first class shall be taught for a period of 3 consecutive training days at least 2 weeks prior to the scheduled Performance Verification Tests. The first course shall be taught in a government provided facility on campus. Training shall be classroom, but have hands-on operation of similar digital controllers. A maximum of 6 personnel will attend this course. Upon completion of this course, each student should be able to perform elementary operations and describe the general hardware architecture and functionality of the system. This course shall include but not be limited to:

a. Using the Operation and Maintenance manuals

b. BACnet and communication architecture

c. Modifying set points

d. Adding and deleting I/O point

e. Writing application programs and creating graphics

f. Data base backup

g. Trend reports

h. Alarm reporting and routing

i. Troubleshooting hardware and communication errors

3.3.2 DDC Training Phase II

The second course shall be taught in the field after the Performance Verification Tests is complete, using the operating equipment at the project site for a total of 2 consecutive days. A maximum of 6 personnel will attend the course. The course shall consist of hands-on training under the constant monitoring of the instructor. The instructor shall determine the password issued to each student before each session. Upon completion of this course, students should be fully proficient in the operation of each system function. At this point the highest level password for complete access to the system will be issued. Each student who successfully meets the criteria of the course given will be given a certificate of satisfactory completion showing their name, course dates and the signature of instructor. Students who do not meet the minimum requirements of the course curriculum may be denied the certificate.

3.3.3 Manufacturer's Factory Training

Additional training shall be provided by the manufacturer at a factory training facility upon completion of site training for maximum of up to 5 days. Maximum of 2 personnel will attend. The course(s) shall be selected by the Government from a list of standard catalog course offerings that are regularly scheduled and available to the end user. All costs associated with the factory training shall be included except for travel and per diem which will remain the responsibility of the Government. Enrollment of the personnel attending factory training will be coordinated with the Government and

dates reserved based on course availability. Provide a confirmation letter within 10 days after the reservations have been made showing the training dates and reservations for the personnel who are attending. The Government reserves the right to substitute personnel attending factory training at any time prior to the training dates. This training may be scheduled to take place up to 2 months after the completion of all other contract phases provided the confirmation letter has been delivered.

-- End of Section –

SECTION 078413

PENETRATION FIRESTOPPING

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:

1. Penetration firestopping systems for the following applications:

a. Penetrations in fire-resistance-rated walls.
b. Penetrations in horizontal assemblies.
c. Penetrations in smoke barriers.

1.2 ACTION SUBMITTALS

A. Product Data: For each type of product.

B. Product Schedule: For each penetration firestopping system. Include location, illustration of firestopping system, and design designation of qualified testing and inspecting agency.

1. Engineering Judgments: Where Project conditions require modification to a qualified testing and inspecting agency's illustration for a particular penetration firestopping system, submit illustration, with modifications marked, approved by penetration firestopping system manufacturer's fire-protection engineer as an engineering judgment or equivalent fire-resistance-rated assembly. Obtain approval of authorities having jurisdiction prior to submittal.

1.3 INFORMATIONAL SUBMITTALS

A. Qualification Data: For Installer.

B. Product Test Reports: For each penetration firestopping system, for tests performed by a qualified testing agency.

1.4 CLOSEOUT SUBMITTALS

A. Installer Certificates: From Installer indicating that penetration firestopping systems have been installed in compliance with requirements and manufacturer's written instructions.

1.5 QUALITY ASSURANCE

A. Installer Qualifications: A firm that has been approved by FM Approval according to FM Approval 4991, "Approval of Firestop Contractors," or been evaluated by UL and found to comply with its "Qualified Firestop Contractor Program Requirements."

PART 2 - PRODUCTS

2.1 PERFORMANCE REQUIREMENTS

A. Fire-Test-Response Characteristics:

1. Perform penetration firestopping system tests by a qualified testing agency acceptable to authorities having jurisdiction.
2. Test per testing standards referenced in "Penetration Firestopping Systems" Article. Provide rated systems complying with the following requirements:

a. Penetration firestopping systems shall bear classification marking of a qualified testing agency.

1) UL in its "Fire Resistance Directory."
2) Intertek Group in its "Directory of Listed Building Products."
3) FM Approval in its "Approval Guide."

2.2 PENETRATION FIRESTOPPING SYSTEMS

A. Penetration Firestopping Systems: Systems that resist spread of fire, passage of smoke and other gases, and maintain original fire-resistance rating of construction penetrated. Penetration firestopping systems shall be compatible with one another, with the substrates forming openings, and with penetrating items if any.

1. 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:

a. 3M Fire Protection Products.
b. HoldRite; Reliance Worldwide Company.
c. Passive Fire Protection Partners.
d. STC Sound Control.

B. Penetrations in Fire-Resistance-Rated Walls: Penetration firestopping systems with ratings determined per ASTM E814 or UL 1479, based on testing at a positive pressure differential of 0.01-inch wg (2.49 Pa).

1. F-Rating: Not less than the fire-resistance rating of constructions penetrated.

C. Penetrations in Horizontal Assemblies: Penetration firestopping systems with ratings determined per ASTM E814 or UL 1479, based on testing at a positive pressure differential of 0.01-inch wg (2.49 Pa).

1. F-Rating: At least one hour, but not less than the fire-resistance rating of constructions penetrated.
2. T-Rating: At least one hour, but not less than the fire-resistance rating of constructions penetrated except for floor penetrations within the cavity of a wall.
3. W-Rating: Provide penetration firestopping systems showing no evidence of water leakage when tested according to UL 1479.

D. Penetrations in Smoke Barriers: Penetration firestopping systems with ratings determined per UL 1479, based on testing at a positive pressure differential of 0.30-inch wg (74.7 Pa).

1. L-Rating: Not exceeding 5.0 cfm/sq. ft. (0.025 cu. m/s per sq. m) of penetration opening at and no more than 50-cfm (0.024-cu. m/s) cumulative total for any 100 sq. ft. (9.3 sq. m) at both ambient and elevated temperatures.

E. Exposed Penetration Firestopping Systems: Flame-spread and smoke-developed indexes of less than 25 and 450, respectively, per ASTM E84.

F. Accessories: Provide components for each penetration firestopping system that are needed to install fill materials and to maintain ratings required. Use only those components specified by penetration firestopping system manufacturer and approved by qualified testing and inspecting agency for conditions indicated.

PART 3 - EXECUTION

3.1 INSTALLATION

A. Examine substrates and conditions, with Installer present, for compliance with requirements for opening configurations, penetrating items, substrates, and other conditions affecting performance of the Work.

B. General: Install penetration firestopping systems to comply with manufacturer's written installation instructions and published drawings for products and applications.

C. Install forming materials and other accessories of types required to support fill materials during their application and in the position needed to produce cross-sectional shapes and depths required to achieve fire ratings.

1. After installing fill materials and allowing them to fully cure, remove combustible forming materials and other accessories not forming permanent components of firestopping.

D. Install fill materials by proven techniques to produce the following results:

1. Fill voids and cavities formed by openings, forming materials, accessories and penetrating items to achieve required fire-resistance ratings.
2. Apply materials so they contact and adhere to substrates formed by openings and penetrating items.
3. For fill materials that will remain exposed after completing the Work, finish to produce smooth, uniform surfaces that are flush with adjoining finishes.

3.2 IDENTIFICATION

A. Wall Identification: Permanently label walls containing penetration firestopping systems with the words "FIRE AND/OR SMOKE BARRIER - PROTECT ALL OPENINGS," using lettering not less than 3 inches (76 mm) high and with minimum 0.375-inch (9.5-mm) strokes.

1. Locate in accessible concealed floor, floor-ceiling, or attic space at 15 feet (4.57 m) from end of wall and at intervals not exceeding 30 feet (9.14 m).

B. Penetration Identification: Identify each penetration firestopping system with legible metal or plastic labels. Attach labels permanently to surfaces adjacent to and within 6 inches (150 mm) of penetration firestopping system edge so labels are visible to anyone seeking to remove penetrating items or firestopping systems. Use mechanical fasteners or self-adhering-type labels with adhesives capable of permanently bonding labels to surfaces on which labels are placed. Include the following information on labels:

1. The words "Warning - Penetration Firestopping - Do Not Disturb. Notify Building Management of Any Damage."
2. Contractor's name, address, and phone number.
3. Designation of applicable testing and inspecting agency.
4. Date of installation.
5. Manufacturer's name.
6. Installer's name.

3.3 FIELD QUALITY CONTROL

A. Where deficiencies are found or penetration firestopping system is damaged or removed because of testing, repair or replace penetration firestopping system to comply with requirements.

B. Do not proceed with enclosing penetration firestopping systems until NIST FFSG has performed inspections.

END OF SECTION 078413

SECTION 260500 - COMMON WORK RESULTS FOR ELECTRICAL

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. Electrical equipment coordination and installation.
2. Sleeves for raceways and cables.
3. Sleeve seals.
4. Grout.
5. Common electrical installation requirements.

1.3 DEFINITIONS

A. EPDM: Ethylene-propylene-diene terpolymer rubber.

B. NBR: Acrylonitrile-butadiene rubber.

1.4 COORDINATION

A. Coordinate arrangement, mounting, and support of electrical equipment:

1. To allow maximum possible headroom unless specific mounting heights that reduce headroom are indicated.
2. To provide for ease of disconnecting the equipment with minimum interference to other installations.
3. To allow right of way for piping and conduit installed at required slope.
4. So connecting raceways, cables, wireways, cable trays, and busways will be clear of obstructions and of the working and access space of other equipment.

B. Coordinate installation of required supporting devices and set sleeves in cast-in-place concrete, masonry walls, and other structural components as they are constructed.

C. Coordinate location of access panels and doors for electrical items that are behind finished surfaces or otherwise concealed.

D. Coordinate sleeve selection and application with selection and application of firestopping specified in Division 07.

PART 2 - PRODUCTS

2.1 SLEEVES FOR RACEWAYS AND CABLES

A. Steel Pipe Sleeves: ASTM A 53/A 53M, Type E, Grade B, Schedule 40, galvanized steel, plain ends.

B. Cast-Iron Pipe Sleeves: Cast or fabricated "wall pipe," equivalent to ductile-iron pressure pipe, with plain ends and integral water stop, unless otherwise indicated.

C. Sleeves for Rectangular Openings: Galvanized sheet steel.

1. Minimum Metal Thickness:

a. For sleeve cross-section rectangle perimeter less than 50 inches (1270 mm) and no side more than 16 inches (400 mm), thickness shall be 0.052 inch (1.3 mm).
b. For sleeve cross-section rectangle perimeter equal to, or more than, 50 inches (1270 mm) and 1 or more sides equal to, or more than, 16 inches (400 mm), thickness shall be 0.138 inch (3.5 mm).

2.2 SLEEVE SEALS

A. Description: Modular sealing device, designed for field assembly, to fill annular space between sleeve and raceway or cable.

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
2. Basis-of-Design Product: Subject to compliance with requirements, provide comparable product by one of the following:

a. Advance Products & Systems, Inc.
b. Calpico, Inc.
c. Metraflex Co.
d. Pipeline Seal and Insulator, Inc.

3. Sealing Elements: EPDM interlocking links shaped to fit surface of cable or conduit. Include type and number required for material and size of raceway or cable.
4. Pressure Plates: Carbon steel. Include two for each sealing element.
5. Connecting Bolts and Nuts: Carbon steel with corrosion-resistant coating of length required to secure pressure plates to sealing elements. Include one for each sealing element.

2.3 GROUT

A. Nonmetallic, Shrinkage-Resistant Grout: ASTM C 1107, factory-packaged, nonmetallic aggregate grout, noncorrosive, nonstaining, mixed with water to consistency suitable for application and a 30-minute working time.

PART 3 - EXECUTION

3.1 COMMON REQUIREMENTS FOR ELECTRICAL INSTALLATION

A. Comply with NECA 1.

B. Measure indicated mounting heights to bottom of unit for suspended items and to center of unit for wall-mounting items.

C. Headroom Maintenance: If mounting heights or other location criteria are not indicated, arrange and install components and equipment to provide maximum possible headroom consistent with these requirements.

D. Equipment: Install to facilitate service, maintenance, and repair or replacement of components of both electrical equipment and other nearby installations. Connect in such a way as to facilitate future disconnecting with minimum interference with other items in the vicinity.

E. Right of Way: Give to piping systems installed at a required slope.

3.2 SLEEVE INSTALLATION FOR ELECTRICAL PENETRATIONS

A. Electrical penetrations occur when raceways, cables, wireways, cable trays, or busways penetrate concrete slabs, concrete or masonry walls, or fire-rated floor and wall assemblies.

B. Concrete Slabs and Walls: Install sleeves for penetrations unless core-drilled holes or formed openings are used. Install sleeves during erection of slabs and walls.

C. Use pipe sleeves unless penetration arrangement requires rectangular sleeved opening.

D. Fire-Rated Assemblies: Install sleeves for penetrations of fire-rated floor and wall assemblies unless openings compatible with firestop system used are fabricated during construction of floor or wall.

E. Cut sleeves to length for mounting flush with both surfaces of walls.

F. Extend sleeves installed in floors 2 inches (50 mm) above finished floor level.

G. Size pipe sleeves to provide 1/4-inch (6.4-mm) annular clear space between sleeve and raceway or cable, unless indicated otherwise.

H. Seal space outside of sleeves with grout for penetrations of concrete and masonry

1. Promptly pack grout solidly between sleeve and wall so no voids remain. Tool exposed surfaces smooth; protect grout while curing.

I. Interior Penetrations of Non-Fire-Rated Walls and Floors: Seal annular space between sleeve and raceway or cable, using joint sealant appropriate for size, depth, and location of joint. Comply with requirements in Division 07 Section "Joint Sealants.".

J. Fire-Rated-Assembly Penetrations: Maintain indicated fire rating of walls, partitions, ceilings, and floors at raceway and cable penetrations. Install sleeves and seal raceway and cable penetration sleeves with firestop materials. Comply with requirements in Division 07 Section "Penetration Firestopping."

K. Aboveground, Exterior-Wall Penetrations: Seal penetrations using steel pipe sleeves and mechanical sleeve seals. Select sleeve size to allow for 1-inch (25-mm) annular clear space between pipe and sleeve for installing mechanical sleeve seals.

3.3 SLEEVE-SEAL INSTALLATION

A. Install to seal exterior wall penetrations.

B. Use type and number of sealing elements recommended by manufacturer for raceway or cable material and size. Position raceway or cable in center of sleeve. Assemble mechanical sleeve seals and install in annular space between raceway or cable and sleeve. Tighten bolts against pressure plates that cause sealing elements to expand and make watertight seal.

3.4 FIRESTOPPING

A. Apply firestopping to penetrations of fire-rated floor and wall assemblies for electrical installations to restore original fire-resistance rating of assembly. Firestopping materials and installation requirements are specified in Division 07.

END OF SECTION 260500

SECTION 260519 - LOW-VOLTAGE ELECTRICAL POWER CONDUCTORS AND CABLES

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:

1. Copper building wire.
2. Fire-alarm wire and cable.
3. Connectors and splices.

1.2 ACTION SUBMITTALS

A. Product Data: For each type of product.

B. Product Schedule: Indicate type, use, location, and termination locations.

1.3 INFORMATIONAL SUBMITTALS

A. Field quality-control reports.

PART 2 - PRODUCTS

2.1 COPPER BUILDING WIRE

A. Description: Flexible, insulated and uninsulated, drawn copper current-carrying conductor with an overall insulation layer or jacket, or both, rated 600 V or less.

B. Standards:

1. Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and use.
2. Conductor and Cable Marking: Comply with wire and cable marking according to UL's "Wire and Cable Marking and Application Guide."

C. Conductors: Copper, complying with ASTM B3 for bare annealed copper and with ASTM B8 for stranded conductors.

D. Conductor Insulation:
1. Type THHN and Type THWN-2: Comply with UL 83.

2.2 CONNECTORS AND SPLICES

A. Description: Factory-fabricated connectors, splices, and lugs of size, ampacity rating, material, type, and class for application and service indicated; listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and use.

B. Jacketed Cable Connectors: For steel and aluminum jacketed cables, zinc die-cast with set screws, designed to connect conductors specified in this Section.

C. Lugs: One piece, seamless, designed to terminate conductors specified in this Section.

1. Material: Copper.
2. Type: One hole with standard barrels.
3. Termination: Compression.

PART 3 - EXECUTION

3.1 CONDUCTOR MATERIAL APPLICATIONS

A. Branch Circuits:

1. Copper. Solid for No. 10 AWG and smaller; stranded for No. 8 AWG and larger.
2. Copper. Solid for No. 12 AWG and smaller; stranded for No. 10 AWG and larger.

B. Power-Limited Fire Alarm and Control: Solid for No. 12 AWG and smaller.

3.2 CONDUCTOR INSULATION AND MULTICONDUCTOR CABLE APPLICATIONS AND WIRING METHODS

A. Exposed Branch Circuits, Including in Crawlspaces: Type THHN/THWN-2, single conductors in raceway

B. Branch Circuits Concealed in Ceilings, Walls, and Partitions: Type THHN/THWN-2, single conductors in raceway.

3.3 INSTALLATION, GENERAL

A. Conceal cables in finished walls, ceilings, and floors unless otherwise indicated.

B. Complete raceway installation between conductor and cable termination points according to Section 260533 "Raceways and Boxes for Electrical Systems" prior to pulling conductors and cables.

C. Use manufacturer-approved pulling compound or lubricant where necessary; compound used must not deteriorate conductor or insulation. Do not exceed manufacturer's recommended maximum pulling tensions and sidewall pressure values.

D. Use pulling means, including fish tape, cable, rope, and basket-weave wire/cable grips, that will not damage cables or raceway.

E. Install exposed cables parallel and perpendicular to surfaces of exposed structural members, and follow surface contours where possible.

F. Support cables according to Section 260529 "Hangers and Supports for Electrical Systems."

3.4 CONNECTIONS

A. Tighten electrical connectors and terminals according to manufacturer's published torque-tightening values. If manufacturer's torque values are not indicated, use those specified in UL 486A-486B.

B. Make splices, terminations, and taps that are compatible with conductor material.

C. Comply with requirements in Division 28 for connecting, terminating, and identifying wires and cables.

3.5 IDENTIFICATION

A. Identify and color-code conductors and cables according to Section 260553 "Identification for Electrical Systems."

B. Identify each spare conductor at each end with identity number and location of other end of conductor, and identify as spare conductor.

3.6 FIRESTOPPING

A. Apply firestopping to electrical penetrations of fire-rated floor and wall assemblies to restore original fire-resistance rating of assembly according to Division 07.

3.7 FIELD QUALITY CONTROL

A. Tests and Inspections:

1. After installing conductors and cables and before electrical circuitry has been energized, test service entrance and feeder conductors for compliance with requirements.

2. Perform each of the following visual and electrical tests:

a. Inspect exposed sections of conductor and cable for physical damage and correct connection according to the single-line diagram.
b. Test bolted connections for high resistance using one of the following:

1) A low-resistance ohmmeter.
2) Calibrated torque wrench.
3) Thermographic survey.

c. Inspect compression-applied connectors for correct cable match and indentation.
d. Inspect for correct identification.
e. Inspect cable jacket and condition.
f. Insulation-resistance test on each conductor for ground and adjacent conductors. Apply a potential of 500 V(dc) for 300 V rated cable and 1000 V(dc) for 600 V rated cable for a one-minute duration.
g. Continuity test on each conductor and cable.
h. Uniform resistance of parallel conductors.

B. Cables will be considered defective if they do not pass tests and inspections.

C. Prepare test and inspection reports to record the following:

1. Procedures used.
2. Results that comply with requirements.
3. Results that do not comply with requirements, and corrective action taken to achieve compliance with requirements.

END OF SECTION 260519

SECTION 260526 - GROUNDING AND BONDING FOR ELECTRICAL SYSTEMS

PART 1 - GENERAL

1.1 SUMMARY

A. Section includes grounding and bonding systems and equipment.

1.2 ACTION SUBMITTALS

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

PART 2 - PRODUCTS

2.1 SYSTEM DESCRIPTION

A. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.

B. Comply with UL 467 for grounding and bonding materials and equipment.

2.2 CONDUCTORS

A. Insulated Conductors: Copper wire or cable insulated for 600 V unless otherwise required by applicable Code or authorities having jurisdiction.

B. Bare Copper Conductors:

1. Solid Conductors: ASTM B3.
2. Stranded Conductors: ASTM B8..
3. Bonding Cable: 28 kcmil, 14 strands of No. 17 AWG conductor, 1/4 inch (6 mm) in diameter.
4. Bonding Conductor: No. 4 or No. 6 AWG, stranded conductor.
5. Bonding Jumper: Copper tape, braided conductors terminated with copper ferrules; 1-5/8 inch (41 mm) wide and 1/16 inch (1.6 mm) thick.

2.3 CONNECTORS

A. Listed and labeled by an NRTL acceptable to authorities having jurisdiction for applications in which used and for specific types, sizes, and combinations of conductors and other items connected.

B. Welded Connectors: Exothermic-welding kits of types recommended by kit manufacturer for materials being joined and installation conditions.

C. Mechanical-Type Bus-Bar Connectors: Cast silicon bronze, solderless compression-type wire terminals, and long-barrel, two-bolt connection to ground bus bar.

D. Compression-Type Bus-Bar Connectors: Copper or copper alloy, with two wire terminals.

E. Beam Clamps: Mechanical type, terminal, ground wire access from four directions, with dual, tin-plated or silicon bronze bolts.

F. Cable-to-Cable Connectors: Compression type, copper or copper alloy.

G. Conduit Hubs: Mechanical type, terminal with threaded hub.

PART 3 - EXECUTION

3.1 APPLICATIONS

A. Conductors: Install solid conductor for No. 8 AWG and smaller, and stranded conductors for No. 6 AWG and larger unless otherwise indicated.

B. Grounding Conductors: Green-colored insulation.

C. Conductor Terminations and Connections:

1. Pipe and Equipment Grounding Conductor Terminations: Bolted connectors.
2. Connections to Structural Steel: Welded connectors.

3.2 EQUIPMENT GROUNDING

A. Install insulated equipment grounding conductors with all feeders and branch circuits.

B. Install insulated equipment grounding conductors with the following items, in addition to those required by NFPA 70:

1. Branch circuits.

3.3 INSTALLATION

A. Grounding Conductors: Route along shortest and straightest paths possible unless otherwise indicated or required by Code. Avoid obstructing access or placing conductors where they may be subjected to strain, impact, or damage.

B. Connections: Make connections so possibility of galvanic action or electrolysis is minimized. Select connectors, connection hardware, conductors, and connection methods so metals in direct contact are galvanically compatible.

1. Use electroplated or hot-tin-coated materials to ensure high conductivity and to make contact points closer in order of galvanic series.
2. Make connections with clean, bare metal at points of contact.

3. Make aluminum-to-steel connections with stainless steel separators and mechanical clamps.
4. Make aluminum-to-galvanized-steel connections with tin-plated copper jumpers and mechanical clamps.
5. Coat and seal connections having dissimilar metals with inert material to prevent future penetration of moisture to contact surfaces.

3.4 FIELD QUALITY CONTROL

A. Tests and Inspections:

1. After installing grounding system but before permanent electrical circuits have been energized, test for compliance with requirements.
2. Inspect physical and mechanical condition. Verify tightness of accessible, bolted, electrical connections with a calibrated torque wrench according to manufacturer's written instructions.

B. Prepare test and inspection reports.

C. Report measured ground resistances that exceed the following values:

1. Power and Lighting Equipment or System with Capacity of 500 kVA and Less: 10 ohms.

D. Excessive Ground Resistance: If resistance to ground exceeds specified values, notify Architect promptly and include recommendations to reduce ground resistance.

END OF SECTION 260526

SECTION 260529 - HANGERS AND SUPPORTS FOR ELECTRICAL SYSTEMS

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:

1. Support, anchorage, and attachment components.
2. Fabricated metal equipment support assemblies.

PART 2 - PRODUCTS

2.1 PERFORMANCE REQUIREMENTS

A. Delegated Design: Engage a qualified structural professional engineer to design hanger and support system.

B. Surface-Burning Characteristics: Comply with ASTM E84; testing by a qualified testing agency. Identify products with appropriate markings of applicable testing agency.

1. Flame Rating: Class 1.
2. Self-extinguishing according to ASTM D635.

2.2 SUPPORT, ANCHORAGE, AND ATTACHMENT COMPONENTS

A. Conduit and Cable Support Devices: Steel hangers, clamps, and associated fittings, designed for types and sizes of raceway or cable to be supported.

B. Support for Conductors in Vertical Conduit: Factory-fabricated assembly consisting of threaded body and insulating wedging plug or plugs for nonarmored electrical conductors or cables in riser conduits. Plugs must have number, size, and shape of conductor gripping pieces as required to suit individual conductors or cables supported. Body must be made of malleable iron.

C. Mounting, Anchoring, and Attachment Components: Items for fastening electrical items or their supports to building surfaces include the following:

1. Mechanical-Expansion Anchors: Insert-wedge-type, zinc-coated steel, for use in hardened portland cement concrete, with tension, shear, and pullout capacities appropriate for supported loads and building materials where used.
2. Concrete Inserts: Steel or malleable-iron, slotted support system units are similar to MSS Type 18 units and comply with MFMA-4 or MSS SP-58.
3. Clamps for Attachment to Steel Structural Elements: MSS SP-58 units are suitable for attached structural element.

4. Through Bolts: Structural type, hex head, and high strength. Comply with ASTM F3125/F3125M, Grade A325 (Grade A325M).
5. Toggle Bolts: All steel springhead type.
6. Hanger Rods: Threaded steel.

PART 3 - EXECUTION

3.1 SELECTION

A. Comply with the following standards for selection and installation of hangers and supports, except where requirements on Drawings or in this Section are stricter:

1. NECA NEIS 101

B. Comply with requirements in Division 07 for firestopping materials and installation for penetrations through fire-rated walls, ceilings, and assemblies.

C. Comply with requirements for raceways and boxes specified in Section 260533 "Raceway and Boxes for Electrical Systems."

D. Maximum Support Spacing and Minimum Hanger Rod Size for Raceways: Space supports for EMT, IMC, and ERMC as required by NFPA 70. Minimum rod size must be 1/4 inch (6 mm) in diameter.

3.2 INSTALLATION OF SUPPORTS

A. Comply with NECA NEIS 101 for installation requirements except as specified in this article.

B. Strength of Support Assemblies: Where not indicated, select sizes of components so strength will be adequate to carry present and future static loads within specified loading limits. Minimum static design load used for strength determination must be weight of supported components plus 200 lb (90 kg).

C. Mounting and Anchorage of Surface-Mounted Equipment and Components: Anchor and fasten electrical items and their supports to building structural elements by the following methods unless otherwise indicated by code:
1. To Masonry: Approved toggle-type bolts on hollow masonry units and expansion anchor fasteners on solid masonry units.
2. To Existing Concrete: Expansion anchor fasteners.
3. To Steel: Welded threaded studs complying with AWS D1.1/D1.1M, with lock washers and nuts.
4. To Light Steel: Sheet metal screws.
5. Items Mounted on Hollow Walls and Nonstructural Building Surfaces: Mount cabinets, panelboards, disconnect switches, control enclosures, pull and junction boxes, transformers, and other devices on slotted-channel racks attached to substrate.

D. Drill holes for expansion anchors in concrete at locations and to depths that avoid the need for reinforcing bars.

3.3 PAINTING

A. Touchup:

1. Clean field welds and abraded areas of shop paint. Paint exposed areas immediately after erecting hangers and supports. Use same materials as used for shop painting. Comply with SSPC-PA 1 requirements for touching up field-painted surfaces.

a. Apply paint by brush or spray to provide minimum dry film thickness of 2.0 mils (0.05 mm).

B. Galvanized Surfaces: Clean welds, bolted connections, and abraded areas and apply galvanizing-repair paint to comply with ASTM A780.

END OF SECTION 260529

SECTION 260533 - RACEWAY AND BOXES FOR ELECTRICAL SYSTEMS

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:
1. Type EMT-S raceways and elbows.
2. Type ERMC-S raceways, elbows, couplings, and nipples.
3. Fittings for conduit, tubing, and cable.
4. Cabinets, cutout boxes, junction boxes, pull boxes, and miscellaneous enclosures.
5. Cover plates for device boxes.

PART 2 - PRODUCTS

2.1 TYPE EMT-S RACEWAYS AND ELBOWS

A. Performance Criteria:

1. Regulatory Requirements: Listed and labeled in accordance with NFPA 70 and marked for intended location and use.
2. General Characteristics: UL 797 and UL Category Control Number FJMX.

B. Steel Electrical Metal Tubing (EMT-S) and Elbows:
1. Material: Steel.
2. Options:
   a. Interior Coating: Zinc with organic top coating.
   b. Minimum Trade Size: Metric designator 21 (trade size 3/4).

2.2 TYPE ERMC-S RACEWAYS, ELBOWS, COUPLINGS, AND NIPPLES

A. Performance Criteria:

1. Regulatory Requirements: Listed and labeled in accordance with NFPA 70 and marked for intended location and use.
2. General Characteristics: UL 6 and UL Category Control Number DYIX.

B. Galvanized-Steel Electrical Rigid Metal Conduit (ERMC-S-G), Elbows, Couplings, and Nipples:
1. Options:

   a. Interior Coating: Zinc with organic top coating.
   b. Minimum Trade Size: Metric designator 21 (trade size 3/4).

2.3 FITTINGS FOR CONDUIT, TUBING, AND CABLE

A. Performance Criteria:

1. Regulatory Requirements: Listed and labeled in accordance with NFPA 70 and marked for intended location and use.

B. Fittings for Type ERMC, Type IMC, Type PVC, Type EPEC, and Type RTRC Raceways:
1. General Characteristics: UL 514B and UL Category Control Number DWTT.
2. Options:

a. Material: Steel.
b. Coupling Method: Compression coupling.
c. Conduit Fittings for Hazardous (Classified) Locations: UL 1203.
d. Expansion and Deflection Fittings: UL 651 with flexible external bonding jumper.

C. Fittings for Type EMT Raceways:
1. General Characteristics: UL 514B and UL Category Control Number FKAV.
2. Options:

a. Material: Steel.
b. Coupling Method: Compression coupling.
c. Conduit Fittings for Hazardous (Classified) Locations: UL 1203.
d. Expansion and Deflection Fittings: UL 651 with flexible external bonding jumper.

2.4 METALLIC OUTLET BOXES, DEVICE BOXES, RINGS, AND COVERS

A. Performance Criteria:

1. Regulatory Requirements: Listed and labeled in accordance with NFPA 70 and marked for intended location and use.
2. General Characteristics: UL 514A and UL Category Control Number QCIT.

B. Metallic Device Boxes:

1. Description: Box with provisions for mounting wiring device directly to box.
2. Options:

a. Material: Sheet steel.
b. Sheet Metal Depth: minimum 1.5 inch (38 mm).

2.5 CABINETS, CUTOUT BOXES, JUNCTION BOXES, PULL BOXES, AND MISCELLANEOUS ENCLOSURES

A. Performance Criteria:

1. Regulatory Requirements: Listed and labeled in accordance with NFPA 70 and marked for intended location and use.
2. General Characteristics:

a. Non-Environmental Characteristics: UL 50.
b. Environmental Characteristics: UL 50E.

B. Indoor Sheet Metal Junction and Pull Boxes:

1. Description: Box with a blank cover that serves the purpose of joining different runs of raceway or cable.
2. Additional Characteristics: UL Category Control Number BGUZ.
3. Options:

a. Degree of Protection: Type 1.

2.6 COVER PLATES FOR DEVICES BOXES

A. Performance Criteria:

1. Regulatory Requirements: Listed and labeled in accordance with NFPA 70 and marked for intended location and use.
2. General Characteristics:

a. Reference Standards: UL 514D and UL Category Control Numbers QCIT and QCMZ.
b. Wallplate-Securing Screws: Metal with head color to match wallplate finish.

B. Metallic Cover Plates for Device Boxes:
1. Options:
a. Wallplate Material: 0.032 inch (0.8 mm) thick Type 302/304 non-magnetic stainless steel with brushed finish.

PART 3 - EXECUTION

3.1 SELECTION OF RACEWAYS

A. Unless more stringent requirements are specified in Contract Documents or manufacturers' written instructions, comply with NFPA 70 for selection of raceways. Consult Architect for resolution of conflicting requirements.

B. Indoors:
1. Exposed and Subject to Severe Physical Damage: ERMC. Subject to severe physical damage includes the following locations:

a. Loading docks.
b. Corridors used for traffic of mechanized carts, forklifts, and pallet-handling units.
c. Mechanical rooms.

2. Exposed and Subject to Physical Damage: ERMC. Subject to physical damage includes the following locations:

a. Locations less than 2.5 m (8 ft) above finished floor.
b. Stub-ups to above suspended ceilings.

3. Exposed and Not Subject to Physical Damage: ERMC.
4. Concealed in Ceilings and Interior Walls and Partitions: EMT.

C. Raceway Fittings: Select fittings in accordance with NEMA FB 2.10 guidelines.

1. ERMC and IMC: Provide threaded type fittings unless otherwise indicated.

3.2 SELECTION OF BOXES AND ENCLOSURES

A. Unless more stringent requirements are specified in Contract Documents or manufacturers' written instructions, comply with NFPA 70 for selection of boxes and enclosures. Consult Architect for resolution of conflicting requirements.

B. Degree of Protection:

1. Indoors:

a. Type 1 unless otherwise indicated.
b. Damp or Dusty Locations: Type 12.
c. Surface Mounted in Kitchens and Other Locations Exposed to Oil or Coolants: Type 12.
d. Flush Mounted in Kitchens and Other Locations Exposed to Oil or Coolants: Type 12.
e. Locations Exposed to Airborne Dust, Lint, Fibers, or Flyings: Type 4.
f. Locations Exposed to Hosedown: Type 4.
g. Locations Exposed to Corrosive Agents: Type 4X.

3.3 INSTALLATION OF RACEWAYS

A. Installation Standards:

1. Unless more stringent requirements are specified in Contract Documents or manufacturers' written instructions, comply with NFPA 70 for installation of raceways. Consult Architect for resolution of conflicting requirements.
2. Comply with NFPA 70 limitations for types of raceways allowed in specific occupancies and number of floors.
3. Comply with requirements in Section 260529 "Hangers and Supports for Electrical Systems" for hangers and supports.
4. Comply with NECA NEIS 101 for installation of steel raceways.
5. Comply with NECA NEIS 102 for installation of aluminum raceways.
6. Comply with NECA NEIS 111 for installation of nonmetallic raceways.
7. Install raceways square to the enclosure and terminate at enclosures without hubs with locknuts on both sides of enclosure wall. Install locknuts hand tight, plus one-quarter turn more.

B. General Requirements for Installation of Raceways:

1. Complete raceway installation before starting conductor installation.
2. Provide stub-ups through floors with coupling threaded inside for plugs, set flush with finished floor. Plug coupling until conduit is extended above floor to final destination or a minimum of 2 ft (0.6 m) above finished floor.
3. Install no more than equivalent of three 90-degree bends in conduit run.Support within 12 inch (300 mm) of changes in direction.
4. Make bends in raceway using large-radius preformed ells except for parallel bends. Field bending must be in accordance with NFPA 70 minimum radii requirements. Provide only equipment specifically designed for material and size involved.
5. Conceal conduit within finished walls, ceilings, and floors unless otherwise indicated. Install conduits parallel or perpendicular to building lines.
6. Support conduit within 12 inch (300 mm) of enclosures to which attached.
7. Install raceway sealing fittings at accessible locations in accordance with NFPA 70 and fill them with listed sealing compound. For concealed raceways, install fitting in flush steel box with blank cover plate having finish similar to that of adjacent plates or surfaces. Install raceway sealing fittings in accordance with NFPA 70.
8. Install devices to seal raceway interiors at accessible locations. Locate seals so no fittings or boxes are between the seal and the following changes of environments. Seal interior of raceways at the following points:

    a. Where conduits pass from warm to cold locations, such as boundaries of refrigerated spaces.
    b. Where an underground service raceway enters a building or structure.
    c. Conduit extending from interior to exterior of building.
    d. Conduit extending into pressurized duct and equipment.
    e. Conduit extending into pressurized zones that are automatically controlled to maintain different pressure set points.
    f. Where otherwise required by NFPA 70.

9. Do not install raceways or electrical items on "explosion-relief" walls or rotating equipment.
10. Do not install conduits within 2 inch (50 mm) of the bottom side of a metal deck roof.
11. Keep raceways at least 6 inch (150 mm) away from parallel runs of flues and steam or hot-water pipes. Install horizontal raceway runs above water and steam piping.
12. Cut conduit perpendicular to the length. For conduits metric designator 53 (trade size 2) and larger, use roll cutter or a guide to make cut straight and perpendicular to the length. Ream inside of conduit to remove burrs.
13. Install pull wires in empty raceways. Provide polypropylene or monofilament plastic line with not less than 200 lb (90 kg) tensile strength. Leave at least 12 inch (300 mm) of slack at both ends of pull wire. Cap underground raceways designated as spare above grade alongside raceways in use.

C. Requirements for Installation of Specific Raceway Types:

1. Types ERMC and IMC:

    a. Threaded Conduit Joints, Exposed to Wet, Damp, Corrosive, or Outdoor Conditions: Apply listed compound that maintains electrical conductivity to threads of raceway and fittings before making up joints. Follow compound manufacturer's written instructions.

D. Stub-ups to Above Recessed Ceilings:

1. Provide EMT, IMC, or ERMC for raceways.
2. Provide a conduit bushing or insulated fitting to terminate stub-ups not terminated in hubs or in an enclosure.

E. Raceway Fittings: Install fittings in accordance with NEMA FB 2.10 guidelines.
1. EMT: Provide setscrew, steel fittings. Comply with NEMA FB 2.10.
2. Flexible Conduit: Provide only fittings listed for use with flexible conduit type. Comply with NEMA FB 2.20.

F. Expansion-Joint Fittings:

1. Install in runs of aboveground PVC that are located where environmental temperature change may exceed 30 deg F (17 deg C) and that have straight-run length that exceeds 25 ft (7.6 m). Install in runs of aboveground ERMC conduit that are located where environmental temperature change may exceed 100 deg F (55 deg C) and that have straight-run length that exceeds 100 ft (30 m).
2. Install fitting(s) that provide expansion and contraction for at least 0.00041 inch per foot of length of straight run per deg F (0.06 mm per meter of length of straight run per deg C) of temperature change for PVC conduits. Install fitting(s) that provide expansion and contraction for at least 0.000078 inch per foot of length of straight run per deg F (0.0115 mm per meter of length of straight run per deg C) of temperature change for metal conduits.
3. Install expansion fittings at locations where conduits cross building or structure expansion joints.
4. Install expansion-joint fitting with position, mounting, and piston setting selected in accordance with manufacturer's written instructions for conditions at specific location at time of installation. Install conduit supports to allow for expansion movement.

G. Raceways Penetrating Rooms or Walls with Acoustical Requirements:

1. Seal raceway openings on both sides of rooms or walls with acoustically rated putty or firestopping.

3.4 INSTALLATION OF BOXES AND ENCLOSURES

A. Provide boxes in wiring and raceway systems wherever required for pulling of wires, making connections, and mounting of devices or fixtures.

B. Mount boxes at heights indicated on Drawings. If mounting heights of boxes are not individually indicated, give priority to ADA requirements. Install boxes with height measured to center of box unless otherwise indicated.

C. Horizontally separate boxes mounted on opposite sides of walls so they are not in the same vertical channel.

D. Locate boxes so that cover or plate will not span different building finishes.

E. Support boxes in recessed ceilings independent of ceiling tiles and ceiling grid.

F. Support boxes of three gangs or more from more than one side by spanning two framing members or mounting on brackets specifically designed for purpose.

G. Fasten junction and pull boxes to, or support from, building structure. Do not support boxes by conduits.

H. Do not rely on locknuts to penetrate nonconductive coatings on enclosures. Remove coatings in the locknut area prior to assembling conduit to enclosure to ensure a continuous ground path.

I. Boxes and Enclosures in Areas or Walls with Acoustical Requirements:

1. Seal openings and knockouts in back and sides of boxes and enclosures with acoustically rated putty.
2. Provide gaskets for wallplates and covers.

3.5 FIRESTOPPING

A. Install firestopping at penetrations of fire-rated floor and wall assemblies. Comply with requirements in Division 07.

3.6 CLEANING

A. Boxes: Remove construction dust and debris from device boxes, outlet boxes, and floor-mounted enclosures before installing wallplates, covers, and hoods.

END OF SECTION 260533

SECTION 260553 - IDENTIFICATION FOR ELECTRICAL SYSTEMS

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. Labels.
2. Bands and tubes.
3. Tapes and stencils.
4. Tags.
5. Signs.
6. Cable ties.
7. Miscellaneous identification products.

1.3 ACTION SUBMITTALS

A. Product Data: For each type of product.

1. Include construction details, material descriptions, dimensions of individual components and profiles, and finishes for electrical identification products.

PART 2 - PRODUCTS

2.1 PERFORMANCE REQUIREMENTS

A. Comply with ASME A13.1 and IEEE C2.

B. Comply with NFPA 70.

C. Comply with ANSI Z535.4 for safety signs and labels.

D. Comply with NFPA 70Erequirements for arc-flash warning labels.

E. Adhesive-attached labeling materials, including label stocks, laminating adhesives, and inks used by label printers, shall comply with UL 969.

F. Thermal Movements: Allow for thermal movements from ambient and surface temperature changes.

1. Temperature Change: 120 deg F (67 deg C), ambient; 180 deg F (100 deg C), material surfaces.

2.2 COLOR AND LEGEND REQUIREMENTS

A. Raceways and Cables Carrying Circuits at 600 V or Less:

1. Black letters on an orange field
2. Legend: Indicate voltage and system or service type.

B. Warning Label Colors:

1. Identify system voltage with black letters on an orange background.

C. Warning labels and signs shall include, but are not limited to, the following legends:

1. Multiple Power Source Warning: "DANGER - ELECTRICAL SHOCK HAZARD - EQUIPMENT HAS MULTIPLE POWER SOURCES."
2. Workspace Clearance Warning: "WARNING - OSHA REGULATION - AREA IN FRONT OF ELECTRICAL EQUIPMENT MUST BE KEPT CLEAR FOR 36 INCHES (915 MM)."

D. Equipment Identification Labels:

1. Black letters on a white field.

2.3 LABELS

A. Vinyl Wraparound Labels: Preprinted, flexible labels laminated with a clear, weather- and chemical-resistant coating and matching wraparound clear adhesive tape for securing label ends.

2.4 BANDS AND TUBES

A. Snap-around, Color-Coding Bands: Slit, pretensioned, flexible, solid-colored acrylic sleeves, 2 inches (50 mm) long, with diameters sized to suit diameters and that stay in place by gripping action.

2.5 TAPES AND STENCILS

A. Self-Adhesive Vinyl Tape: Colored, heavy duty, waterproof, fade resistant; not less than 3 mils (0.08 mm) thick by 1 to 2 inches (25 to 50 mm) wide; compounded for outdoor use.
1. Color and Printing:

a. Comply with ANSI Z535.1, ANSI Z535.2, ANSI Z535.3, ANSI Z535.4, and ANSI Z535.5.
b. Inscriptions for Red-Colored Tapes: "ELECTRIC LINE, HIGH VOLTAGE"
c. Inscriptions for Orange-Colored Tapes: "TELEPHONE CABLE, CATV CABLE, COMMUNICATIONS CABLE, OPTICAL FIBER CABLE"

B. Stenciled Legend: In nonfading, waterproof, black ink or paint. Minimum letter height shall be 1 inch (25 mm).

2.6 TAGS

A. Nonmetallic Preprinted Tags: Polyethylene tags, 0.015 inch (0.38 mm) thick, color-coded for phase and voltage level, with factory printed permanent designations; punched for use with self-locking cable tie fastener.
   a. Machine-printed, permanent, waterproof, black ink marker recommended by printer manufacturer.

2.7 SIGNS

A. Baked-Enamel Signs:
   1. Preprinted aluminum signs, punched or drilled for fasteners, with colors, legend, and size required for application.
   2. 1/4-inch (6.4-mm) grommets in corners for mounting.
   3. Nominal Size: 7 by 10 inches (180 by 250 mm).

2.8 CABLE TIES

A. General-Purpose Cable Ties: Fungus inert, self-extinguishing, one piece, self-locking, and Type 6/6 nylon.

   1. Minimum Width: 3/16 inch (5 mm).
   2. Tensile Strength at 73 Deg F (23 Deg C) according to ASTM D638: 12,000 psi (82.7 MPa).
   3. Temperature Range: Minus 40 to plus 185 deg F (Minus 40 to plus 85 deg C).
   4. Color: Black, except where used for color-coding.

2.9 MISCELLANEOUS IDENTIFICATION PRODUCTS

A. Paint: Comply with requirements in painting Sections for paint materials and application requirements. Retain paint system applicable for surface material and location (exterior or interior).

B. Fasteners for Labels and Signs: Self-tapping, stainless-steel screws or stainless-steel machine screws with nuts and flat and lock washers.

PART 3 - EXECUTION

3.1 PREPARATION

A. Self-Adhesive Identification Products: Before applying electrical identification products, clean substrates of substances that could impair bond, using materials and methods recommended by manufacturer of identification product.

3.2 INSTALLATION

A. Verify and coordinate identification names, abbreviations, colors, and other features with requirements in other Sections requiring identification applications, Drawings, Shop Drawings, manufacturer's wiring diagrams, and operation and maintenance manual. Use consistent designations throughout Project.

B. Install identifying devices before installing acoustical ceilings and similar concealment.

C. Verify identity of each item before installing identification products.

D. Coordinate identification with Project Drawings, manufacturer's wiring diagrams, and operation and maintenance manual.

E. Apply identification devices to surfaces that require finish after completing finish work.

F. Install signs with approved legend to facilitate proper identification, operation, and maintenance of electrical systems and connected items.

G. System Identification for Raceways and Cables under 600 V: Identification shall completely encircle cable or conduit. Place identification of two-color markings in contact, side by side.

1. Secure tight to surface of conductor, cable, or raceway.
2. Secure tight to surface of conductor, cable, or raceway.

H. Auxiliary Electrical Systems Conductor Identification: Identify field-installed alarm, control, and signal connections.

I. Elevated Components: Increase sizes of labels, signs, and letters to those appropriate for viewing from the floor.

J. Accessible Fittings for Raceways: Identify the covers of each junction and pull box of the following systems with the wiring system legend and system voltage. System legends shall be as follows:

1. "EMERGENCY POWER."
2. "POWER."

K. Vinyl Wraparound Labels:

1. Secure tight to surface of raceway or cable at a location with high visibility and accessibility.
2. Attach labels that are not self-adhesive type with clear vinyl tape, with adhesive appropriate to the location and substrate.

L. Self-Adhesive Vinyl Tape: Secure tight to surface at a location with high visibility and accessibility.

1. Field-Applied, Color-Coding Conductor Tape: Apply in half-lapped turns for a minimum distance of 6 inches (150 mm) where splices or taps are made. Apply last two turns of tape with no tension to prevent possible unwinding.

M. Baked-Enamel Signs:

1. Attach signs that are not self-adhesive type with mechanical fasteners appropriate to the location and substrate.
2. Unless otherwise indicated, provide a single line of text with 1/2-inch- (13-mm-) high letters on minimum 1-1/2-inch- (38-mm-) high sign; where two lines of text are required, use signs minimum 2 inches (50 mm) high.

N. Cable Ties: General purpose, for attaching tags, except as listed below:

1. Outdoors: UV-stabilized nylon.
2. In Spaces Handling Environmental Air: Plenum rated.

3.3 IDENTIFICATION SCHEDULE

A. Install identification materials and devices at locations for most convenient viewing without interference with operation and maintenance of equipment. Install access doors or panels to provide view of identifying devices.

B. Identify conductors, cables, and terminals in enclosures and at junctions, terminals, pull points, and locations of high visibility. Identify by system and circuit designation.

C. Accessible Raceways and Metal-Clad Cables, 600 V or Less, for Service, Feeder, and Branch Circuits, More Than 30 A and 120V to Ground: Identify with self-adhesive raceway labels.

1. Locate identification at changes in direction, at penetrations of walls and floors, at 50-foot (15-m) maximum intervals in straight runs, and at 25-foot (7.6-m) maximum intervals in congested areas.

D. Accessible Fittings for Raceways and Cables within Buildings: Identify the covers of each junction and pull box of the following systems with self-adhesive labels containing the wiring system legend and system voltage. System legends shall be as follows:

1. "EMERGENCY POWER."
2. "POWER."

E. Power-Circuit Conductor Identification, 600 V or Less: For conductors in vaults, pull and junction boxes use self-adhesive wraparound labels to identify the phase.

1. Locate identification at changes in direction, at penetrations of walls and floors, at 50-foot (15-m) maximum intervals in straight runs, and at 25-foot (7.6-m) maximum intervals in congested areas.

F. Control-Circuit Conductor Identification: For conductors and cables in pull and junction boxes, manholes, and handholes, use self-adhesive labels with the conductor or cable designation, origin, and destination.

G. Control-Circuit Conductor Termination Identification: For identification at terminations, provide self-adhesive labels with the conductor designation.

H. Conductors to Be Extended in the Future: Attach Self-adhesive vinyl tape to conductors and list source.

I. Auxiliary Electrical Systems Conductor Identification: Self-adhesive vinyl tape that is uniform and consistent with system used by manufacturer for factory-installed connections.

1. Identify conductors, cables, and terminals in enclosures and at junctions, terminals, and pull points. Identify by system and circuit designation.

J. Warning Labels for Indoor Cabinets, Boxes, and Enclosures for Power: Self-adhesive labels.

1. Apply to exterior of door, cover, or other access.
2. For equipment with multiple power or control sources, apply to door or cover of equipment, including, but not limited to, the following:

a. Power-transfer switches.
b. Controls with external control power connections.

K. Equipment Identification Labels:

1. Indoor Equipment: Self-adhesive label.
2. Equipment to Be Labeled:
a. Enclosures and electrical cabinets.
b. Contactors.
c. Monitoring and control equipment.

END OF SECTION 260553

SECTION 284621.11 - DIGITAL, ADDRESSABLE FIRE-ALARM SYSTEM

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. Fire-alarm control unit.
2. Manual fire-alarm boxes.
3. System smoke detectors.
4. Duct smoke detectors
5. Heat detectors.
6. Flame detectors.
7. Notification appliances.
8. Addressable interface device.
9. Network communications.

1.3 DEFINITIONS

A. EMT: Electrical metallic tubing

B. FACU: Fire-alarm control unit

C. FA/MNS: Fire Alarm/Mass Notification

D. LED: Light-emitting diode.

E. NICET: National Institute for Certification in Engineering Technologies.

F. Voltage Class: For specified circuits and equipment, voltage classes are defined as follows:

1. Control Voltage: Listed and labeled for use in remote-control, signaling, and power-limited circuits supplied by a Class 2 or Class 3 power supply having rated output not greater than 150 V and 5 A, allowing use of alternate wiring methods complying with NFPA 70, Article 725.
2. Low Voltage: Listed and labeled for use in circuits supplied by a Class 1 or other power supply having rated output not greater than 1000 V, requiring use of wiring methods

complying with NFPA 70, Article 300, Part I.

1.4 SYSTEM DESCRIPTION

A. Noncoded, UL-certified addressable system, with multiplexed signal transmission, dedicated to fire-alarm service only.

1.5 ACTION SUBMITTALS

A. Product Data: For each type of product, including furnished options and accessories.

1. Include construction details, material descriptions, dimensions, profiles, and finishes.
2. Include rated capacities, operating characteristics, and electrical characteristics.

B. Shop Drawings: For fire-alarm system.

1. Comply with recommendations in the "Documentation" Section of the "Fundamentals of Fire Alarm Systems" Chapter in NFPA 72.
2. Include plans, elevations, sections, details, and attachments to other work.
3. Include details of equipment assemblies. Indicate dimensions, weights, loads, and required clearances, method of field assembly, components, and locations. Indicate conductor sizes, indicate termination locations and requirements, and distinguish between factory and field wiring.
4. Detail assembly and support requirements.
5. Include voltage drop calculations for notification appliance circuits.
6. Include battery-size calculations.
7. Include input/output matrix.
8. Include statement from manufacturer that all equipment and components have been tested as a system and meet all requirements in this Specification and in NFPA 72.
9. Include performance parameters and installation details for each detector.
10. Verify that each duct detector is listed for complete range of air velocity, temperature, and humidity possible when air-handling system is operating.
11. Provide program report showing that air-sampling detector pipe layout balances pneumatically within the airflow range of the air-sampling detector.
12. Include plans, sections, and elevations of heating, ventilating, and air-conditioning ducts, drawn to scale and coordinating installation of duct smoke detectors and access to them.
    a. Show critical dimensions that relate to placement and support of sampling tubes, detector housing, and remote status and alarm indicators.
    b. Show field wiring required for HVAC unit shutdown on alarm.
    c. Locate detectors according to manufacturer's written recommendations.
13. Include voice/alarm signaling-service equipment rack or console layout, grounding schematic, amplifier power calculation, and single-line connection diagram.
    a. In electrical rooms where there is insufficient space to hold two fire alarm control panels, the new replacement panel will be temporarily mounted in a selected location until the existing panel is demolished.

14. Include floor plans to indicate final outlet locations showing address of each addressable device. Show size and route of cable and conduits.
15. Existing mechanical and electrical (M&E) points shall be transferred to new corresponding addressable input modules (AIM's) and addressable output modules (AOM's) prior to demolition of the existing FA system. Anticipated downtime shall be coordinated with the NIST AHJ and OFPM.

C. Testing Plan

1. All testing shall be per manufacturer's instructions and NFPA 72. Contractor shall complete internal testing and correct all deficiencies found prior to requesting an official government test witnessed by FFSG. The installing contractor shall furnish a written statement stating that the system has been installed in accordance with approved plans and tested in accordance with the manufacturer's published instructions and the appropriate NFPA requirements. All components must be functionally tested end-to-end. For example, the Contractor must flow water to confirm activation of water flow alarm switches.
2. Contractor shall perform the following actions prior to and during testing:
   a. All fire alarm testing must be coordinated with the NIST COR, FFSG, and maintenance organization. Testing must be performed on weekdays.
   b. Simplex panel database changes must be done between Monday and Thursday by a Simplex authorized programmer (NIST COR must approve programmer). This includes the NIST Supervising Stations (Simplex TrueSite Workstations "TSW"; total of five).
   c. The contractor shall tie in the newly programmed devices no later than the next day after programming.
   d. Within two days after programming, and in accordance with NFPA 72 latest edition, the contractor shall provide two representatives to assist with testing the newly installed devices and up to 50 initiating devices not affected by the programming changes. All testing will conclude by 5:00pm. If the test reveals that devices are not reporting correctly either textually or graphically, the contractor shall correct and retest as noted above. Any additional testing must be approved and scheduled by the NIST COR.

D. General Submittal Requirements:

1. Submittals shall be approved by the NIST Authorities Having Jurisdiction (AHJ).
2. Shop Drawings shall be prepared by persons with the following qualifications:
   a. Trained and certified by manufacturer in fire-alarm system design.
   b. NICET-certified fire-alarm technician, Level IV minimum.
   c. Licensed or certified by the NIST AHJ.

E. Delegated-Design Submittal: For notification appliances and smoke and heat detectors, in addition to submittals listed above, indicate compliance with performance requirements and

design criteria, including analysis data signed and sealed by the qualified professional engineer responsible for their preparation.

1. Drawings showing the location of notification appliance and smoke and heat detector, ratings of each, and installation details as needed to comply with listing conditions of the device.
2. Design Calculations: Calculate requirements for selecting the spacing and sensitivity of detection, complying with NFPA 72. Calculate spacing and intensities for strobe signals and sound-pressure levels for audible appliances.
3. Indicate audible appliances required to produce square wave signal per NFPA 72.

1.6 INFORMATIONAL SUBMITTALS

A. Qualifications for persons designing, installing, and commissioning fire alarm systems shall be as follows:
   1. Fire alarm system submittals including design drawings, construction documents, shop drawings, and calculations shall be stamped by a licensed fire protection engineer or a NICET Level IV certified Technician (Fire Alarm Systems).
   2. A NICET Level III (minimum) certified technician (Fire Alarm Systems) shall supervise the final tie-in and all system testing.
   3. System components including fire alarm, suppression releasing, and mass notification system panels and devices shall be installed and terminated by a NICET Level II (minimum) certified Technician (Fire Alarm Systems).

B. Field quality-control reports.

1.7 CLOSEOUT SUBMITTALS

A. Operation and Maintenance Data: For fire-alarm systems and components to include in emergency, operation, and maintenance manuals. In addition to items specified in other sections, deliver copies to authorities having jurisdiction and include the following:

   1. Comply with the "Records" Section of the "Inspection, Testing and Maintenance" Chapter in NFPA 72.
   2. Provide "Fire Alarm and Emergency Communications System Record of Completion Documents" according to the "Completion Documents" Article in the "Documentation" section of the "Fundamentals" chapter in NFPA 72.
   3. Complete wiring diagrams showing connections between all devices and equipment. Each conductor shall be numbered at every junction point with indication of origination and termination points.
   4. Riser diagram.
   5. Device addresses.
   6. Record copy of site-specific software.
   7. Provide "Maintenance, Inspection and Testing Records" according to NFPA 72 article of the same name and include the following:
      a. Equipment tested.

b. Frequency of testing of installed components.
c. Frequency of inspection of installed components.
d. Requirements and recommendations related to results of maintenance.
e. Manufacturer's user training manuals.

8. Manufacturer's required maintenance related to system warranty requirements.
9. Abbreviated operating instructions for mounting at fire-alarm control unit.

B. Software and Firmware Operational Documentation:

1. Software operating and upgrade manuals including installation, user, programming, etc…
2. Device address list.
3. Printout of graphic screens.

1.8 QUALITY ASSURANCE

A. Installer Qualifications: Installation shall be by personnel certified by NICET as fire-alarm Level II technician.

B. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.

C. NFPA Certification: Obtain certification according to NFPA 72 by an NRTL.

1.9 PROJECT CONDITIONS

A. Perform a full test of the existing system prior to starting work. Document any equipment or components not functioning as designed.

B. Interruption of Existing Fire-Alarm Service: Do not interrupt fire-alarm service to facilities occupied by Owner or others unless permitted under the following conditions and then only after arranging to provide temporary guard service according to requirements indicated:

1. Notify Construction Manager no fewer than five days in advance of proposed interruption of fire-alarm service.
2. Do not proceed with interruption of fire-alarm service without Construction Manager's written permission.

C. Use of Devices during Construction: Protect devices during construction unless devices are placed in service to protect the facility during construction.

1.10 SEQUENCING AND SCHEDULING

A. Existing Fire-Alarm Equipment: Maintain existing equipment fully operational until new equipment has been tested and accepted. As new equipment is installed, label it "NOT IN SERVICE" until it is accepted. Remove labels from new equipment when put into service and

label existing fire-alarm equipment "NOT IN SERVICE" until removed from the building.

B. Equipment Removal: After acceptance of new fire-alarm system, remove existing disconnected fire-alarm equipment and wiring.

C. M&E Points: Existing mechanical and electrical (M&E) points shall be transferred to new corresponding AIM's and AOM's prior to demolition of the existing FA system. Anticipated downtime shall be coordinated with the NIST AHJ and OFPM.

1.11 WARRANTY

A. Special Warranty: Manufacturer agrees to repair or replace fire-alarm system equipment and components that fail in materials or workmanship within specified warranty period.

1. Warranty Extent: All equipment and components not covered in the Maintenance Service Agreement.
2. Warranty Period: Five years from date of Substantial Completion.

PART 2 - PRODUCTS

2.1 ADDRESSABLE FIRE-ALARM SYSTEM

A. Description: New FACP shall be 4100ES.

B. Performance Criteria:
1. Regulatory Requirements:
   a. Fire-Alarm Components, Devices, and Accessories: Listed and labeled by a NRTL in accordance with NFPA 70 for use with selected fire-alarm system and marked for intended location and application.

2.2 MANUFACTURERS

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

1. Johnson Controls
   a. All equipment shall be current production models manufactured by Simplex unless otherwise noted in this document. All devices shall be compatible with the new devices and new fire alarm control equipment.

2.3 SYSTEMS OPERATIONAL DESCRIPTION

A. Fire-alarm signal initiation shall be by one or more of the following devices and systems:

1. Manual stations.
2. Heat detectors.
3. Smoke detectors.
4. Automatic sprinkler system water flow.

B. Fire-alarm signal shall initiate the following actions:
1. Continuously operate alarm notification appliances.
2. Identify alarm at fire-alarm control unit and TSW's.
3. Transmit an alarm signal to the TSW's.
4. Activate voice/alarm communication system.
5. Recall elevators to primary or alternate recall floors.
6. Record events in the system memory.

C. Fire-alarm signal shall initiate the following priority 2 signals and actions:
1. Activate voice/alarm communication system.
2. Identify specific device initiating the event at fire-alarm control unit and TSW's.

D. Supervisory signal initiation shall be by one or more of the following devices and actions:
1. Valve supervisory switch.
2. User disabling of zones or individual devices.

E. System trouble signal initiation shall be by one or more of the following devices and actions:
1. Open circuits, shorts, and grounds in designated circuits.
2. Opening, tampering with, or removing alarm-initiating and supervisory signal-initiating devices.
3. Loss of communication with any addressable sensor, input module, relay, control module, TSW, or Ethernet module.
4. Loss of primary power at fire-alarm control unit.
5. Ground or a single break in fire-alarm control unit internal circuits.
6. Abnormal ac voltage at fire-alarm control unit.
7. Break in standby battery circuitry.
8. Failure of battery charging.
9. Abnormal position of any switch at fire-alarm control unit or annunciator.
10. Voice signal amplifier failure.
11. Loss of communication with any panel on the network.

F. System Supervisory Signal Actions:
1. Initiate notification appliance.
2. Identify specific device initiating the event at fire-alarm control unit and TSW's.
3. After a time delay of 200 seconds, transmit a trouble or supervisory signal to the TSW's.

2.4 FIRE-ALARM CONTROL UNIT

A. General Requirements for Fire-Alarm Control Unit:
1. Field-programmable, microprocessor-based, modular, power-limited design with electronic modules, complying with UL 864 and listed and labeled by an NRTL.

a. System software and programs shall be held in flash electrically erasable programmable read-only memory (EEPROM), retaining the information through failure of primary and secondary power supplies.
b. Include a real-time clock for time annotation of events on the event recorder and printer.
c. Provide communication between the FACP and TSW's.
d. The FACP shall be listed for connection to a central-station signaling system service.
e. Provide nonvolatile memory for system database, logic, and operating system and event history. The system shall require no manual input to initialize in the event of a complete power down condition. The FACP shall provide a minimum 500-event history log.

2. Addressable Initiation Device Circuits: The FACP shall indicate which communication zones have been silenced and shall provide selective silencing of alarm notification appliance by building communication zone
3. Addressable Control Circuits for Operation of Notification Appliances and Mechanical Equipment: The FACP shall be listed for releasing service.
4. All new 4100es panels shall have a fiber optic (ST connectors) break-out box mounted above the panel. Incoming fibers to the 4100ES shall terminate in this panel, as should all outgoing fibers. Contractor shall provide ST duplex jumpers (multi-mode 62.5 uM) between the patch panel and the panel.

B. Alphanumeric Display and System Controls: Arranged for interface between human operator at fire-alarm control unit and addressable system components including annunciation and supervision. Display alarm, supervisory, and component status messages and the programming and control menu.

1. Annunciator and Display: Liquid-crystal type, 3 line(s) of 80 characters, minimum.
2. Keypad: Arranged to permit entry and execution of programming, display, and control commands and to indicate control commands to be entered into the system for control of smoke-detector sensitivity and other parameters.

C. Circuits: Each building shall be provided with one fire alarm control panel (FACP) located within the first floor lobby (serving circuits within the sub-basement/ zone SB, basement/ zone B, first floor/ zone 1, and second floor/ zone 2), and one fire alarm transponder panel (FATP) located within the attic (serving circuits within the third floor/ zone 3, attic/ zone A, and penthouse/ zone P).

1. Zoning:
   a. Each floor shall contain its own separate zone. The lobby FACP serves zones SB, B, 1 and 2. The attic FATP serves zones 3, A, and P.
2. Requirements: Fire alarm circuits shall be provided as follows:
   a. Separate Strobe Circuits for Each Level: Class A.
   b. Separate Strobe Circuits for Each Spine: Class A.
   c. Separate Speaker Circuits for Each Level: Class A
   d. Separate Speaker Circuits for Each Spine: Class A.

e. Separate SLC Circuits for Each Level: Class A.
f. Separate SLC Circuits for Each Spine: Class A.
g. Separate Exterior Speaker Circuits for Each 1st Level and Penthouse Level: Class B.
h. Separate Acoustic Hailing Device (Loudspeaker) Circuit for Each 1st Level: Class B.
i. Separate M&E Circuit for Each Panel: Class A.
j. Install no more than 100 addressable devices on each signaling line circuit.
k. Circuits shall be at no more than 75% capacity on SLC or NAC.

D. Serial Interfaces:

1. One dedicated RS 485 port for TSW operation using point ID DACT.
2. One RS 485 port for TSW's, Ethernet module, or multi-interface module (printer port).
3. One RS 232 port for PC configuration.
4. One RS 232 port for voice evacuation interface

E. Smoke-Alarm Verification:

1. Initiate audible and visible indication of an "alarm-verification" signal at fire-alarm control unit.
2. Activate an NRTL-listed and -approved "alarm-verification" sequence at fire-alarm control unit and detector.
3. Record events by the system printer.
4. Sound general alarm if the alarm is verified.
5. Cancel fire-alarm control unit indication and system reset if the alarm is not verified.

F. Notification-Appliance Circuit:

1. Audible appliances shall sound in a three-pulse temporal pattern, as defined in NFPA 72.
2. Where notification appliances provide signals to sleeping areas, the alarm signal shall be a 520-Hz square wave with an intensity 15 dB above the average ambient sound level or 5 dB above the maximum sound level, or at least 75 dBA, whichever is greater, measured at the pillow.
3. Visual alarm appliances shall flash in synchronization where multiple appliances are in the same field of view, as defined in NFPA 72.

G. Elevator Recall:

1. Smoke detectors at the following locations shall initiate automatic elevator recall
   a. Elevator lobby detectors except the lobby detector on the designated floor.
   b. Smoke detector in elevator machine room.
   c. Smoke detectors in elevator hoistway.
2. Elevator lobby detectors located on the designated recall floors shall be programmed to move the cars to the alternate recall floor.

H. Remote Smoke-Detector Sensitivity Adjustment: Controls shall select specific addressable smoke detectors for adjustment, display their status and sensitivity settings, and change those settings. Allow controls to be used to program repetitive, time-scheduled, and automated changes in sensitivity of specific detector groups. Record sensitivity adjustments and sensitivity-

adjustment schedule changes in system memory and print out the final adjusted values on system printer.

I. Transmission to TSW: Automatically transmit alarm, supervisory, and trouble signals to TSW's.

J. Voice/Alarm Signaling Service: Central emergency communication system with redundant microphones, preamplifiers, amplifiers, and tone generators provided as a special module that is part of fire-alarm control unit.

1. Indicated number of alarm channels for automatic, simultaneous transmission of different announcements to different zones or for manual transmission of announcements by use of the central-control microphone. Amplifiers shall comply with UL 1711 and be listed by an NRTL.
   a. Allow the application of and evacuation signal to indicated number of zones and, at same time, allow voice paging to the other zones selectively or in any combination.
   b. Programmable tone and message sequence selection.
   c. Standard digitally recorded messages for "Evacuation", "Storm Warning", "Shelter in Place", "Toxic Gas", and "All Clear."
   d. Generate tones to be sequenced with audio messages of type recommended by NFPA 72 and that are compatible with tone patterns of notification appliance circuits of fire-alarm control unit.
2. Status Annunciator: Indicate the status of various voice/alarm speaker zones.
3. Preamplifiers, amplifiers, and tone generators shall automatically transfer to backup units, on primary equipment failure.

K. Primary Power: 24-V dc obtained from 120-V ac service and a power-supply module. Initiating devices, notification appliances, signaling lines, trouble signals, supervisory and digital alarm communicator transmitters shall be powered by 24-V dc source.

1. Alarm current draw of entire fire-alarm system shall not exceed 80 percent of the power-supply module rating.

L. Secondary Power: 24-V dc supply system with batteries, automatic battery charger, and automatic transfer switch.

1. Batteries: Valve regulated lead-acid (VRLA).

M. Instructions: Computer printout or typewritten instruction card mounted behind a plastic or glass cover in a stainless-steel or aluminum frame. Include interpretation and describe appropriate response for displays and signals. Briefly describe the functional operation of the system under normal, alarm, and trouble conditions.

2.5 MANUAL FIRE-ALARM BOXES

A. General Requirements for Manual Fire-Alarm Boxes: Comply with UL 38. Boxes shall be finished in red with molded, raised-letter operating instructions in contrasting color; shall show

visible indication of operation; and shall be mounted on recessed outlet box. If indicated as surface mounted, provide manufacturer's surface back box.

1. Double-action mechanism requiring two actions to initiate an alarm, pull-lever type; with integral addressable module arranged to communicate manual-station status (normal, alarm, or trouble) to fire-alarm control unit.
2. Station Reset: Key- or wrench-operated switch.
3. Indoor Protective Shield: Factory-fabricated clear plastic enclosure hinged at the top to permit lifting for access to initiate an alarm. Lifting the cover actuates an integral battery-powered audible horn intended to discourage false-alarm operation.
4. Weatherproof Protective Shield: Simplex 2099-9144 or similar model with weather-proof enclosure; DPD contacts; NEMA 4X.

2.6 SYSTEM SMOKE DETECTORS

A. General Requirements for System Smoke Detectors:

1. Comply with UL 268; operating at 24-V dc, nominal.
2. Detectors shall be two-wire type.
3. Integral Addressable Module: Arranged to communicate detector status (normal, alarm, or trouble) to fire-alarm control unit.
4. Self-Restoring: Detectors do not require resetting or readjustment after actuation to restore them to normal operation.
5. Integral Visual-Indicating Light: LED type indicating detector has operated and power-on status.
6. Remote Control: Unless otherwise indicated, detectors shall be analog-addressable type, individually monitored at fire-alarm control unit for calibration, sensitivity, and alarm condition and individually adjustable for sensitivity by fire-alarm control unit.

B. Photoelectric Smoke Detectors:

1. Detector address shall be accessible from fire-alarm control unit and shall be able to identify the detector's location within the system and its sensitivity setting.
2. An operator at fire-alarm control unit, having the designated access level, shall be able to manually access the following for each detector:
   a. Primary status.
   b. Device type.
   c. Present average value.
   d. Present sensitivity selected.
   e. Sensor range (normal, dirty, etc.).

2.7 DUCT SMOKE DETECTORS

A. Description: Photoelectric-type, duct-mounted smoke detector.

B. Performance Criteria:

1. Regulatory Requirements:
   a. NFPA 72.
   b. UL 268A.
2. General Characteristics:
   a. Detectors must be **two**-wire type with external addressable relay as required.
   b. Detector address shall be accessible from fire-alarm control unit and shall be able to identify the detector's location within the system and its sensitivity setting.
   c. Each sensor shall have multiple levels of detection sensitivity.
   d. Sampling Tubes: Design and dimensions as recommended by manufacturer for specific duct size, air velocity, and installation conditions where applied.
   e. Integral Addressable Module: Arranged to communicate detector status (normal, alarm, or trouble) to FACU.
   f. Self-Restoring: Detectors do not require resetting or readjustment after actuation to restore them to normal operation.
   g. Integral Visual-Indicating Light: LED type, indicating detector has operated **and power-on status**.
   h. Detector address must be accessible from FACU and must be able to identify detector's location within system and its sensitivity setting.
   i. Operator at FACU, having designated access level, must be able to manually access the following for each detector:
      1) Primary status.
      2) Device type.
      3) Present average value.
      4) Present sensitivity selected.
      5) Sensor range (normal, dirty, etc.).
   j. Weatherproof Duct Housing Enclosure: NEMA 250, Type 4X; NRTL listed for use with supplied detector for smoke detection in HVAC system ducts.
   k. Sampling Tubes: Design and dimensions as recommended by manufacturer for specific duct size, air velocity, and installation conditions where applied.
   l. Relay Fan Shutdown: Fully programmable relay rated to interrupt fan motor-control circuit.

2.8 HEAT DETECTORS

A. General Requirements for Heat Detectors: Comply with UL 521.

B. Heat Detector, Combination Type: Actuated by either a fixed temperature of 135 deg F or a rate of rise that exceeds 15 deg F per minute unless otherwise indicated.

1. Mounting: Adapter plate for outlet box mounting.
2. Integral Addressable Module: Arranged to communicate detector status (normal, alarm, or trouble) to fire-alarm control unit.
3. Rate-of-rise temperature characteristic shall be selectable at fire-alarm control unit for 15 deg F per minute.
4. Fixed-temperature sensing shall be independent of rate-of-rise sensing and shall be set at

fire-alarm control unit to operate at 135 deg F.

5. Weatherproofing: THERMOTECH 302-ET-135 or similar model hermetically sealed for moisture proof installations.

2.9 FLAME DETECTORS

A. Detectors must be sensitive to the micron range best suited for their intended use. Detectors must operate over electrically supervised wiring circuits and the loss of power to the detector must result in a trouble signal. A self-test feature must be provided for each detector to be individually tested.

B. Combination UV/IR Flame Detector
   1. The UV/IR detector must provide discrimination against false alarms by requiring both UV and IR flame detection before an alarm is sent. The UV sensor must be sensitive in the range of 0.185 to 0.265 micrometers only. The IR sensor must be sensitive in the range of 2.5 to 3.0 micrometers only. Detectors must be completely insensitive to light sources in the visible frequency range.

2.10 NOTIFICATION APPLIANCES

A. General Requirements for Notification Appliances: Connected to notification appliance signal circuits, zoned as indicated, equipped for mounting as indicated and with screw terminals for system connections.

B. Combination Devices: Factory-integrated audible and visible devices in a single- mounting assembly, equipped for mounting as indicated and with screw terminals for system connections.
   1. Weatherproofing: Simplex 49SVH-APPLC or similar that includes weatherproof backbox.
   2. Backbox: Wheelock Model 4815, Johnson Controls Model 2975-9145, or approved equivalent.

C. Visible Notification Appliances: Xenon strobe lights comply with UL 1971, with clear or nominal white polycarbonate lens mounted on an aluminum faceplate. The word "ALERT" is engraved in minimum 1-inch high letters on the lens.

   1. Rated Light Output:
      a. 15/30/75/110 cd, selectable in the field.
   2. Mounting: Wall mounted unless otherwise indicated.
   3. For units with guards to prevent physical damage, light output ratings shall be determined with guards in place.
   4. Flashing shall be in a temporal pattern, synchronized with other units.
   5. Strobe Leads: Factory connected to screw terminals.
   6. Mounting Faceplate: Factory finished, red.

D. Voice/Tone Notification Appliances:

   1. Appliances shall comply with UL 1480 and shall be listed and labeled by an NRTL.

2. Speakers for Voice Notification: Locate speakers for voice notification to provide the audibility and intelligibility requirements of the "Notification Appliances" and "Emergency Communications Systems" chapters in NFPA 72.
3. Interior and exterior speakers: Rated 1/4 to 2 W.
4. Mounting: Flush.
5. Matching transformers: Tap range matched to acoustical environment of speaker location.
6. Hyperspikes/Loudspeakers: One shall be provided per building, to be mounted on the exterior near the entrance to each building facing the assembly area/parking lot. The TCPA-100 model shall be used.
7. Zone Notification: Initiating devices will activate all speakers in the corresponding zone. Each floor is covered by a single zone.

2.11 ADDRESSABLE INTERFACE DEVICE

A. Description: Microelectronic monitor module, NRTL listed for use in providing a system address for alarm-initiating devices for wired applications with normally open contacts.

B. Integral Relay: Capable of providing a direct signal to elevator controller to initiate elevator recall.

C. Control Module:

1. Operate notification devices.
2. Activate door holder unit.
3. Activate fan shut down.

2.12 NETWORK COMMUNICATIONS

A. Provide network communications for fire-alarm system according to fire-alarm manufacturer's written requirements.

B. New fire alarm panels to be connected via fiber to the campus loop. All panel's report to the campus TSW in building 101.

C. Four 62.5/125/900 distribution fiber cable, FRPE jacket
1. Optical Characteristics
   a. Maximum Attenuation @ 850nm 3.5 dB/km
   b. Maximum Attenuation @ 1300nm 1.0 dB/km
   c. Point Loss @ 850nm & @ 1300nm 0.2 dB
   d. Maximum Bandwidth @ 850nm 220 MHz-km
   e. Maximum Bandwidth @ 1300nm 600 MHz-km
   f. Refractive Index @ 850nm 1.496
   g. Refractive Index @ 1300nm 1.491
   h. Numerical Aperture 0.275
2. Mechanical Characteristics

a. Fiber Type 62.5/125/900 Micron
b. Number of Fibers Four (4)
c. Core Diameter 62.5 +/- 2.5 microns
d. Core Non-Circularity 5% maximum
e. Clad Diameter 125 +/- 2 microns
f. Clad Non-Circularity 1% maximum
g. Core Clad Offset 1.5 microns maximum
h. Primary Coating Material Acrylate
i. 245 +/- 10 microns
j. Secondary Coating Material Engineering Thermoplastic
k. 900 +/- 50 microns
l. Outer Jacket FRPE, 0.035" Nominal Wall
m. 0.197" Nominal Diameter

D. Provide network communications pathway per manufacturer's written requirements and requirements in NFPA 72 and NFPA 70.

2.13 SURGE SUPPRESSION

A. Provide surge protective devices for 120VAC power to each panel.

PART 3 - EXECUTION

3.1 EQUIPMENT INSTALLATION

A. Comply with NFPA 72, NFPA 101, and requirements of authorities having jurisdiction for installation and testing of fire-alarm equipment. Install all electrical wiring to comply with requirements in NFPA 70 including, but not limited to, Article 760, "Fire Alarm Systems."

1. Devices placed in service before all other trades have completed cleanup shall be replaced.
2. Devices installed but not yet placed in service shall be protected from construction dust, debris, dirt, moisture, and damage according to manufacturer's written storage instructions.

B. Connecting to Existing Equipment: Verify that existing fire-alarm system is operational before making changes or connections.

1. Connect new equipment to existing control panel in existing part of the building.
2. Connect new equipment to existing monitoring equipment at the supervising station.
3. Expand, modify, and supplement existing control and monitoring equipment as necessary to extend existing control and monitoring functions to the new points. New components shall be capable of merging with existing configuration without degrading the performance of either system.
4. After the completion of the construction, the contractor shall upgrade the programming and graphic maps for the Global Command Control (CSS) at Building 101, 231, 318, and 302 at no additional cost to the Giver.

C. Install wall-mounted equipment, with tops of cabinets not more than 72 inches above the finished floor.

D. Manual Fire-Alarm Boxes:

1. Install manual fire-alarm box in the normal path of egress within 60 inches of the exit doorway.
2. Mount manual fire-alarm box on a background of a contrasting color.
3. The operable part of manual fire-alarm box shall be between 42 inches and 48 inches above floor level. All devices shall be mounted at the same height unless otherwise indicated.

E. Smoke- or Heat-Detector Spacing:

1. Comply with NFPA 72, "Smoke-Sensing Fire Detectors" Section in the "Initiating Devices" Chapter, for smoke-detector spacing.
2. Comply with NFPA 72, "Heat-Sensing Fire Detectors" Section in the "Initiating Devices" Chapter, for heat-detector spacing.
3. Smooth ceiling spacing shall not exceed 30 feet.
4. Spacing of detectors for irregular areas, for irregular ceiling construction, and for high ceiling areas shall be determined according to Appendix A in NFPA 72.
5. HVAC: Locate detectors not closer than 3 feet from air-supply diffuser or return-air opening.
6. Lighting Fixtures: Locate detectors not closer than 12 inches from any part of a lighting fixture.

F. Install a cover on each smoke detector that is not placed in service during construction. Cover shall remain in place except during system testing. Remove cover prior to system turnover.

G. Duct Smoke Detectors: Comply with NFPA 72 and NFPA 90A. Install sampling tubes so they extend the full width of duct. Tubes more than 36 inches long shall be supported at both ends.

1. Do not install smoke detector in duct smoke-detector housing during construction. Install detector only during system testing and prior to system turnover.

H. Remote Status and Alarm Indicators: Install near each smoke detector and each sprinkler water-flow switch and valve-tamper switch that is not readily visible from normal viewing position.

I. Coordinate first paragraph below with Drawings.

J. Audible Alarm-Indicating Devices (Speakers): Install not less than 6 inches below the ceiling. Install speakers on flush-mounted back boxes with the device-operating mechanism concealed behind a grille. Install all devices at the same height unless otherwise indicated.

K. Visible Alarm-Indicating Devices (Strobes): Install at least 6 inches below the ceiling. Install all devices at the same height unless otherwise indicated.

L. Audible and Visible Alarm-Indicating Devices (Speaker/Strobes): Comply with the requirements of both Audible and Visible Alarm-Indicating Devices.

M. Device Location-Indicating Lights: Locate in public space near the device they monitor.

N. Fire-Alarm Control Unit: Surface mounted, with tops of cabinets not more than 72 inches above the finished floor.

O. The following are NIST requirements:
1. Installation of a new fire alarm system or alteration to an existing fire alarm system shall require a NIST Work Permit.
2. Do not splice existing or new circuits. "T-Taps" are not permitted under any circumstances.
3. Fire alarm conductors for new installations shall be as recommended by the manufacturer and approved by FFSG. Minimum sizes are as follows:
   a. Signaling line circuits (SLC) and initiating device circuits (IDC): #18 AWG
   b. Notification appliance circuits (NAC), speaker: #16 AWG
   c. Notification appliance circuits (NAC), strobe: #14 AWG
4. Fire alarm conductors for repairs or alterations to existing systems shall be as follows:
   a. Signaling line circuits (SLC) shall be 18/2 TSP, such as West Penn D975 or approved equal.
   b. Speaker notification appliance circuits shall be 16/2 TP red and black, such as West Penn 991 (riser), 60990B (plenum), or approved equal. See below for additional color coding for wiring -
      SLC: Red
      Speakers: Yellow
      Strobes: Red
      RUI: Blue
   c. Strobe notification appliance circuits shall be red and black conductors, min #14 AWG.
   d. 24V power circuits shall be blue and white conductors.
   e. Monitor module circuits shall be blue and white conductors, min #14 AWG.
   f. All wires shall be solid copper type. Stranded wire is not permitted for new installations.
5. Install all conductors in conduit suitable for the environment. Minimum conduit shall be 3/4-in. EMT.
6. All conduits, boxes, covers, etc. shall be factory painted red unless red conduit has been assigned to a different utility or exposed conduit is painted to match the room finish. In those instances, a 360-degree red cover shall be applied to the conduit every 10 ft.
7. Connections to water flow switch and tamper switches shall be via liquid tight flexible conduit.
8. Construction constraints require that the installing contractor comply with the following:
   a. All existing devices must remain in service when the new work is being installed.

b. All new circuits shall be NFPA 72 “Class A”.
c. Provide complete and accurate as-built drawings in current AutoCAD format.

9. Qualifications for persons designing, installing, and commissioning fire alarm systems shall be as follows:
   a. Fire alarm system submittals including design drawings, construction documents, shop drawings, and calculations shall be stamped by a licensed fire protection engineer or a NICET Level IV certified Technician (Fire Alarm Systems).
   b. A NICET Level III (minimum) certified Technician (Fire Alarm Systems) shall supervise the final tie-in and all system testing.
   c. System components including fire alarm, suppression releasing, and mass notification system panels and devices shall be installed and terminated by a NICET Level II (minimum) certified Technician (Fire Alarm Systems).

3.2 PATHWAYS

A. New pathways shall be installed in EMT.

B. Exposed EMT shall be painted red enamel.

3.3 CONNECTIONS

A. For fire-protection systems related to doors in fire-rated walls and partitions and to doors in smoke partitions, comply with requirements in other sections. Connect hardware and devices to fire-alarm system.

   1. Verify that hardware and devices are NRTL listed for use with fire-alarm system in this Section before making connections.

B. Make addressable connections with a supervised interface device to the following devices and systems. Install the interface device less than 3 feet from the device controlled. Make an addressable confirmation connection when such feedback is available at the device or system being controlled.
   1. Smoke dampers in air ducts of designated air-conditioning duct systems.
   2. Alarm-initiating connection to elevator recall system and components.
   3. Supervisory connections at valve supervisory switches.

3.4 ELECTRICAL CONNECTIONS

A. Connect wiring in accordance with Section 260519 "Low-Voltage Electrical Power Conductors and Cables."
B. Ground equipment in accordance with Section 260526 "Grounding and Bonding for Electrical Systems."
C. Install electrical devices furnished by manufacturer, but not factory mounted, in accordance with

NFPA 70 and NECA 1.

D. Install nameplate for each electrical connection, indicating electrical equipment designation and circuit number feeding connection.
   1. Nameplate must be laminated acrylic or melamine plastic signs, as specified in Section 260553 "Identification for Electrical Systems."

3.5 CONTROL CONNECTIONS

A. Install control and electrical power wiring to field-mounted control devices.
B. Connect control wiring in accordance with Section 260523 "Control-Voltage Electrical Power Cables."
C. Install nameplate for each control connection, indicating field control panel designation and I/O control designation feeding connection.

3.6 IDENTIFICATION

A. Identify system components, wiring, cabling, and terminals. Comply with requirements for identification specified in other sections.

B. Install framed instructions in a location visible from fire-alarm control unit.

3.7 GROUNDING

A. Ground fire-alarm control unit and associated circuits; comply with IEEE 1100. Install a ground wire from main service ground to fire-alarm control unit.

B. Ground shielded cables at the control panel location only. Insulate shield at device location.

3.8 FIELD QUALITY CONTROL

A. Field tests shall be witnessed by authorities having jurisdiction.

B. Perform tests and inspections.

   1. Manufacturer's Field Service: Engage a factory-authorized service representative to inspect components, assemblies, and equipment installations, including connections, and to assist in testing.

C. Tests and Inspections:

   1. Visual Inspection: Conduct visual inspection prior to testing.
      a. Testing plan is required. Certification of pretesting required prior to AHJ acceptance testing.
      b. Inspection shall be based on completed Record Drawings and system documentation that is required by NFPA 72 in its "Completion Documents, Preparation" Table in the "Documentation" Section of the "Fundamentals of Fire

Alarm Systems" Chapter.

c. Comply with "Visual Inspection Frequencies" Table in the "Inspection" Section of the "Inspection, Testing and Maintenance" Chapter in NFPA 72; retain the "Initial/Reacceptance" column and list only the installed components.

2. System Testing: Comply with "Test Methods" Table in the "Testing" Section of the "Inspection, Testing and Maintenance" Chapter in NFPA 72.
3. Test audible appliances for the public operating mode according to manufacturer's written instructions. Perform the test using a portable sound-level meter complying with Type 2 requirements in ANSI S1.4.
4. Test audible appliances for the private operating mode according to manufacturer's written instructions.
5. Test visible appliances for the public operating mode according to manufacturer's written instructions.
6. Factory-authorized service representative shall prepare the "Fire Alarm System Record of Completion" in the "Documentation" Section of the "Fundamentals of Fire Alarm Systems" Chapter in NFPA 72 and the "Inspection and Testing Form" in the "Records" Section of the "Inspection, Testing and Maintenance" Chapter in NFPA 72.
7. All testing shall be per manufacturer's instructions and NFPA 72. Contractor shall complete internal testing prior to requesting an official government test.
8. Contractor shall perform the following actions prior to and during testing:
   a. All fire alarm testing must be coordinated with the NIST COR, FFSG, and maintenance organization. Testing must be performed on weekdays.
   b. Simplex panel database changes must be done between Monday and Thursday by a Simplex authorized programmer (NIST COR must approve programmer). This includes the NIST Supervising Stations (Simplex TrueSite Workstations "TSW"; total of five).
   c. The contractor shall tie in the newly programmed devices no later than the next day after programming.
   d. Within two days after programming, and in accordance with NFPA 72 latest edition, the contractor shall provide two representatives to assist with testing the newly installed devices and up to 50 initiating devices not affected by the programming changes. All testing will conclude by 5:00pm. If the test reveals that devices are not reporting correctly either textually or graphically, the contractor shall correct and retest as noted above. Any additional testing must be approved and scheduled by the NIST COR.

D. Reacceptance Testing: Perform reacceptance testing to verify the proper operation of added or replaced devices and appliances.

E. Fire-alarm system will be considered defective if it does not pass tests and inspections.

F. Prepare test and inspection reports.

3.9 DEMONSTRATION

A. Engage a factory-authorized service representative to train Owner's maintenance personnel to adjust, operate, and maintain fire-alarm system.

3.10 MAINTENANCE

A. Maintenance Service: Beginning at Substantial Completion, maintenance service must include 12 months' full maintenance by skilled employees of manufacturer's designated service organization. Include preventive maintenance, repair or replacement of worn or defective components, lubrication, cleaning, and adjusting as required for proper operation. Parts and supplies must be manufacturer's authorized replacement parts and supplies.

1. Include visual inspections in accordance with "Visual Inspection Frequencies" table in "Testing" paragraph of "Inspection, Testing and Maintenance" chapter in NFPA 72.
2. Perform tests in "Test Methods" table in "Testing" paragraph of "Inspection, Testing and Maintenance" chapter in NFPA 72.
3. Perform tests per "Testing Frequencies" table in "Testing" paragraph of "Inspection, Testing and Maintenance" chapter in NFPA 72.

END OF SECTION 283111