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ELECTRICAL

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SECTION 16000

ELECTRICAL

(FILED SUB-BID REQUIRED)

PART 1 - GENERAL

1.00 FILED SUB BID

- A. Bidding procedures shall be in accordance with latest edition of Massachusetts General Laws, Chapter 149, Section 44, including provisions for pre-qualification; and Chapter 30, Section 39M. Time and place for submission of sub-bids is given in Advertisement for Bids.
- B. Sub-bids for work under this Section shall be for complete work of this Section and shall be filed in a sealed envelope with Awarding Owner, at time and place specified in Advertisement for Bids. The following shall appear on the face of the envelope:
[JOB TITLE]
[NAME OF BIDDER]
SUB-BID FOR SECTION 16000, ELECTRICAL
- C. Every sub-bid submitted for work under this Section shall be on forms furnished by awarding Owner, as required by Section 44 of Mass. General Laws, and specified in Advertisement for Bids.
- D. Sub-bids filed with the Awarding Owner shall be as accompanied by bid deposits in form of a bid bond, or cash, or a certified check on, or a treasurer's or cashier's check issued by, a responsible bank or trust company, payable to "**Hampshire County Sheriff's Department**" in compliance with Chapter 149, Section 44 B. Amount of bid deposit shall be 5 percent of value of bid.
- E. Additional Requirements:
1. Sub-bidder's attention is directed to Massachusetts G.L. Chapter 149 §44H, as amended, which provides in part as follows:
 - a. Each sub-bidder shall list in Paragraph E of the "Form for Sub-bids" the name and bid price of each person, firm or corporation performing each class of work or part thereof for which the Section of the Specifications for that subtrade requires such listing, provided that, in the absence of a contrary provision in the Specifications, any sub-bidder may, without listing any bid price, list his own name or part thereof and perform that work with persons on his own payroll, if such sub-bidders, after sub-bid openings, shows to the satisfaction of the Awarding Owner that he does customarily perform such class of work with persons on his own payroll and is qualified to do so. This Section of the Specifications requires that the following classes of work shall be listed in Paragraph E under the conditions indicated herein.
- F. The work to be done under this section is generally shown on Drawings: E000, E110, E120, E130, FA000, FA001, FAD110, FAD120, FAD130, FAD140, FAD150, FA110, FA120, FA130, FA140, FA150, FA160, FA200, FA201, FA202, FA300, FA400.

1.01 GENERAL PROVISIONS

- A. The GENERAL REQUIREMENTS, DIVISION 1, and BIDDING AND CONTRACT REQUIREMENTS, DIVISION 0, are hereby made a part of this Specification Section.
- B. Examine all Drawings and all Sections of the Specifications and requirements and provisions affecting the work of this Section.

1.02 SCOPE OF WORK

- A. The project will be a complete migration and upgrade of the existing fire alarm systems in three (3) existing buildings (Main Building, Maintenance Building and Housing/Minimum Security at the Hampshire County House of Corrections facility in Northampton, MA. It will also include emergency and egress lighting upgrades in these same buildings as necessary.

The project will also include the installation of a new fire alarm communication network between the Main Building, Maintenance Building, Housing/Minimum Security, Regional Holding Facility and the Modular Buildings to annunciate all point details at the Main Building's fire alarm control panel and Main Security Control Room. It will also include all reprogramming and re-acceptance testing as required.

The existing fire alarm control panel and system at the Modular Buildings will remain and only be provided with the required equipment necessary to allow for network communications and monitoring.

The existing fire alarm control panel and systems at the Regional Holding Facility will remain and be provided with new CO (carbon monoxide) detection and the required equipment necessary to allow for network communications and monitoring.

Existing fire alarm systems shall remain active until the new systems have been tested and approved. All existing, replaced system shall be removed and all surfaces patched to restore conditions.

The project will also include lighting and power renovations of the Main Building's entry vestibule restrooms to accommodate accessibility requirements.

- B. Refer to the specific requirements for this project included in the "Narrative Report for Compliance with the Fire Protection and Life Safety Systems Section of the Massachusetts State Building Code (780CMR) – Fire Protection Construction Documents", which shall be considered part of these specifications. Include all associated testing and certifications necessary for compliance and any required remedial actions and retest due to failure.
- C. The work under this Section shall include the furnishing of all materials, labor, equipment and supplies and the performance of all operations to provide complete working systems, in general, to include the following items:
 - 1. Identification
 - 2. Raceways and Conduit
 - 3. Wire and Cable (600V)
 - 4. Wiring Devices and Plates
 - 5. Outlet Boxes
 - 6. Junction Boxes, Pull Boxes and Wireways
 - 7. Safety Disconnect Switches
 - 8. Lamps and Light Fixtures
 - 9. Fire Alarm System
 - 10. Fire Alarm System Modifications / Additions

11. Battery Powered Emergency Lighting System
 12. Sleeving
 13. Fire Seal and Fireproof Sealant
 14. Supervision and Approval
 15. Electrical Connections to HVAC, Fire Protection, and Plumbing Equipment, Kitchen Equipment, and other Equipment provided under other Sections or by Owner.
 16. Relocation of existing electrical components that interfere with new construction and removal and disposal of obsolete components.
 17. Testing
 18. Operating and maintenance instructions and manuals
 19. Coordination drawings
 20. Shop drawings
 21. Record (as-built) drawings
- D. Work of this Section is generally shown on the Electrical Drawings.

1.03 RELATED WORK

- A. Principal classes of Work related to the Work of this Section are listed in the Specification Table of Contents, and are specified to be performed under the indicated Sections of the Specifications. Refer to the indicated Sections for description of the extent and nature of the indicated Work, and for coordination with related trades. This listing may not include all related Work items. It is the responsibility of the Contractor to coordinate and schedule the Work of this Section with that of all other trades.
- B. The following work is not included in this section and will be provided under other sections:
 1. Structural supports necessary to distribute loading from equipment to roof or floor except as specified.
 2. Temporary light, power, water, heat, gas and sanitary facilities for use during construction and testing. Refer to Division 1, General Conditions.
 3. Excavation and backfill.
 4. Concrete work including concrete housekeeping pads and blocks for vibrating and rotating equipment, and ductbank envelopes.
 5. Flashing of roof and wall penetrations.
 6. Painting, except as specified herein.

1.04 PRODUCTS FURNISHED, BUT NOT INSTALLED UNDER THIS SECTION

- A. Furnish the following items for installation under other sections and provide wiring and connections as required:
 1. Duct mounted smoke and carbon monoxide (CO) detectors for installation under Section 15500. Lengths of sampling tubes shall be coordinated with Sheet metal Contractor. Control wiring for fan shut-down shall be provided under Section 15900.
 2. Access panels and doors for installation by the General Contractor.

- a. Furnish access panels for installation in walls, ceiling and floors at locations to permit access for adjustment, removal, replacement and servicing of all concealed equipment, valves and materials installed under this Section of the specifications.
- b. Access panels will be installed under the Section of the related trades of the finished surfaces in which they are located.
- c. Access panels shall be located in closets, storage rooms and/or other non-public areas if possible, positioned so that the equipment can be easily reached, and the size shall be sufficient for this purpose (min. 16" x 16"). When access panels are required in corridors, lobby or other habitable areas, they will be located as directed by the Owner's Representative.
- d. Access panels shall be prime painted, keyed alike and provided with cylinder lock and two keys for each panel. Units shall be manufactured by Milcor, Inland Steel, Miami Carie or approved equal. Required fire resistance of walls and ceilings shall be maintained.

1.05 PRODUCTS INSTALLED AND WIRED, BUT NOT FURNISHED UNDER THIS SECTION

- A. Install and provide wiring connections for the following items furnished under other sections:
 1. Door controllers and associated safety and interface devices.

1.06 DEFINITIONS

- A. As used in this Section, the following items are understood to have the following meaning:
 1. **"Contractor or Subcontractor"**, unless otherwise qualified, shall mean the installer of the work specified under this Section.
 2. **"Furnish"** shall mean purchase and deliver to the project site, complete with every necessary appurtenance.
 3. **"Install"** shall mean unload at the delivery point at the site and perform all work necessary to establish secure mounting and proper operation at the proper location in the project.
 4. **"Provide"** shall mean "Furnish" and "Install".
 5. **"Work"** shall mean all labor, materials, equipment, apparatus, controls, accessories and all other items required for a proper and complete installation.
 6. **"Concealed"** shall mean hidden from sight in chases, furred-in spaces, shafts, hung ceilings, embedded in construction or in a crawl space. Areas to be concealed as part of tenant alterations to the building shall also be considered in this definition.
 7. **"Exposed"** shall mean not installed underground or concealed as defined above.
 8. **"Furnished by Others"** shall mean materials or equipment purchased under other sections of the general contract and installed by this section of the specifications by this trade contractor.
 9. **"Owners Representative"** shall be the party responsible to make decisions regarding all contractual obligations in reference to the Scope of Work for the Owner.

10. **"Date of Substantial Completion"** shall indicate the date where the work has been formally accepted as evidenced by completed final punch list or where the work has reached the stage that the owner obtains beneficial use and commences utilization of the installed systems for business or occupancy purposes. The GENERAL REQUIREMENTS, DIVISION 1, shall supersede this definition where specifically defined.

1.07 CODES, REFERENCES AND PERMITS

- A. Materials, installation of systems and equipment provided under this section shall be done in strict accordance with the Department of Public Safety, Department of Environmental Protection, State Building Code and any other Codes and Regulations having jurisdiction including but not limited to:
 1. All Applicable NFPA Standards
 2. Massachusetts Electrical Code (MEC).
 3. Occupational Safety and Health Administration (OSHA)
 4. State and Local Building Codes
 5. Underwriters' Laboratories, Inc (UL)
- B. Unless otherwise specified or indicated, materials, workmanship and equipment performance shall conform with the latest governing edition of the following standards, codes, specifications, requirements, and regulations, except when more rigid requirements are specified or are required by applicable codes but not limited to:
 1. American National Standards Institute (ANSI)
 2. American Society of Mechanical Engineers (ASME).
 3. American Society of Testing and Materials (ASTM)
 4. Certified Ballast Manufacturers (CME)
 5. Illuminating Engineering Society (IES)
 6. Institute of Electrical and Electronics Engineers (IEEE)
 7. Insulated Cable Engineers Association (ICEA)
 8. National Electrical Contractors Association (NECA)
 9. National Electric Manufacturers Association (NEMA)
 10. Thermal Insulation Manufacturers Association (TIMA)
- C. Codes, laws and standards provide a basis for the minimum installation criteria acceptable. The drawings and specifications illustrate the scope required for this project, which may exceed minimum codes, laws and standards.
- D. Give all notices, file all plans, obtain all permits and licenses, and obtain all necessary approvals from authorities having jurisdiction. Deliver all certificates of inspection to the authorities having jurisdiction. No work shall be covered before examination and approval by the Owner's Representative, inspectors, and authorities having jurisdiction. Replace imperfect or condemned work to conform to requirements, satisfactory to Owner's Representative, and without extra cost to the Owner. If work is covered before inspection and approval, this Contractor shall pay costs of uncovering and reinstalling the covering, whether it meets contract requirements or not.

1.08 GENERAL REQUIREMENTS

- A. Nameplates

1. Each major component of equipment shall have the manufacturer's name, address, type or style, model or serial number, and catalog number on a plate secured to the equipment.
- B. Equipment Guards
1. Belts, pulleys, chains, gears, couplings, projecting setscrews, keys, and other rotating parts so located that any person may come in close proximity thereto shall be completely enclosed or guarded. High-temperature equipment and piping so located as to endanger personnel or create a fire hazard shall be guarded or covered with insulation of type specified for service.

1.09 MATERIAL AND EQUIPMENT STANDARDS

- A. Where equipment or materials are specified with the name of a manufacturer, such specification shall be deemed to be used for the purpose of establishing a standard for that particular item. No equipment or material shall be used unless previously approved by the Owner's Representative.
- B. Substitutions may be offered for review provided the material, equipment or process offered for consideration is equal in every respect to that indicated or specified. The request for each substitution must be accompanied by complete specifications together with drawings or samples to properly appraise the materials, equipment or process. The contractor shall highlight and list all applicable specification requirements which the substituted material deviates from.
- C. If a substitution of materials or equipment in whole or in part is made, this Contractor shall bear the cost of any changes necessitated by any other trade as a result of said substitution.
- D. All materials, equipment and accessories provided under this section shall be new and unused products of recognized manufacturers as approved.

1.10 SUBMITTALS

- A. Conform to the requirements of Division 1, General Conditions, for schedule and form of all submittals unless specifically noted otherwise in this section. Coordinate this submittal with submittals for all other finishes. Shop drawings and design layouts shall be prepared by licensed installing contractors and shall note the name(s), license number(s) and license expiration date(s) of the contractor(s) installing electrical systems.
- B. Definitions:
 1. Shop Drawings are information prepared by the Contractor to illustrate portions of the work in more detail than indicated in the Contract Documents.
 2. Acceptable Manufacturers: The mechanical design for each product is based on the single manufacturer listed in the schedule or shown on the drawings. In Part 2 of the specifications, certain Alternate Manufacturers are listed as being acceptable. In addition, the MATERIAL AND EQUIPMENT STANDARDS paragraph potentially allows for substitutions as being acceptable. These are acceptable only if, as a minimum, they:
 - a. Meet all performance criteria listed in the schedules and outlined in the specifications. For example, to be acceptable, an emergency generator must deliver equal kW / kVA at equal or greater efficiency using equal or less fuel as the emergency generator listed in the schedules.
 - b. Fit within the available space it was designed for, including space for maintenance and component removal, with no modification to either the space or the product. Clearances to walls, ceilings, and other equipment will be at least equal to those shown on the design drawings. The fact

that a manufacturer's name appears as acceptable shall not be taken to mean the Engineer has determined that the manufacturer's products will fit within the available space – this determination is solely the responsibility of the contractor.

- c. Products must adhere to all architectural considerations including, but not limited to; being of the same color as the product scheduled or specified, fitting within the architectural enclosures and details, and for lighting – being the same size and of the same physical appearance as scheduled or specified products.

C. Submittal Procedures, Format and Requirements

1. Review submittal packages for compliance with Contract Documents and then submit to Owner's Representative for review. Submit enough sets of shop drawings such that, after review, two sets will be kept by the reviewer, with only the remaining sets returned with reviewer's marks and comments.
2. Each Shop Drawing shall indicate in title block, and each Product Data package shall indicate on cover sheet, the following information:
 - a. Title
 - b. Equipment number
 - c. Name and location of project
 - d. Names of Owner, Engineer and Seller
 - e. Names of manufacturers, suppliers, vendors, etc.
 - f. Date of submittal
 - g. Whether original submittal or resubmitted
3. Shop Drawings showing manufacturer's product data shall contain detailed dimensional drawings (minimum ¼" – 1' scale) including plans and sections (where physical clearance could be an issue). Provide larger scale details as necessary.
4. Submit accurate and complete description of materials of construction, manufacturer's published performance characteristics, sizes, weights, capacity ratings (performance data, alone, is not acceptable), electrical requirements, starting characteristics, wiring diagrams, and acoustical performance for complete assemblies. Drawings shall clearly indicate location (terminal block or wire number), voltage and function for all field terminations, and other information necessary to demonstrate compliance with all requirements of Contract Documents.
5. Provide Shop Drawings showing details of piping connections to all equipment. If connection details are not submitted and connections are found to be installed incorrectly, this contractor shall reinstall them within the original contract price.
6. Provide complete data for all auxiliary services and utilities required by submitted equipment. This shall include fuel, cooling and exhaust requirements and points of connections.
7. Provide a complete description of all controls and instrumentation required including electrical power connection drawing for all components and interconnection wiring to starters, detailed information on starters, control diagrams, termination diagrams, and all control interfaces with a central control system.

8. Provide installation and erection information including; lifting requirements, and any special rigging or installation requirements for all equipment.
 9. The Owner's Representative shall approve all materials before commitment for materials is made.
- D. Product Data: Submit complete manufacturer's product description and technical information including:
1. Identification
 2. Raceways and Conduit
 3. Wire and Cable (600V)
 4. Wiring Devices and Plates
 5. Outlet Boxes
 6. Junction Boxes, Pull Boxes and Wireways
 7. Lamps and Light Fixtures
 8. Battery Powered Emergency Lighting System
 9. Fire Alarm System and One Line Wiring Diagrams.
 10. Fire Alarm System Modifications/Additions
 11. Fire Seal and Fireproof Sealant
 12. Seismic Restraints
 13. Identification, labels and tags, including database for all equipment, and devices.
 14. O&M table of contents
- E. Submit shop drawings and product data grouped to include complete submittals of related systems, products and accessories in a single submittal.
1. Access panel shop drawings shall be submitted to the Construction Supervisor for approval.
 2. Do not submit multiple product information in a single bound manual.
 3. Three-ring binders shall not be accepted.
- F. Deviations:
1. Concerning deviations other than substitutions, proposed deviations from Contract Documents shall be requested individually in writing whether deviations result from field conditions, standard shop practice, or other cause. Submit letter with transmittal of Shop Drawings which flags the deviation to the attention of the Owner's Representative.
 2. Without letters flagging the deviation to the Owner's Representative, it is possible that the Engineer may not notice such deviation or may not realize its ramifications. Therefore, if such letters are not submitted to the Owner's Representative, the Seller shall hold the Engineers, his consultants and the Owner harmless for any and all adverse consequences resulting from the deviations being implemented. This shall apply regardless of whether the Engineer has reviewed or approved shop drawings containing the deviation, and will be strictly enforced.
 3. Approval of proposed deviations, if any, will be made at discretion of Engineer.
- G. Schedule: Incorporate shop drawing review period into construction schedule so that Work is not delayed. This contractor shall assume full responsibility for delays caused by

not incorporating the following shop drawing review time requirements into his project schedule. Allow at least 10 working days, exclusive of transmittal time, for review each time shop drawing is submitted or resubmitted with the exception that 20 working days, exclusive of transmittal time are required for the following:

1. Coordination drawings.
2. If more than five shop drawings of a single trade are received in one calendar week.

H. Responsibility

1. Intent of Submittal review is to check for capacity, rating, and certain construction features. The contractor shall ensure that work meets requirements of Contract Documents regarding information that pertains to fabrication processes or means, methods, techniques, sequences and procedures of construction; and for coordination of work of this and other Sections. Work shall comply with approved submittals to extent that they agree with Contract Documents. Submittal review shall not diminish responsibility under this Contract for dimensional coordination, quantities, installation, wiring, supports and access for service, nor the shop drawing errors or deviations from requirements of Contract Documents. The Engineer's noting of some errors while overlooking others will not excuse the contractor from proceeding in error. Contract Documents requirements are not limited, waived nor superseded in any way by review.
2. Inform contractors, manufacturers, suppliers, etc. of scope and limited nature of review process and enforce compliance with contract documents.

I. In the event that the contractor fails to provide Shop Drawings for any of the products specified herein:

1. The contractor shall furnish and install all materials and equipment herein specified in complete accordance with these Specifications.
2. If the contractor furnishes and installs material and/or equipment that is not in complete accordance with these Specifications, he shall be responsible for the removal of this material and/or equipment. He shall also be responsible for the replacement of this material and/or equipment with material and/or equipment that is in complete accordance with these Specifications, at the direction of the Owner's Representative.
3. Removal and replacement of materials and/or equipment that is not in complete compliance with these Specifications shall be done at no extra cost to the Owner.
4. Removal and replacement of materials and/or equipment that is not in complete compliance with these Specifications shall not be allowed as a basis for a claim of delay of completion of the Work.

J. Mark dimensions and values in units to match those specified.

K. Submit Material Safety Data Sheets (MSD) on each applicable product with submittal.

1.11 OPERATION AND MAINTENANCE DATA

- A. Commence preparation of the Operating and Maintenance (O&M) manuals immediately upon receipt of "Approved" or "Approved as Noted" shop drawings and submit each section within one month. The final submission shall be no later than two months prior to the projected date of Substantial Completion of the Project.
- B. Submit O&M table of contents in the submittal phase. O&M manuals shall be built as submittals are accepted and shall include the individual equipment manufacturer's data retrieval sheet, as per Attachment A in Part IV for input into the Owner's Maintenance Management System. Form shall be provided and completed electronically.

- C. Each O&M document shall include the manufacturer's web address for equipment specific O&M information for Internet access by the owner.
- D. The manual shall consist of three (3) sets of manuals and include three (3) sets of CDs, which shall contain the scanned content of the entire manual. The manual shall highlight the actual equipment used and not be a master catalog of all similar products of the manufacturer. The manual shall be submitted for review prior to creation of the CDs.
- E. The Manual shall contain the following:
 - 1. Operations Manual
 - a. Systems description including all relevant information needed for day-to-day operations and management including start-up and shut-down instructions.
 - b. Wiring diagrams, schematics, logic diagrams and sequence of operations that accurately depict the controls system.
 - c. Depiction of each interface screen where programmable logic and visual displays are provided. Descriptors shall be provided to define displayed data, alarms, etc.
 - d. A single sheet (for ease of removal) of all access codes and passwords necessary to access all levels of control and programming.
 - e. Trouble shooting guide defining common alarms/problems with possible cause and effect.
 - 2. Maintenance Manual
 - a. Define all maintenance activities required to ensure system operation within manufacturers specified parameters. Provide table of all required activities plotted vs. interval with adequate fill-in-space for "activity completion date" and "comments". Where multiple instrument readings are required, provide data sheet formatted to accommodate activity.
 - b. Define recommended spare parts inventory with part numbers and source defined for ordering by the Owner. Identify lead time on all parts, source location and cost.
 - c. Provide copy of all warranty information with associated date of substantial completion (commencement of warranty) and end date of coverage. Define all components/subsystems specifically included and excluded.
 - d. Provide all information as listed on the Facility Support Services data sheet as per Attachment A in Part IV for input into the owner's Maintenance Management System. Form shall be provided and completed electronically.
- F. Provide O&M manuals for each of the following:
 - 1. Fire Alarm System
 - 2. Emergency Lighting System

1.12 RECORD DRAWINGS

- A. Refer to DIVISION 1, General Conditions, for record drawings and procedures to be provided under this section, unless specifically noted otherwise in this section.
- B. Record Drawings (red-line drawings) will be updated by this Contractor daily for review with the monthly requisition. The record drawing shall be an accurate depiction of the

systems as completed, including dimensions (vertical/horizontal) of concealed components off fixed building elements.

- C. The Electrical Foreman shall maintain complete and separate set of prints of Contract Drawings at job site at all times and shall record work completed and all changes from original Contract Drawings clearly and accurately including work installed as a modification or addition to the original design.
- D. At completion of work the Electrical Contractor shall prepare a complete set of record drawings on AutoCAD showing all systems as actually installed. The Architectural background AutoCAD files will be made available for the contractor's copying, at his expense, to serve as backgrounds for the drawings. The Electrical Contractor shall transfer changes from field drawings onto AutoCAD drawings and submit copy of files and three sets of prints to Owner's Representative for comments as to compliance with this section. CADD layering as established by the A&E design team shall be maintained with any and all changes done by the contractor.
- E. The Architect and Engineer are not granting to the Contractor any ownership or property interest in the CADD Drawings by the delivery of the CADD Disks to the Contractor. The Contractor's rights to use the CADD disks and the CADD Drawings are limited to use for the sole purpose of assisting in the Contractor's performance of its contractual obligations under its contract with respect to the Project. The Architect and Engineer are granting no further rights. Any reuse or other use by the Contractor will be at the Contractor's sole risk and without liability to the Architect and Engineer. The Contractor hereby waives and releases any losses, claims, damages, liabilities of any nature whatsoever, and costs (including attorney fees) arising out of, resulting from, or otherwise related to the use of the CADD Disks and CADD Drawings by the Contractor. The Contractor, to the maximum extent permitted by law, hereby agrees to indemnify, defend and hold the Architect and Engineer harmless from all loses, claims, damages, liabilities, and costs (including attorney fees) arising out of, resulting from, or otherwise related to the use of the CADD Disks and CADD Drawings by the Contractor.
- F. Record Drawings, shall show "as-built" condition of details, sections, riser diagrams, control changes and corrections to schedules. Schedules shall show actual manufacturer and model numbers of final equipment installation.
- G. The Electrical Contractor shall submit the record set for approval by the engineer a minimum of four weeks prior to seeking the permanent certificate of occupancy.

1.13 WARRANTIES

- A. Submit manufacturer's standard replacement warranties for material and equipment furnished under this Section. Such warranties shall be in addition to and not in lieu of all liabilities which the manufacturer and the Electrical contractor may have by law or by provisions of the Contract Documents.
- B. All materials, equipment and work furnished under this Section shall be guaranteed against all defects in materials and workmanship for a minimum period of one-year (1) commencing with the Date of Substantial Completion. Where individual equipment sections specify longer warranties, provide the longer warranty. Any failure due to defective material, equipment or workmanship which may develop, shall be corrected at no expense to the Owner including all damage to areas, materials and other systems resulting from such failures.
- C. Guarantee that all elements of each system meet the specified performance requirements as set forth herein or as indicated on the Drawings.
- D. Upon receipt of notice from the Owner of the failure of any part of the systems during the warranty period, the affected parts shall be replaced. Any equipment requiring excessive service shall be considered defective and shall be replaced.

1.14 COORDINATION

- A. Refer to Division 1, General Conditions, for coordination requirements applicable to this section, unless specifically noted otherwise in this section.
- B. Materials and apparatus shall be installed as fast as conditions of the building will permit and must be installed promptly when and as required.
- C. Confer with all other trades relative to location of all apparatus and equipment to be installed and select locations so as not to conflict with work of other Sections. Any conflicts shall be referred immediately to the Owner's Representative for decision to prevent delay in installation of work. All work and materials placed in violation of this clause shall be readjusted to the Owner's Representative's satisfaction at no expense to the Owner.
- D. Where work of this section will be installed in close proximity to work of other sections or where there is evidence that the work of this section may interfere with work of other sections, assist in working out space conditions to make satisfactory adjustment. Prepare and submit for approval 3/8" scale or larger working drawings and sections, clearly showing how the work is to be installed in relation to the work of other sections. If the work of this section is installed before coordinating with other trades or so as to cause interference with work of other trades, make changes necessary to protect conditions without extra charge.
- E. Keep fully informed as to the shape, size and position of all openings required for all apparatus, conduit, cable, sleeves, etc., and give information in advance to allow construction of required openings. Furnish all sleeves, pockets, supports and incidentals, and coordinate with the General Contractor for the proper setting of same.
- F. All distribution systems which require pitch or slope such as condensate drains and water piping shall have the right of way over those which do not. Confer with other trades as to the location of pipes, ducts, lights and apparatus and install work to avoid interferences.
- G. Make reasonable modifications in the work as required by structural interferences, or by interference with work of other trades, or for proper execution of the work without extra charge.

1.15 COORDINATION DRAWINGS

- A. Provide a set of Electrical coordination drawings for use in verifying required code clearances of all electrical equipment and for use in coordinating installation of equipment with other trades. Where practical, the CADD layering as established by the A&E team for the construction documents, shall be utilized in the preparation of all coordination drawings. Where CADD layering deviates from the A&E team's layering convention, submit the proposed layering system for approval. The CADD layering used shall provide, as a minimum, the flexibility of illustrating trade specific items similar to the established A&E team layering standard.
- B. The intent of the coordination drawings is to identify and resolve installation conflicts prior to fabrication and installation of any MEP trade.
- C. The CADD Drawings prepared by the Architect and Engineer contain representations of certain elements of the Project, and are not necessarily complete, nor are the CADD Drawings comparable or identical to final construction drawings. The Architect and Engineer make no representations or warranties with respect to the accuracy or completeness of the CADD Drawings. The Architect and Engineer do not recommend that the Contractor use the CADD Drawings in connection with the preparation of shop drawings. Should the Contractor choose to do so, however, the Contractor shall carefully review and compare the CADD Drawings with the corresponding final construction drawings to verify their accuracy and identify all discrepancies, differences, and

inconsistencies in design, locations, dimensions, scope, and all other respects between the CADD Drawings and the corresponding final construction drawings. The Contractor, shall base the preparation and submission of shop drawings, and in general, shall base the performance of all its obligations with respect to the Project upon the information contained in the final construction drawings and not the CADD drawings. Nothing shall be construed as to relieve the Contractor of any of its obligations (such as, by way of illustration, the obligation to make field measurements or to coordinate drawings) under its contract with respect to the Project.

- D. Electrical Coordination Drawings shall be prepared as outlined below.
1. Prepare Electrical Coordination Drawings showing all Electrical work to be installed as part of Section 16000. The Coordination Drawings shall be created using AutoCAD and shall have a scale of 1/4" or 3/8".
 2. The Electrical Coordination Drawings shall show distribution equipment (switchboards, panelboards, transformers, motor control centers, etc), feeders, light fixtures, cable tray and conduit racks. Drawings shall include dimensions and elevation tags for all equipment, devices and material.
 3. After incorporating all trades, resolve any areas of conflicts between trades under the direction of the General Contractor / Construction Manager and submit fully coordinated drawings to the Owner's Representative.
 4. Do not install any of this work prior to the preparation and Engineer's review of the final Coordination Drawings. If Electrical work proceeds prior to the final Coordination Drawings, any change to the Electrical work to correct the interferences and conflicts which result will be made by this Contractor at no additional cost to the Owner.
 5. Coordination Drawings are for this Contractor's and Owner's Representative's use during construction and shall not be construed as replacing any shop, "as-built", or Record Drawings required elsewhere in these Contract Documents.
 6. Owner's Representative's review of Coordination Drawings shall not relieve this Contractor from his overall responsibility for coordination of all work performed pursuant to the Contract or from any other requirements of the Contract.

1.16 INTERPRETATION OF DRAWINGS AND SPECIFICATIONS

- A. It is the intention of the Specifications and Drawings to call for complete, finished work, tested and ready for continuous operation. Any apparatus, appliance, material or work not shown on the Drawings, but mentioned in the Specifications or vice-versa, or any incidental accessories necessary to make the work complete in all respects and ready for operation, even if not particularly specified, shall be provided by this Contractor without additional expense to the Owner.
- B. The Drawings are generally diagrammatic. The locations of all items that are not definitely fixed by dimensions are approximate only. The exact locations must be determined at the project and shall have the approval of the Owner's Representative before being installed. This Contractor shall follow Drawings, including his shop drawings, in laying out work and shall check the Drawings of other trades to verify spaces in which work will be installed. Maintain maximum headroom and space conditions. Where space conditions appear inadequate, notify the Owner's Representative before proceeding with the installation. This Contractor shall, without extra charge, make reasonable modifications in the layout as needed to prevent conflict with work of other trades or for proper execution of the work.

- C. Any requests for information (RFI) for resolving an apparent conflict or unclarity, or a request for additional detail, shall include a sketch or equivalent description of contractors proposed solution.
- D. Size of conduits, cable trays, raceways and methods of running them are shown, but it is not intended to show every offset and fitting, nor every structural difficulty that may be encountered. To carry out the true intent and purpose of the Drawings, all necessary parts to make complete approved working systems ready for use, shall be furnished without extra charge. All work shall be installed in an approved workmanlike manner.

1.17 INSPECTION OF SITE CONDITIONS

- A. Prior to submission of bid, visit the site and review the related construction documents to determine the conditions under which the Work has to be performed and send a report, in writing, to the Owner's Representative, noting any conditions which might adversely affect the Work of this Section of the Specifications.

1.18 SURVEY AND MEASUREMENTS

- A. Base all required measurements, horizontal and vertical, from referenced points established WITH the Owner's Representative. The Electrical Contractor shall be responsible for correctly laying out the Work required under this Section of the Specifications.
- B. In the event of discrepancy between actual measurements and those indicated, notify the Owner's Representative in writing and do not proceed with the related work until instructions have been issued.

1.19 DELIVERY, STORAGE AND HANDLING

- A. No materials shall be delivered or stored on site until corresponding Shop Drawings have been approved.
- B. All manufactured materials shall be delivered to the site in original packages or containers bearing the manufacturer's labels and product identification.
- C. Protect materials against dampness. Store off floors, under cover and adequately protected from damage.
- D. Inspect all equipment and materials, upon receipt at the job site, for damage and conformance to approved shop drawings.

1.20 PROTECTION OF WORK AND PROPERTY

- A. This Contractor shall be responsible for the care and protection of all work included under this Section until the completion and final acceptance of this Contract.
- B. Protect all equipment and materials from damage from all causes including, but not limited to, fire, vandalism and theft. All materials and equipment damaged or stolen shall be repaired or replaced with equal material or equipment at no additional cost to the Owner.
- C. Protect all equipment, outlets and openings with temporary plugs, caps and covers. Protect work and materials of other trades from damage that might be caused by work or workmen under this Section and make good damage thus caused.
- D. Damaged materials are to be removed from the site; no site storage of damaged materials will be allowed.

1.21 SUPERVISION

- A. Supply the service of a competent Supervisor with a minimum of 5 years experience in Electrical construction supervision who shall be in charge of the Electrical work at the site.

1.22 SAFETY PRECAUTIONS

- A. Life safety and accident prevention shall be a primary consideration. Comply with all of the safety requirements of the owner and OSHA throughout the entire construction period of the project.
- B. Furnish, place and maintain proper guards and any other necessary construction required to secure safety of life and/or property.

1.23 SCHEDULE

- A. Construct work in sequence under provisions of Division 1 and as coordinated with the Owner's Representative.

1.24 HOISTING, SCAFFOLDING AND PLANKING

- A. The work to be done under this Section of the Specifications shall include the furnishing, set-up and maintenance of all derricks, hoisting machinery, cranes, helicopters, scaffolds, staging and planking as required for the work.

1.25 CUTTING AND PATCHING

- A. Provide all cutting and patching necessary for the proper installation of work to be performed under this Section.
- B. All work shall be fully coordinated with all phases of construction, in order to minimize the requirements for cutting and patching.
- C. Form all chases or openings for the installation of the work of this Section of the specifications, or cut the same in existing work and see that all sleeves or forms are in the work and properly set in ample time to prevent delays. Be responsible that all such chases, openings, and sleeves are located accurately and are of the proper size and shape and consult with the Owner's Representative and all other trades concerned in reference to this work. Confine the cutting to the smallest extent possible consistent with the work to be done. In no case shall piers or structural members be cut without the approval of the Owner's Representative.
- D. Fit around, close up, repair, patch, and point around the work specified herein to match the existing adjacent surfaces and to the satisfaction of the Owner's Representative.
- E. Fill and patch all openings or holes left in the existing structures by the removal of existing equipment which is part of this Section of the Specifications.
- F. All of this work shall be carefully done by workmen qualified to do such work and with the proper and smallest tools applicable.
- G. Any cost caused by defective or ill-timed work required by this Section of the specifications shall be borne by this Contractor.
- H. When, in order to accommodate the work required under this Section of the specifications, finished materials of other trades must be cut or fitted, furnish the necessary drawings and information to the trades whose materials must be cut or fitted.

1.26 SLEEVES, INSERTS AND ANCHOR BOLTS

- A. Coordinate with other trades the location of and maintaining in proper positions, sleeves, inserts and anchor bolts to be supplied and/or set in place under this section of the specifications. In the event of incorrectly located preset sleeves, inserts and anchor bolts, etc., all required cutting and patching of finished work shall be done under this section of the specifications.
- B. All pipes passing through floors, walls, ceilings or partitions shall be provided with fire stopping to maintain the fire rating of the structure. All penetrations and associated fire stopping shall be installed in accordance with the fire stopping manufacturer's listed

installation details. Provide sleeves for all penetrations where required by the listed detail, for the penetration of all mechanical room floors and where specifically required on the drawings.

- C. Field drilling (core drilling), when required, shall be performed under this section of the specifications, after receipt of approval by the Owner's Representative.
 - 1. When coring can not be avoided, provide ¼ inch pilot hole prior to coring. When coring through floor or slab, verify location of core on floor below and protect and piping, ductwork, wiring, furniture, personnel, etc., below the location of the core.

1.27 SUPPLEMENTARY STEEL, CHANNELS AND SUPPORTS

- A. Provide all supplementary steel, factory fabricated channels and supports required for the proper installation, mounting and support of all Electrical equipment, piping, etc., required by the Specifications.
- B. Supplementary steel and factory fabricated channels shall be firmly connected to building construction in a manner approved by the Owner's Representative as shown on the drawings or herein specified.
- C. The type and size of the supporting channels and supplementary steel shall be determined by the Contractor and shall be of sufficient strength and size to allow only a minimum deflection in conformance with the manufacturer's requirements for loading.
- D. All supplementary steel and factory fabricated channels shall be installed in a neat and workmanlike manner parallel to the walls, floors and ceiling construction. All turns shall be made with 90 degree and 45 degree fittings, as required to suit the construction and installation conditions.
- E. All supplementary steel including factory fabricated channels, supports and fittings shall be galvanized steel, aluminum or stainless steel where exposed or subject to rust producing atmosphere. Factory fabricated channels shall be manufactured by Unistrut, H-strut, Powerstrut or approved equal.

1.28 HAZARDOUS MATERIALS

- A. Removed batteries shall be recycled by a facility approved by the owner's representative. A uniform hazardous waste manifest shall be prepared for all disposals and returned with all applicable signoffs prior to application for final payment.
- B. Removed fluorescent and HID lamps shall be recycled by a facility approved by the owner's representative. A uniform hazardous waste manifest shall be prepared for all disposals and returned with all applicable signoffs prior to application for final payment.
- C. All ballasts in lighting fixtures to be disposed shall be verified to be PCB free. All ballasts manufactured prior to 1979 and not labeled as PCB free shall be considered to contain PCB's. Provide written verification to the owner's representative that confirms PCB free waste. Where PCB free waste cannot be verified, ballasts shall be recycled by a facility approved by the owner's representative, with PCB components eliminated by a high temperature incineration. A uniform hazardous waste manifest shall be prepared for all disposals and returned with all applicable signoffs prior to application for final payment. All handling shall conform to EPA requirements. Provide breakout cost for this scope.
- D. Where it has been identified that asbestos-containing material exists within the scope limits, refer to the Asbestos Abatement specification section for requirements.

1.29 ACCESSIBILITY

- A. All work provided under this Section of the Specification shall be installed so that parts requiring periodic inspection, maintenance and repair are accessible. Work of this trade shall not infringe upon clearances required by equipment of other trades, especially code

required clearances to electrical gear. Minor deviations from the drawings may be made to accomplish this, but changes of substantial magnitude shall not be made prior to written approval from the Owner's Representative.

1.30 SEISMIC RESTRAINT REQUIREMENTS

- A. Submit working plans and calculations reviewed, signed and stamped by a professional engineer who is registered in the State where the project is located and has specific experience in seismic calculations, certifying that the plans meet all seismic requirements established by authorities having jurisdiction over the project.
- B. For each seismic restraint, provide certified calculations to verify adequacy to meet the following design requirements:
 - 1. Ability to accommodate relative seismic displacements of supported item between points of support.
 - 2. Ability to accommodate the required seismic forces.
- C. For each respective set of anchor bolts provide calculations to verify adequacy to meet combined seismic-induced sheer and tension forces.
- D. For each weldment between structure and item subject to seismic force, provide calculations to verify adequacy.
- E. Restraints shall maintain the restrained item in a captive position without short circuiting the vibration isolation.

1.31 PROJECT CLOSEOUT

- A. Certificates Of Approval
 - 1. Upon completion of all work, provide certificates of inspections from the following equipment manufacturers stating that the authorized factory representatives have inspected and tested the operation of their respective equipment and found the equipment to be in satisfactory operating condition and installed per the manufacturers installation instructions and requirements.
 - a. Fire Alarm System
- B. Construction Observations By The Engineer
 - 1. The engineer is contracted to make progress site visits during construction, **one** substantial completion (punch list) site visit for determining substantial completion and **one** Final site visit to determine if all work is complete.
 - 2. The Trade Contractors and the General Contractor are required to inspect their own work and make any corrections to the work to comply with the specifications and the contract documents. It is not the responsibility of the engineer to develop lists of incomplete work items.
 - 3. Progress Site Visits
 - a. The purpose of the progress site visit by the engineer is to observe if the work is proceeding in accordance with the contract documents.
 - b. The engineer will prepare a field report which will note in general the work completed since the last observation visit, work found not to be in accordance with the contract documents and work not corrected since the previous observation visit.
- C. Substantial Completion
 - 1. When the Contractor considers the Work under this Section is substantially complete, the Contractor shall submit written notice, through the General

Contractor, with a detailed list of items remaining to be completed or corrected and a schedule of when each remaining work item will be completed. Should the engineer determine the list of remaining work does not constitute substantial completion the engineer will notify the Architect and/or Owner and he will not make a substantial completion site visit.

2. The following items shall be completed prior to the written request for substantial completion site visit:
 - a. Certification of successful operation of all systems.
 - b. Training of the owner's personnel in the operation of the systems.
 - c. Record Drawings in accordance with the contract specifications.
 - d. Operation and Maintenance manuals.
 - e. Testing reports.
 - f. Manufacturer's certificates of approvals.
 - g. Emergency contact list for reporting of malfunctioning equipment during the warrantee period.
 - h. Contractors Project Completion certificate.
3. Should the Engineer, during the substantial completion visit, observe that the Work is substantially complete, s/he will provide a written listing of the observed deficiencies referred herein as the Punch List. The Punch List will provide for a place for the Contractor and general contractor to sign off and date each item individually indicating that the observed deficiency item has been corrected.
4. Should the Engineer, during the substantial completion site visit, observe that the Work is not substantially complete, s/he will provide, a written list of the major deficiencies and a reason for the work not being considered substantially complete.
5. If the work is found not to be substantially complete then the engineer shall be reimbursed for his time to reobserve the work. A reobservation fee shall be charged to the Contractor through the contractual agreement for any further observations by the engineer.
6. The Contractor shall remedy all deficiencies listed in the punch list within the time frame required by the contract.

D. Engineers Construction Completion Certification

1. Where required by the applicable code, the Engineers Construction Completion Certification will be issued by RDK Engineers when all life safety and health related issues are complete, all required functional tests are complete and all reports are complete. The following is a minimum listing of the required systems to be tested with reports generated indicating they are complete and ready for use:
 - a. Emergency and Egress Lighting System
 - b. Fire Alarm System
2. There shall be NO outstanding items identified on the punch list for scope within any of these categories.

E. Final Completion

1. The following items shall be submitted prior to the written request for Final completion:

- a. Revised Substantial Completion items to be resubmitted in accordance with the review process comments.
 - b. Warranties commencing the date of Substantial completion
 - c. Individual Signed and dated Punch List acknowledging completion of all punch list items
 2. When the Contractor considers all of the punch list work items complete, the Contractor shall submit written notice through the General Contractor that all Punch List items are complete and resolved and the work is ready for final observation site visit. The signature lines for completion of each punch list item shall be signed by the Contractor indicating the work is complete and signed by the General contractor indicating s/he has inspected the work and found it to be complete. Should the Engineer find the work to be finally complete and all Punch List items are complete the Engineer will make a recommendation to the Architect or Owner. If the Engineer has found the punch list work to be incomplete during final inspection a written listing of the observed deficiencies will be prepared by the Engineer.
- F. Contractor's Project Completion Certificate
1. Upon completion of work and prior to request for Certificate of Occupancy, each Trade Contractor and the General Contractor shall issue a certificate stating that work has been installed generally consistent with construction documents and all applicable codes. RDK Engineers can furnish a blank contractor's certificate form upon request. The certificate shall certify:
 - a. Execution of all work has been in accordance with the approved construction documents.
 - b. Execution and control of all methods of construction was in a safe and satisfactory manner in accordance with all applicable local, state and federal statutes and regulations.
 2. The certificate shall include the following information:
 - a. Project.
 - b. Permit Number.
 - c. Location.
 - d. Construction Documents.
 - e. Date on Plans and Specifications submitted for approval and issuance of the Building Permit.
 - f. Addendum(a) and Revision Dates.
 3. The certificate shall be signed by the Contractor and include the following:
 - a. Signature.
 - b. Date.
 - c. Company.
 - d. License Number.
 - e. License Expiration Date.

PART 2 - PRODUCTS

2.00 IDENTIFICATION

- A. Nameplates
1. Nameplates shall be laminated black Bakelite with minimum 1/4" high white recessed letters.
 2. Nameplates shall be securely attached to the equipment. Utilize mechanical fasteners such as galvanized steel or brass screws for exterior applications. High strength adhesives or cements may be used for interior applications.
 3. Equipment panel and valve bar code labels shall be 4" by 2½" and designed to withstand temperatures of -22°F to +392°F. Labels are designed to be resistant to water, acid/solvent, dirt and oil repellent. Labels shall be high tensile Graphiplast® tearing strength as well as scratch resistant and affixed to equipment by cable ties or adhesive clear pouch. Location of label shall be at unit control panel, next to factory nameplate, lower right-hand corner of panel, and/or tie wrapped to localize disconnect at unit. Installation instructions shall be provided with the labels to assure durability (i.e., clean surface prior to adhering adhesive label, leave cable ties loose on outside of equipment to allow freedom of movement due to the elements, etc.) and with adhesive tags not secured when temperatures are below 45°F ambient temperature.

2.01 RACEWAYS AND CONDUIT

- A. Rigid Galvanized Steel (RGS) Conduit
1. RGS shall be zinc-coated steel that conforms to ANSI C80.1, UL Specification No. 6 and Federal Specification WW-C-581e by Allied Tube and Conduit, Republic Steel, Wheatland Tube or approved equal.
 2. RGS fittings shall be threaded. Split couplings or non-threaded fittings shall not be used.
 3. Nipples and Close Nipples shall be RGS, length as noted or as required to conform to field conditions.
- B. Electrical Metallic Tubing (EMT)
1. EMT shall be zinc-coated steel that conforms to ANSI C80.3, UL Standard No. 797 and Federal Specification WW-C-563 a by Republic Steel, Allied Tube and Conduit or approved equal.
 2. EMT fittings shall be zinc plated pressed steel gland and ring compression up to 2" and zinc plated pressed steel double set screw from 2" and up
- C. Polyvinyl Chloride (PVC) Non-metallic Conduit
1. PVC conduit and fittings shall be Schedule 40 or Schedule 80, 90°C. UL Listed equal to Carlon Plus 40 or Plus 80. PVC shall meet NEMA Specification TC-2, TC-3 and UL-651.
 2. PVC, fittings and solvent cement shall be by single approved manufacturer.
 3. PVC shall be sunlight resistant and listed for exposed or outdoor usage.
 4. PVC shall only be used for exterior underground work.
- D. Miscellaneous Conduit Fittings
1. Elbows shall be standard radius unless noted otherwise. Where Large Radius elbows are specified, provide 48" radius unless noted otherwise.
 2. Bushings shall be threaded pressed steel hot dipped galvanized with conduit end stop and integrally molded noncombustible phenolic insulated surface rated for 150°C.

3. Bonding bushings shall be threaded pressed steel hot dipped galvanized with conduit end stop and integrally molded noncombustible phenolic insulated surface rated for 150°C with a lay-in tin plated copper grounding lug.
 4. Exposed conduit expansion fittings shall be hot-dipped galvanized malleable iron with external bonding jumper equal to O.Z./Gedney Type EX for RGS or Type TX for EMT (4" maximum expansion).
- E. Flexible Metallic Conduit
1. Liquidtight Metal Conduit shall be UL Listed fabricated from a spiral wound strip of heavy gauge, corrosion resistant, hot dipped galvanized steel equal to Electric Company Type LA. The jacket shall be flame retarded, sunlight resistant PVC extruded over the spiral wrap. Sizes through 1 ¼" shall have an integral copper bonding strip.
 2. Liquidtight fittings shall be UL listed zinc plated insulated throat.
 3. Flexible metal conduit shall be UL Listed non-jacketed steel fabricated from a spiral wound strip of heavy gauge, corrosion resistant, hot dipped galvanized steel equal to Electric Company Type BR.
- F. Wireways shall be minimum 16-gauge steel with all straight runs having hinged spring-latched covers. Finish shall be painted over a corrosion resistant phosphate pretreatment to protect against corrosion. Interior parts shall be smooth and free of sharp edges and burrs. Provide wireway as identified on the drawings for NEMA 1, 3R or 12 service. Wireways shall be equal to Square D and UL Listed.
- G. Refer to drawings for locations and use of each conduit type.

2.02 WIRE AND CABLE (600V)

- A. Provide single-conductor, annealed copper wire and cable with insulation rated for 600 V, of sizes specified and scheduled on Drawings, by General Electric, Southwire, Okonite or approved equal, for secondary service, feeders, branch and system wiring. Wire sizes shown and specified are American Wire Gauge for copper conductors.
- B. The use of aluminum conductors is not allowed.
- C. Wire #10 and larger shall be stranded; #12 and smaller shall be solid. Wire and cable shall have THWN-THHN or XHHW insulation for branch circuit and feeder conductors. Type RHWUSE shall be used for all conductors installed in below grade raceways for generator applications only.
- D. Conductor Color-coding
1. Branch circuit and feeder conductors shall be color-coded. Conductors #12 and #10 shall be colored with a factory applied solid or striped compound coating (black, red, blue, brown, orange or yellow). Neutrals and equipment grounds shall have solid compound or solid color coating (white, gray and green), except that neutrals with colored stripe shall be used where required by code. Phase conductors #8 and larger with stripes, bands or hash marks shall have background color other than white, green and gray.
 2. Alternative field-applied color coding methods may be used for wire #8 or larger, with color code as specified in other sections of this specification. Coloring shall be applied by the use of flame-retardant vinyl tape, equal to 3M Scotch 35.
- E. Cable
1. Flexible Metal Clad (MC) cable shall be UL Listed with THHN insulated conductors with an insulated grounding conductor within galvanized steel or

aluminum interlocked armor. Connectors shall be provided with lock nut connection to the termination point enclosure.

2. Flexible Metal Clad (MC) cable utilized for Fire Alarm service shall be identified with a factory applied tracer along the entire length.

F. Splices and Terminations

1. Ampacity and temperature rating of splices and connectors shall be equal to or greater than those of associated wires and cables.
2. Make splices in branch circuit or feeder wiring from #12 to #10 with UL-listed, solderless screw on connectors rated 600 V.
3. Make splices in branch circuit or feeder wiring above #10 with UL-listed 90°C, 600V, compression butt splice barrel equal to Burndy YS-L HYLINK.
4. Conductor terminations shall be standard bolt-on lugs with hex screws listed for attachment of copper wire and cable to panelboards, switchboards, disconnect switches and other electrical equipment.
5. Make terminations for stranded conductors on screw terminals with UL Listed 105°C, 600V PVC insulated barrel compression locking fork tongue terminal equal to Burndy TP-LF VINYLUG.

- G. Wire management shall be provided by self-extinguishing self-locking nylon ties with -65 to 350°F. range for bundling conductors.

- H. Cable pulling compounds shall be UL Listed and be suitable for use with the specified cable insulation system. The compound shall reduce the coefficient of friction, while not adding any long term issues to the installation such as premature aging of the insulation system, added flammability or drying in such a manner as to stick the cable in place in the raceway.

2.03 WIRING DEVICES AND PLATES

- A. Provide wiring devices by single manufacturer. Catalog designations of Cooper are specified, unless noted otherwise, to establish standards of quality for materials and performance. Colors of devices as specified below are White for standard applications. Refer to the drawings for color requirements that vary from White. Equal products by Leviton, Pass & Seymour or Hubbell will be accepted. Provide published manufacturers cross-reference sheet highlighted with the device specified and that being submitted with all device product data for approval.

- B. Wall switches shall be of the totally enclosed tumbler type. Wiring terminals shall be spring loaded terminal screws for back or side wiring. Switches shall be rated 20-ampere 277 volt for use on alternating current only. The yoke shall have a grounding terminal with a green hex head screw. Pilot lights indicated shall consist of red lighted handle, illuminated when the switch is on.

- C. Toggle Switches shall be heavy duty, UL listed, specification grade as follows:

1. Single-pole shall be No. 2221W
2. Double-pole shall be No. 2222W
3. Three-way shall be No. 2223W
4. Four-way shall be No. 2224W
5. Single-pole locking shall be No. 2221L

- D. Receptacles:

1. Receptacles shall be nylon faced with rigid, glass reinforced nylon bodies. Wiring terminals shall be spring loaded terminal screws for back or side wiring. Receptacles shall be rated 20-ampere 125 volt. The yoke shall have a grounding terminal with a green hex head screw.
 2. Duplex receptacles shall be UL Federal Specification WC-596 Specification Grade Extra Hard Duty 125V, 20A, 2 pole, 3 wire as follows:
 - a. General Use shall be No. 5362W (White)
 - b. General Use single receptacle shall be No. 5361W (White)
 - c. Emergency shall be No. 5362RD (Red)
 - d. GFCI Interior shall be No. GF20W (White)
 - e. GFCI Exterior shall be GF20BK (Black) UL listed Weather Resistant
 3. Special purpose outlets shall be provided as indicated on the drawings at the ratings listed on the schedules and notes.
- E. Wiring Device Plates:
1. Provide 0.032" nominal brushed Type 430 stainless steel device plates by the manufacturer of the wiring device for all flush mounted switches and receptacles installed in dry locations and where not subjected to physical abuse. Ganged plates shall be of one-piece construction to accommodate the required number of installed devices. Oversized plates to cover wall finish blemishes adjacent to the device box shall not be used.
 2. Provide heavy-duty cast aluminum horizontally mounted weatherproof covers for GFCI receptacles where weatherproof devices are specified equal to Hubbell No. WP26MH. Cover shall be attached to FS box with 4 screws and spring back to the closed position upon removal of the cord set. Fasteners chrome-plated brass.
 3. Receptacle device plates for other than 20 amp, 120 V, 2-wire, circuits shall be provided with typed clear plastic label (equal to P-Touch) mounted to the device plate indicating voltage characteristics, panelboard and circuit number of outlet
 Receptacle device plates for other than 20 amp, 120 V, 2-wire, circuits shall be identified by engravings or laser etching on the plate indicating voltage characteristics, panelboard and circuit number of outlet.

2.04 OUTLET BOXES

- A. Outlet and switch boxes on concealed work shall be at least 4" square, galvanized pressed steel conforming to UL 514A. Where installed in plaster, boxes shall be fitted with galvanized steel plaster covers of required depth to finish flush with finished wall or ceiling. Outlet boxes shall be by Steel City Electric Company, Appleton Electric Company, or approved equal.
- B. Outlet boxes installed in masonry walls or in concrete decking shall be UL Listed for the application.
- C. Outlet boxes for interior surface mounted locations where RGS is specified where exposed to moisture, at kitchen and cafeteria equipment, adjacent to water or steam connections, and where indicated as weatherproof on Drawings shall be cast malleable iron with an aluminum polymer enamel coating equal to Appleton Type FD. Conduit entries shall be threaded cast hubs. Device covers shall be coated malleable iron with moisture sealing gasket and stainless steel fasteners.

- D. Outlet boxes for exterior surface mounting shall be cast aluminum alloy with an aluminum polymer enamel coating equal to Appleton Type FD. Conduit entries shall be threaded cast hubs. Device covers shall be cast aluminum alloy with moisture sealing gasket and stainless steel fasteners.
- E. All boxes shall have at least one tapped and threaded grounding hole for connection of a 10-32 grounding screw.
- F. Box depth shall accommodate code required volume for the specified installation. Through wall boxes shall not be used.
- G. Outlet boxes for various systems including but not limited to fire alarm, paging and master clocks shall be sized as required by the manufacturer. Boxes shall be cast where exposed to physical damage or installed in an exposed exterior location.
- H. Floor outlets shall be heavy-wall cast iron bodies with edge frames and floor plates of polished bronze. Boxes shall be watertight and be fully adjustable before and after pouring. Provide insert floor plates with hinged covers for duplex receptacles or for telephone connection as shown on the drawings. Multi-gang boxes shall be provided with internal removable barriers for separation of different voltages. Provide carpet plates where required. Boxes shall be equal to Steel City 840 SC Series.

2.05 JUNCTION AND PULL BOXES

- A. Provide galvanized steel junction and pull boxes where indicated and as necessary to facilitate installation. Steel shall be minimum 16 gauge. Junction and pull boxes shall be of code required dimensions. Cover shall be of the same type and thickness material as the box construction.
- B. Junction and pull boxes intended for dry interior locations shall be NEMA 1 enclosures with accessible, removable screw-on covers. Covers shall be secured with corrosion-resistant screws with keyhole slots to accommodate easy removal.
- C. Junction and pull boxes intended for wet or exterior locations shall be NEMA 3R enclosures with hinged gasketed covers. Interior and exterior shall be finished with a gray enamel powder coat over the galvanized metal. Hinge shall be galvanized steel with stainless steel pin. Covers shall be secured with corrosion-resistant zinc plated lockable pull catches.
- D. Custom fabricated medium to large junction and pull boxes shall have internal structural steel bracing welded to form a rigid assembly adequate to maintain alignment and shape in shipment and installation.

2.06 LIGHTING FIXTURES

- A. Provide lighting fixtures, equipment and components where shown on Drawings, as listed in fixture schedules and as specified, wired and assembled. Provide approved aligned canopies, hangers and other appurtenances as required, for a complete and functional system.
- B. Refer to the lighting fixture schedule for specific ballast requirement. In general:
 - 1. HID fixtures shall have a high power factor (>90%), encapsulated ballasts, sound rating "A" and voltage as indicated on the fixture schedule, and shall be CBM-certified. Ballasts shall be by Advance Electric, G.E., Osram Sylvania or Universal.
 - 2. Fluorescent fixtures shall have electronic ballasts with high power factor, 277V or 120V, with sound rating "A" and shall be CBM-certified. Total harmonic distortion rating shall be less than 10%. Ballasts shall be instant start or programmed rapid start for maximum performance and energy savings and have a minimum ballast

factor of 0.88. Acceptable ballasts manufacturer are Osram Sylvania Inc., Advance Electric, GE or Universal.

3. Electronic ballasts that operate T-5 and compact fluorescent lamps shall have end-of-lamp-life shut down to protect against lamp over heating.
- C. Refer to the lighting fixture schedule for specific lamp type, CRI and color.
1. Tungsten-halogen lamps shall be rated for 130V.
 2. Incandescent lamps shall be inside-frosted, extended service.
 3. Fluorescent lamps shall have minimum CRI rating of 82.
 4. HID lamps shall be rated for the operating position required for the specified fixture. Provide universal burn wherever possible.
 5. Acceptable lamp manufacturers are: Osram Sylvania Inc., G.E., Philips, or approved equal.
- D. Refer to fixture schedule for specific lamp and ballast requirements which may deviate from this specification.
- E. Verify ceiling constructions, and provide frames, rings and other accessories suitable for construction encountered.
- F. Provide polyester covers to protect fluorescent fixtures with parabolic louvers during construction.

2.07 FIRE ALARM – ADDRESSABLE

- A. Scope of Work
1. The project will be a completed migration and upgrade of the existing fire alarm system in the following buildings (Main BLDG, Housing (Minimum Security) BLDG, and Maintenance BLDG) To reduce the need for fire watch the system shall be migrated using zone circuits in the new panel and then upgraded to addressable initiation one circuit at a time. The new FACP zone circuits shall be UL listed for use with all existing devices. The new system will annunciate all point details at the Main Building FACP via network communications including Regional Holding and Modular Building which will use the existing FACP.
- B. General
1. Provide a complete non-coded, addressable fire detection, alarm and control system with horn/strobe signaling devices in compliance with all applicable codes and authorities having jurisdiction. The system shall interface with all other building systems for monitoring and control functions as specified.
 2. Provide automatic and manual, closed circuit, multiplex fire alarm communications according to the following Specifications and as shown on the Drawings, wired, connected and left in first class operating condition.
 3. Network fire alarm control panels shall include all features as described in this specification for stand-alone FACP's and shall have network communication capabilities as described herein.
 - a. All points monitored and controlled by a single node shall be capable of being programmed as "Public". Each point made public to the network may be programmed to be operated by any other node connected to the network.
 - b. Network communications shall be capable of supporting "point lists" that can be handled as though they were a single point.

4. The network shall provide a means to log into any node on the system via a laptop computer or CRT/Keyboard and have complete network access (Set Host) for diagnostics, maintenance reporting, and information gathering of all nodes in the system. Systems not meeting this requirement must provide all diagnostic tools required to support this function from selected points on the network. This Section covers fire alarm systems, including initiating devices, notification appliances, controls, and supervisory devices.
5. The system design and installation shall conform to the following standards:
 - a. All equipment shall be UL listed for its intended purpose.
 - b. All applicable NFPA standards, including but not limited to: 70, 72, 90A, 92A, and 101.
 - c. State Building Code.
 - d. The Americans with Disabilities Act (ADA)
 - e. All requirements of the Authority Having Jurisdiction (AHJ)
6. The equipment supplier and the Contractor shall demonstrate a minimum 5 years experience in the successful design and installation of addressable fire alarm systems similar in size and scope to that required for this project.
7. System shall operate from 3 wire AC supply with emergency generator backup on failure of normal system and integral standby battery source backup on failure of the emergency generator.
8. The installer and manufacturers warranty shall be for a minimum period of one (1) year from the date of the final acceptance test approval.
9. Equipment shall be by one of the following manufacturer's:
 - a. Simplex Grinnell
 - b. Notifier
 - c. FCI
 - d. Edwards Systems Technologies (EST)

All references to manufacturers or suppliers model numbers are supplied to establish minimum standards of performance, function and quality. Equivalent equipment from one of the listed manufacturers above may be substituted for that specified.

Alternate products must be submitted to the Engineer two weeks prior to bid for approval. Alternate or as-equal products submitted under this contract must provide a detailed line-by-line comparison of how the submitted product meets, exceeds, or does not comply with this specification.

- C. Sequence of Operation
 1. Refer to Sequence of Operation Matrix on the plans and the Fire Protection Narrative for the intended system operation.
- D. Control
 1. General Requirements
 - a. Provide a complete, non-coded addressable microprocessor-based fire alarm system with initiating devices, notification appliances, and monitoring and control devices as indicated on the drawings and as specified herein.

- b. Install Mode: For the purposes of phased system installation, check-out and final testing, the system shall provide the capability to group all non-commissioned points and devices, during installation, into a single "Install Mode" trouble condition, allowing an operator to clearly identify event activations from commissioned points and devices in occupied areas.
- 1) It shall be possible to individually remove points from Install Mode as required for phased system commissioning.
 - 2) It shall be possible to retrieve an Install Mode report listing that includes a list of all points assigned to the Install Mode. Panels not having an install mode shall be reprogrammed to remove any non-commissioned points and devices.
 - 3) Alternate systems not equipped with such feature shall be required to clear all circuits and devices within the field wiring at the end of each work day to ensure the difference between actual system fault conditions from incomplete installation caused fault conditions. No deviation from this requirement shall be allowed.
- c. Software: The fire alarm system shall allow for loading and editing instructions and operating sequences as necessary.
- 1) The system shall be capable of on-site programming to accommodate system expansion and facilitate changes in operation.
 - 2) All software operations shall be stored in a non-volatile programmable memory within the fire alarm control unit. Loss of primary and secondary power shall not erase the instructions stored in memory.
 - 3) Panels shall be capable of full system operation during new site specific configuration download, master exec downloads, and slave exec downloads.
 - 4) Panels shall automatically store all program changes to the panel's non-volatile memory each time a new program is downloaded. Panels shall be capable of storing the active site-specific configuration program and no less than 9 previous revisions in reserve. A compare utility program shall also be available to authorized users to compare any two of the saved programs. The compare utility shall provide a deviation report highlighting the changes between the two compared programs.
 - 5) Panels shall provide electronic file storage with a means to retrieve a record copy of the site-specific software and up to 9 previous revisions. Sufficient file storage shall be provided for other related system documentation such as record drawings, record of completion, owner's manuals, testing and maintenance records, etc.
 - 6) The media used to store the record copy of site-specific software and other related system documentation shall be electrically supervised. If the media is removed a trouble shall be reported on the fire alarm control panel.

- d. History Logs: The system shall provide a means to recall alarms and trouble conditions in chronological order for the purpose of recreating an event history. A separate alarm and trouble log shall be provided.
- e. Recording of Events: Record all alarm, supervisory, and trouble events by means of system printer. The printout shall include the type of signal (alarm, supervisory, or trouble) the device identification, date and time of the occurrence. The printout differentiates alarm signals from all other printed indications.
- f. Network communication:
 - 1) Network node communication shall be through a token ring, hub, or star topology configuration, or combination thereof.
 - 2) A single open, ground or short on the network communication loop shall not degrade network communications. Token shall be passed in opposite direction to maintain communications throughout all network nodes. At the same time the status of the communication link shall be reported.
 - 3) If a group of nodes becomes isolated from the rest of the network due to multiple fault conditions, that group shall automatically form a sub-network with all common interaction of monitoring and control remaining intact. The network shall be notified with the exact details of the lost communications.
 - 4) Fiber optics communication shall be provided via a fiber optics modem. Modem shall multiplex audio signals and digital communication via full duplex transmission over a single fiber optic cable, either single mode or multi mode.
 - 5) The communication method shall be NFPA 72 style 7.
- g. Required Functions: The following are required system functions and operating features:
 - 1) Priority of Signals: Fire alarm events have highest priority. Subsequent alarm events are queued in the order received and do not affect existing alarm conditions. Priority Two, Supervisory and Trouble events have second-, third-, and fourth-level priority, respectively. Signals of a higher-level priority take precedence over signals of lower priority even though the lower-priority condition occurred first. Annunciate all events regardless of priority or order received.
 - 2) Noninterfering: An event on one zone does not prevent the receipt of signals from any other zone. All zones are manually resettable from the FACP after the initiating device or devices are restored to normal. The activation of an addressable device does not prevent the receipt of signals from subsequent addressable device activations.
 - 3) Transmission to an approved Supervising Station: Automatically route alarm, supervisory, and trouble signals to an approved supervising station service provider, under another contract.
 - 4) Annunciation: Operation of alarm and supervisory initiating devices shall be annunciated at the FACP and the remote annunciator, indicating the type of device, the operational state

of the device (i.e., alarm, trouble or supervisory) and shall display the custom label associated with the device.

- 5) Selective Alarm: A system alarm shall include:
 - i. Indication of alarm condition at the FACP and the annunciator(s).
 - ii. Identification of the device /zone that is the source of the alarm at the FACP and the annunciator(s).
 - iii. Operation of audible and visible notification appliances until silenced at FACP.
 - iv. Selectively closing doors normally held open by magnetic door holders on the fire floor, floor above and floor below.
 - v. Unlocking designated doors.
 - vi. Shutting down supply and return fans serving zone where alarm is initiated.
 - vii. Closing smoke dampers on system serving zone where alarm is initiated.
 - viii. Transmission of signal to the supervising station.
- 6) Supervisory Operations: Upon activation of a supervisory device such as a low air pressure switch, and tamper switch, the system shall operate as follows:
 - i. Activate the system supervisory service audible signal and illuminate the LED at the control unit and the remote annunciator.
 - ii. Pressing the Supervisory Acknowledge Key will silence the supervisory audible signal while maintaining the Supervisory LED "on" indicating off-normal condition.
 - iii. Record the event in the FACP historical log.
 - iv. Transmission of supervisory signal to the supervising station.
 - v. Restoring the condition shall cause the Supervisory LED to clear and restore the system to normal.
- 7) Alarm Silencing: If the "Alarm Silence" button is pressed, all audible alarm signals shall cease operation.
- 8) System Reset
 - a) The "System Reset" button shall be used to return the system to its normal state. Display messages shall provide operator assurance of the sequential steps ("IN

PROGRESS", "RESET COMPLETED") as they occur. The system shall verify all circuits or devices are restored prior to resetting the system to avoid the potential for re-arming the system. The display message shall indicate "ALARM PRESENT, SYSTEM RESET ABORTED."

- b) Should an alarm condition continue, the system will remain in an alarmed state.
- 9) A manual evacuation (drill) switch shall be provided to operate the notification appliances without causing other control circuits to be activated.
- 10) WALKTEST: The system shall have the capacity of 8 programmable passcode protected one person testing groups, such that only a portion of the system need be disabled during testing. The actuation of the "enable one person test" program at the control unit shall activate the "One Person Testing" mode of the system as follows:
- i. The city circuit connection and any suppression release circuits shall be bypassed for the testing group.
 - ii. Control relay functions associated with one of the 8 testing groups shall be bypassed.
 - iii. The control unit shall indicate a trouble condition.
 - iv. The alarm activation of any initiating device in the testing group shall cause the audible notification appliances assigned only to that group to sound a code to identify the device or zone.
 - v. The unit shall automatically reset itself after signaling is complete.
 - vi. Any opening of an initiating device or notification appliance circuit wiring shall cause the audible signals to sound for 4 seconds indicating the trouble condition.
- h. Standby batteries shall support the system in the event of a loss of primary power for 60 hours of full supervisory operation followed by 15 minutes of alarm. Batteries shall be mounted integral to the FACP.
- i. An integral real time clock will provide time control functions including day of week programming to schedule control of detector sensitivity and alarm functions. The system shall be capable of multiple levels of alarm prioritization, and allow control by event, and may include cross zoning, stepping, and/or logic statement inputs.
- j. Addressable loop wiring (Signaling Line Circuits - SLC) shall be wired in a Class A, Style 6 method. Each circuit shall allow for a minimum of 25% additional devices.
- k. Communication circuits between networked fire alarm control panels shall be Class A, Style 7.

- l. Isolation Modules shall be provided to maintain circuit integrity in the event of an open, short or ground fault. Each addressable loop shall have a minimum of one (1) isolation module for every 20 devices or one (1) per floor; whichever is greater.
- m. Non-addressable loop wiring (Initiating Device Circuits - IDC) shall be wired in a Class B, Style B method.
- n. Audible and visual circuits (Notification Appliance Circuits - NAC) shall be wired in a Class A, Style Z method. Each circuit shall allow for a minimum of 25% additional devices. Provide a minimum of two (2) circuits per floor or area, alternately wiring adjacent notification appliances between circuits. Circuit and power supply sizing shall be based upon all strobes at 75cd and horns at 1 watt. Strobe circuits shall not exceed 1.5 Amps.

2. Control Panel

Main Building

- a. The fire alarm control panel shall be equal to Simplex Model # 4100ES.
- b. The following FACP hardware shall be provided:
 - 1) Power Limited base panel with red cabinet and door, 120 VAC input power.
 - 2) 2,000 point capacity where (1) point equals (1) monitor (input) or (1) control (output).
 - 3) 2,000 points of Network Annunciation at FACP Display when applied as a Network Node.
 - 4) 2000 points of annunciation where one (1) point of annunciation equals:
 - a) 1 LED driver output on a graphic driver or 1 switch input on a graphic switch input module.
 - b) 1 LED on panel or 1 switch on panel.
 - 5) From all battery charging circuits in the system provide battery voltage and ammeter readouts on the FACP LCD Display.
 - 6) Municipal City Circuit Connection with Disconnect switch, 24VDC Remote Station (reverse polarity), local energy, shunt master box, or a form "C" contact output.
 - 7) One Auxiliary electronically resettable fused 2A @24VDC Output, with programmable disconnect operation for 4-wire detector reset.
 - 8) One Auxiliary Relay, SPDT 2A @32VDC, programmable as a trouble relay, either as normally energized or de-energized, or as an auxiliary control.
 - 9) Three (3) Class B or A (Style Y/Z) Notification Appliance Circuits (NAC; rated 3A@24VDC, resistive).
 - 10) Where required provide Intelligent Remote Battery Charger for charging up to 110Ah batteries.

- 11) Power Supplies with integral intelligent Notification Appliance Circuit [Class B] [Class A] for system expansion.
 - 12) Four (4) form "C" Auxiliary Relay Circuits (Form C contacts rated 2A @ 24VDC, resistive), operation is programmable for trouble, alarm, supervisory of other fire response functions. Relays shall be capable of switching up to ½ A @ 120VAC, inductive.
 - 13) The FACP shall support up to (5) RS-232-C ports and one service port. All (5) RS-232 Ports shall be capable of two-way communications.
 - 14) Remote Unit Interface: supervised serial communication channel for control and monitoring of remotely located annunciators and I/O panels.
 - 15) Modular Network Communications Card.
 - 16) Programmable DACT for either Common Event Reporting or per Point Reporting.
- c. Distributed Module Operation: FACP shall be capable of allowing remote location of the following modules; interface of such modules shall be through a Style 7 (Class A) supervised serial communications channel (SLC):
- 1) Addressable Signaling Line Circuits
 - 2) Initiating Device Circuits
 - 3) Notification Appliance Circuits
 - 4) Auxiliary Control Circuits
 - 5) Graphic Annunciator LED/Switch Control Modules
 - a) In systems with two or more Annunciators and/or Command Centers, each Annunciator/Command Center shall be programmable to allow multiple Annunciators/Command Centers to have equal operation priority or to allow hierarchal priority control to be assigned to individual Annunciator/Command Center locations.
- d. Cabinet: Lockable steel enclosure. Arrange unit so all operations required for testing or for normal care and maintenance of the system are performed from the front of the enclosure. If more than a single unit is required to form a complete control unit, provide exactly matching modular unit enclosures.
- e. Alphanumeric Display and System Controls: Panel shall include an 80 character LCD display to indicate alarm, supervisory, and component status messages and shall include a keypad for use in entering and executing control commands.
- 1) The system shall include the necessary hardware to provide expanded content, multi-line, operator interface displays. The expanded content multi-line displays shall be Quarter-VGA (QVGA) or larger and be capable of supporting a minimum of 854 standard ASCII characters to minimize or eliminate the levels of navigation required for access to information when responding to critical emergencies and abnormal system

conditions. The QVGA operator interface shall provide operator prompts and six context sensitive soft-keys for intuitive operation.

- a) Expanded content, multi-line operator interfaces shall be capable of providing the following functions:
 - i. Dual language operation with Instant-Switch language selection during runtime.
 - ii. Activity display choices for:
 - a. First 8 Events.
 - b. First 5 Events and Most Recent Event (with first and most recent event time and date stamps).
 - c. First Event and Most Recent Event (with first and most recent event time and date stamps).
 - d. Scrollable List Display [displays a scrollable list of active points for the event category (alarm, priority 2, supervisory, or trouble) selected. The position in this list will be the last acknowledged point (not flashing) at the top followed by the next 7 unacknowledged points (flashing)].
 - e. General Event Status (alarm, priority 2, supervisory, or trouble in system)
 - f. Site Plan
 - iii. Equal or hierarchal priority assignment. In systems with two or more operator interfaces, each operator interface shall be programmable to allow multiple operator interfaces to have equal operation priority or to allow hierarchal priority control to be assigned to individual operator interfaces (locations).
 - iv. Up to 50 custom point detail messages for providing additional point specific information in detailed point status screens.
 - v. Bitmap file import for operator interface display of site plan and background watermark images. Site plan status icons shall indicate area status for highest priority active events.
- b) Expanded content, multi-line displays shall have the capability to provide Dual-Language operation.
 - i. Language selection shall be via a switch on the operator interface panel. Operator interface panels shall support instant-language-switchover during runtime to allow the operator to toggle between languages each time the language selection switch is operated, without requiring complicated multi-step processes.

- ii. Both one-byte and two-byte characters shall be supported.

Maintenance Building and Housing (Minimum Security)

- a. The fire alarm control panel shall be equal to Simplex Model #4010ES.
- b. The following FACP hardware shall be provided:
 - 1) Power Limited base panel with red cabinet and door, 120 VAC input power
 - 2) Panel is capable of 250 addressable points from two isolated IDNET+ Class A or B connections. (1) point equals (1) monitor (input) or (1) control (output).
 - 3) SLC circuits shall be capable of using any NEC 760 approved wire included THHN (No Shield required).
 - 4) Panel shall be capable of adding 8 conventional zone circuits to connect to existing system devices for ease in retrofit applications.
 - 5) Panel is capable of annunciating 100 external points at FACP Display when applied as a Network Node allowing for peer to peer operation.
 - 6) From all battery charging circuits in the system provide battery voltage and ammeter readouts on the FACP LCD Display.
 - 7) Municipal City Circuit Connection with Disconnect switch, 24VDC Remote Station (reverse polarity), local energy, shunt master box, or a form "C" contact output.
 - 8) One Auxiliary electronically resettable fused 2A @24VDC Output, with programmable disconnect operation for 4-wire detector reset.
 - 9) One Auxiliary Relay, SPDT 2A @32VDC, programmable as a trouble relay, either as normally energized or de-energized, or as an auxiliary control.
 - 10) Four (4) Class B or A (Style Y/Z) Notification Appliance Circuits (NAC; rated 3A@24VDC, resistive).
 - 11) Where required provide Intelligent Remote Battery Charger for charging up to 50Ah batteries.
 - 12) Remote Power Supplies with integral intelligent Notification Appliance Circuit Class A for system expansion.
 - 13) Four (4) form "C" Auxiliary Relay Circuits (Form C contacts rated 2A @ 24VDC, resistive), operation is programmable for trouble, alarm, supervisory of other fire response functions. Relays shall be capable of switching up to ½ A @ 120VAC, inductive.
 - 14) The FACP shall support up to (5) RS-232-C ports and one service port. All (5) RS-232 Ports shall be capable of two-way communications.
 - 15) Remote Unit Interface: supervised serial communication channel for control and monitoring of remotely located annunciators and I/O panels.

- 16) Modular Network Communications Card.
 - 17) Programmable DACT for either Common Event Reporting or per Point Reporting.
- c. Distributed Module Operation: FACP shall be capable of allowing remote location of the following modules; interface of such modules shall be through a Style 7 (Class A) supervised serial communications channel (SLC):
- 1) Initiating Device Circuits
 - 2) Notification Appliance Circuits
 - 3) Auxiliary Control Circuits
 - 4) Graphic Annunciator LED/Switch Control Modules
 - a) In systems with two or more Annunciators and/or Command Centers, each Annunciator/Command Center shall be programmable to allow multiple Annunciators/Command Centers to have equal operation priority or to allow hierarchal priority control to be assigned to individual Annunciator/Command Center locations.
- d. Cabinet: Lockable steel enclosure. Arrange unit so all operations required for testing or for normal care and maintenance of the system are performed from the front of the enclosure. If more than a single unit is required to form a complete control unit, provide exactly matching modular unit enclosures.
- e. Alphanumeric Display and System Controls: Panel shall include an 80 character LCD display to indicate alarm, supervisory, and component status messages and shall include a keypad for use in entering and executing control commands.
- 1) The system shall have the capability to provide a remote expanded content, multi-line, operator interface displays. The expanded content multi-line displays shall be Quarter-VGA (QVGA) or larger and be capable of supporting a minimum of 854 standard ASCII characters to minimize or eliminate the levels of navigation required for access to information when responding to critical emergencies and abnormal system conditions. The QVGA operator interface shall provide operator prompts and six context sensitive soft-keys for intuitive operation.
 - a) Expanded content, multi-line operator interfaces shall be capable of providing the following functions:
 - i. Dual language operation with Instant-Switch language selection during runtime.
 - ii. Activity display choices for:
 - a. First 8 Events.

- b. First 5 Events and Most Recent Event (with first and most recent event time and date stamps).
 - c. First Event and Most Recent Event (with first and most recent event time and date stamps).
 - d. Scrollable List Display [displays a scrollable list of active points for the event category (alarm, priority 2, supervisory, or trouble) selected. The position in this list will be the last acknowledged point (not flashing) at the top followed by the next 7 unacknowledged points (flashing)].
 - e. General Event Status (alarm, priority 2, supervisory, or trouble in system)
 - f. Site Plan
- iii. Equal or hierarchal priority assignment. In systems with two or more operator interfaces, each operator interface shall be programmable to allow multiple operator interfaces to have equal operation priority or to allow hierarchal priority control to be assigned to individual operator interfaces (locations).
 - iv. Up to 50 custom point detail messages for providing additional point specific information in detailed point status screens.
 - v. Bitmap file import for operator interface display of site plan and background watermark images. Site plan status icons shall indicate area status for highest priority active events.
- b) Expanded content, multi-line displays shall have the capability to provide Dual-Language operation.
 - i. Language selection shall be via a switch on the operator interface panel. Operator interface panels shall support instant-language-switchover during runtime to allow the operator to toggle between languages each time the language selection switch is operated, without requiring complicated multi-step processes. Both one-byte and two-byte characters shall be supported
- f. Provide matrix switches and LED status panels for zone annunciation and control functions, integral to the FACP. Keypad entered commands for these functions shall not be an acceptable substitute. Alarm LEDs shall be provided by type of device on a per floor and/or zone basis. Programmable two (2) position zone disconnect switches shall be provided on a per floor and/or zone basis with corresponding status

LEDs. Placement of a switch in other than the normal condition shall initiate a supervisory signal.

3. Remote Cabinets

- a. Provide fire alarm terminal cabinets where necessary. The cabinets shall have a removable hinged cover with lock and high barrier terminal strips with 64 or 128 point capacity mounted to a plywood backboard. Terminal cabinets shall be red and labeled with permanent white lettering

E. Initiating Devices and Accessories

1. Provide addressable detectors as shown on the drawings. Detectors shall be connected to the addressable loop with two wires. All detectors shall incorporate built-in identification for the system to automatically identify various types of sensors. Detectors shall utilize a flashing LED which denotes normal operation, and latched LED which indicates an alarm condition. All common types of analog detectors shall be interchangeable with common twist-lock bases. The standard base shall have a supervised LED output, and optional relay and isolator bases shall be available.
2. Analog sensors shall provide indication to the control panel that a detector requires maintenance, and shall operate in stand-alone mode in the event of an addressable loop communications failure.
3. Analog Photoelectric Smoke Detectors shall be continually monitored to measure any change in their sensitivity because of the environment (dirt, air temperature, humidity, etc.), and shall allow changes in sensitivity levels within the UL approved sensor's range. The photoelectric detector shall consist of a dust resistant, field cleanable photo chamber with microprocessor based solid state electronics.
4. Analog Duct Smoke Detectors shall be continually monitored to measure any change in their sensitivity because of the environment (dirt, air temperature, humidity, etc.), and shall allow changes in sensitivity levels within the UL approved sensor's range. Detector shall be photoelectric in accordance with the ceiling mounted device specified above. Duct detectors shall be supplied with a housing, remote indicator and sampling tubes sized according to duct width.
5. Furnish each duct smoke detector with alarm and remote test control station. Test control shall be key actuated two position Test-Normal.
6. Analog Thermal detectors shall monitor the ambient temperature from 32 to 158° F, and provide fast response to rapid increases in temperature. Rate of rise detection rate and fixed setpoint shall be panel selectable.
7. Manual Pull Stations shall be lockable, double action type with screw terminals and an integral toggle switch. The station shall be constructed of red Lexan with white raised letters, a key reset switch and an optional break glass rod. The station shall have integral addressable electronics and mount to a standard single gang switch box or to a red cast aluminum, surface mount box when required. Provide institutional key operated covers where indicated in Main Building and Housing (Minimum Security)
8. Monitor Modules shall be provided to monitor and connect conventional initiating devices onto the addressable loop.
9. Duct Carbon Monoxide Detectors shall be continually monitored to measure any change in their sensitivity because of the environment (dirt, air temperature, humidity, etc.), and shall allow changes in sensitivity levels within the UL

approved sensor's range. Duct detectors shall be supplied with a housing, remote indicator and sampling tubes sized according to duct width.

Duct Carbon Monoxide Detectors

- a. Provide carbon monoxide detectors equal to Macurco CM-21A
- b. Provide duct mounted enclosures equal to Macurco DML-1

F. Notification Appliances and Accessories

1. Primary Notification Appliances shall be flush mounted combination horn/strobe units. Assembly shall be mounted on red lexan frame, on surface or flush wall/ceiling box. Where box is surface mounted, it shall be red cast aluminum.
2. Visual notification appliances shall be self-synchronizing xenon strobes rated by UL 1971 test criteria and in accordance with the Americans with Disabilities Act and NFPA 72. Appliances shall have a field adjustable intensity listing ranging from 15 candela(cd) to 110 candela(cd) or as otherwise specified on the drawings.
3. Audible notification appliances shall have a field adjustable UL 464 sound pressure level listing ranging from 80dBA to 90dBA at 10 ft.
4. Exterior alarm bells shall be 24VDC, 6-inch diameter – red suitable for wet location.
5. Provide institutional guards as required and where indicated.

G. Remote Alarm Indicators shall be LED indicators on single gang plastic plates for smoke detectors as indicated on the plans.

H. Control and Relay Modules shall be used to control conventional devices (notification circuits, AHUs, door holders, etc.) over the addressable loop. Modules shall provide a supervised output rated for 2 amps at 24VDC, and .5 amps at 120VAC.

I. Remote Annunciator shall be an 80 character alphanumeric LCD display with common LED indicators of Power On, Trouble, Supervisory and Alarm conditions. Where remote system control functions are required, the annunciator shall provide key-enabled Alarm Silence, Trouble Silence, Drill/Test and Reset switches. An eleven inch by seventeen inch graphic depicting the architectural layout of the facility with stairwells, corridors, elevators and egress points clearly shown shall be framed and permanently mounted adjacent to the annunciator. Alphanumeric descriptors for each initiating device shall correspond to descriptors included on the graphic. Simplex Model # 4603-9101 Annunciator at Main Control shall be capable to disconnect/disable city connection for testing purposes. Provide at Main Building: Entry Lobby and Control A142; Housing (minimum security): Office E10 (next to FACP)

Remote Graphic Annunciator shall incorporate LED indications of alarm and trouble conditions as per the zone schedule. The annunciator shall depict the building layout as represented on the floor plans, and be approved by the Owner, Architect, Engineer and the local authority prior to construction. Where remote system control functions are required, the annunciator shall provide key-enabled Alarm Silence, Trouble Silence, Drill/Test and Reset switches. Provide at Main Building Control Room A142.

J. Remote Command Unit shall be provided with 8 red LED zone status indicators, local power (green) and trouble (yellow) LED's; local tone alert; and switches for Trouble Silence, Alarm Silence, System Reset, and Manual Evacuation. Simplex Model# 4602-9102. Provide in all Main Building Control Stations (except Control A142).

Remote Graphic Annunciator shall incorporate LED indications of alarm and trouble conditions as per the zone schedule. The annunciator shall depict the building layout as represented on the floor plans, and be approved by the Owner, Architect, Engineer and the local authority prior to construction.

- K. System Event Printer shall print out all status changes, messages, and event histories. The printer shall be a high speed high resolution 24-pin wide carriage printer which will print all alarms, troubles, restorations, history files and maintenance reports.
- L. Provide BACnet interface to allow transmission of all alarm and status information for monitoring and/or control functions by the building ATC system.
- M. Exterior Strobe shall be a flashing weatherproof strobe/beacon with a minimum 150,000 candlepower. The strobe shall be installed on a weatherproof cast aluminum box and cover.
- N. Municipal Connection: Provide an RF – 2 way, multi-zone radio masterbox Transceiver/Receiver (Keltron RF750F8 - 8 zone) for municipal reporting as required by the City of Northampton Fire Department. The technology shall be approved by the local fire department.
- O. Provide Digital Alarm Communicator/Transmitter for transmission of the alarm, Supervisory and Trouble signals to the Remote Supervisory Station. The Remote Supervisory Station shall retransmit these signals to the owner's designated representative.
- P. Door Holders shall be rated 24VAC/DC magnetic flush, semi-flush, surface and/or floor mounted as indicated on the drawings. Minimum holding force shall be 25 pounds. Body shall be die cast with polished chrome finish. Provide swivel catch with required rod lengths and back plates for secure mounting to door. Door holders will be powered from the fire alarm system.
- Q. Network System Integrator (Regional Holding Facility and Modular Building)
 - 1. The Network System Integrator shall provide Agency Listed integration capable of communicating the status information from multiple brands and/or vintages of control panels onto fire alarm network for reporting at a central command center location and at other network nodes (panels).
- R. Provide As-Built Drawing Cabinet to house a complete set of as-built drawings housed in a red cabinet clearly marked 'As-Built Drawings' locked and keyed the same as the FACP.
- S. Submittals
 - 1. The manufacturer shall provide copies of the following documents for review and evaluation in accordance with general requirements of Division 1 and 16:
 - a. Point to point wiring diagrams of the entire system including all conductor quantity and sizing, labeling (numerical and color coding) and interconnections. Each initiating device and notification appliance shall be given a unique identification. This identification and visual notification appliance devices and audible notification appliance tap settings shall be illustrated on the floor plans and submitted for approval with the wiring diagrams.
 - b. Individual device interconnection diagrams. Panel layouts shall indicate module placement and spare capacity allowance for future expansion.
 - c. Manufacturers catalog cut sheets of all components and devices.

- d. Battery capacity calculations clearly indicating required and spare capacity.
 - e. Power supply capacity calculations including each circuit load, voltage drop and spare capacity.
2. Submission of certification records for qualifications of the technicians performing final connection and testing.
 3. Submit written test report in accordance with NFPA72 Section 10.6 for notification of successful completion of each required test and a system Record of Completion in accordance with NFPA72 Section 4.5. Provide floor plan illustrating ambient and alarm sound levels to document notification appliance testing.
 4. Submit operations manual detailing all functions and operations of the system. User operating instructions shall be provided prominently displayed on a separate sheet located next to the control unit in accordance with UL Standard 864.
 5. Submit maintenance manuals and recommended spare parts list required to conform to NFPA maintenance guidelines. Instructions shall include but not be limited to:
 - a. Instructions for replacing any components of the system, including internal parts.
 - b. Instructions for periodic cleaning and adjustment of equipment with a schedule of these functions.
 - c. A complete list of all equipment and components with information as to the address and telephone number of both the manufacturer and local supplier of each item.
 6. As-built drawings shall include all device addresses, alphanumeric descriptors assigned in the control panel, and final notification appliance tap settings with modified spare power supply capacity illustrated.

2.08 FIRE ALARM CIRCUIT INTEGRITY CABLE

- A. Circuit Integrity Cable (CI) shielded pair power limited fire alarm signal cable shall be designed for service at a maximum continuous operating temperature of 90°C. Cables are rated 300 volt and are UL listed as Type FPL meeting the requirements of NEC Article 760 and UL Standard No. 1424. Cables are also UL listed as Types CL3R and MPR in accordance with NEC Articles 725 and 800 respectively. Cables are 2 hour fire rated per UL Standard No. 2196. They are specifically designed to meet the survivability requirements of the NFAC and are UL classified as "CL" cables (Circuit Integrity).
- B. Cables shall have thermoset elastomeric insulated conductors, twisted together to form a pair wrapped with a copper/polyester tape shield and drain wire covered with a low smoke, zero halogen polyolefin jacket. Conductors are solid bare annealed copper per ASTM B-3. All Conductors are insulated with a 35 mil layer of proprietary thermoset Fire-Roc elastomer. Circuit identification is accomplished by means of printed color designations.
- C. Two insulated conductors are twisted together along with a flexible stranded bare copper drain wire. This assembly is helically wrapped with a laminated copper / polyester foil tape in continuous contact with the drain wire. The shielded cable core is covered with an extruded layer of red flame retardant, low smoke, zero halogen polyolefin with its thickness and tolerance in accordance with UL Standard No. 1424. Cables shall have a printed outer jacket containing cable identification, pertinent UL information and

sequential footage markers. Cables shall be 2 hour fire rated per UL Standard No. 2196 and have a maximum application voltage of 72V. Additionally, cables are "Riser" rated by virtue of passing the flame propagation test stated in UL Standard 1666. Cables shall be UL listed as Type FPLR-C1 in accordance with Article 760 of the National Electrical Code and are intended for use in "Power Limited Fire Alarm Circuits". Cables are also UL listed as Types CL3R in accordance with NEC Article 725.

D. Submittals

1. Provide Product Data for each cable assembly type and all system components.
2. Manufacturer's Installation Instructions shall be highlighted to indicate application conditions and limitations of use stipulated by UL.
3. Manufacturer's qualifications with applicable experience shall be documented.
4. Label material and proposed list of labels.

2.09 FIRE ALARM – MODIFICATION TO EXISTING SYSTEM

A. General

1. Provide the illustrated changes to the existing addressable fire detection, alarm and control system with new duct mounted carbon monoxide detectors at the Regional Holding Facility and new network system integrators at the Modular Buildings in compliance with all applicable codes and authorities having jurisdiction.
2. The system design and installation shall conform to the following standards:
 - a. All new equipment shall be UL listed for its intended purpose and cross listed for addition to the existing system.
 - b. All applicable NFPA standards, including but not limited to: 70, 72, 90A, 92A, and 101.
 - c. State Building Code.
 - d. The Americans with Disabilities Act (ADA)
 - e. All requirements of the Authority Having Jurisdiction (AHJ)
3. The installer and manufacturers warrantee shall be for a minimum period of one (1) year from the date of the final acceptance test approval.
4. Equipment shall be by Simplex to match existing system.

B. Sequence of Operation

1. Refer to the Sequence of Operations Matrix on the plans and the Fire Protection Narrative for the intended system operation.

C. Control

1. General Requirements

- a. New addressable loop wiring (Signaling Line Circuits - SLC) shall be wired in a Class B, Style 4 OR Class A, Style 6 method. Each circuit shall allow for a minimum of 25% additional devices. Where connecting into an existing loop, match existing. No tee tapping allowed.
- b. New non-addressable loop wiring (Initiating Device Circuits - IDC) shall be wired in a Class A method. Where connecting into an existing loop, match existing. No tee tapping allowed.

D. Initiating Devices and Accessories

1. Provide addressable detectors as shown on the drawings. Detectors shall be connected to the addressable loop with two wires. All detectors shall incorporate built-in identification for the system to automatically identify various types of sensors. Detectors shall utilize a flashing LED which denotes normal operation, and latched LED which indicates an alarm condition. All common types of analog detectors shall be interchangeable with common twist-lock bases. The standard base shall have a supervised LED output, and optional relay and isolator bases shall be available.
2. Analog sensors shall provide indication to the control panel that a detector requires maintenance, and shall operate in stand-alone mode in the event of an addressable loop communications failure.
3. Duct CO (carbon monoxide) Detectors shall be continually monitored to measure any change in their sensitivity because of the environment (dirt, air temperature, humidity, etc.), and shall allow changes in sensitivity levels within the UL approved sensor's range. Duct detectors shall be supplied with a housing, remote indicator and sampling tubes sized according to duct width. Two programmable form C contact outputs will be provided with each device to provide the required HVAC control interface functions. Provide duct smoke detectors equal to Macurco CM-21A.
4. Furnish each duct detector with alarm and remote test control station. Test control shall be key actuated two-position Test-Normal.

E. Notification Devices and Accessories

1. Remote Alarm Indicators shall be LED indicators on single gang plastic plates for smoke detectors as indicated on the plans.

F. Submittals

1. The manufacturer shall provide copies of the following documents for review and evaluation in accordance with general requirements of Division 1 and 16:
 - a. Point to point wiring diagrams of the entire system including all conductor quantity and sizing, labeling (numerical and color coding) and interconnections. Each initiating device and notification appliance shall be given a unique identification. This identification and visual notification appliance devices and audible notification appliance tap settings shall be illustrated on the floor plans and submitted for approval with the wiring diagrams.
 - b. Individual device interconnection diagrams. Panel layouts shall indicate module placement and spare capacity allowance for future expansion.
 - c. Manufacturers catalog cut sheets of all components and devices.
 - d. Battery capacity calculations clearly indicating required and spare capacity.
 - e. Power supply capacity calculations including each circuit load, voltage drop and spare capacity.
2. Submission of certification records for qualifications of the technicians performing final connection and testing.
3. Submit written test report in accordance with NFPA72 Section 10.6 for notification of successful completion of each required test and a system Record

of Completion in accordance with NFPA72 Section 4.5. Provide floor plan illustrating ambient and alarm sound levels to document notification appliance testing.

4. Submit operations manual detailing all functions and operations of the system. User operating instructions shall be provided prominently displayed on a separate sheet located next to the control unit in accordance with UL Standard 864.
5. Submit maintenance manuals and recommended spare parts list required to conform to NFPA maintenance guidelines. Instructions shall include but not be limited to:
 - a. Instructions for replacing any components of the system, including internal parts.
 - b. Instructions for periodic cleaning and adjustment of equipment with a schedule of these functions.
 - c. A complete list of all equipment and components with information as to the address and telephone number of both the manufacturer and local supplier of each item.
6. As-built drawings shall include all device addresses and alphanumeric descriptors assigned in the control panel.

PART 3 - EXECUTION

3.00 DEMOLITION

A. General

1. The Electrical Contractor shall visit the site before submitting his bid to familiarize himself with the existing conditions and the extent of the work. No extra compensation will be allowed for work required to be performed or to overcome existing conditions, by failure to visit the site.
2. The Electrical demolition work shall be performed by the Electrical Contractor in cooperation with the other trades and as scheduled and approved by the Owner's Representative.
3. The locations of existing equipment to remain including piping, ductwork, conduits, etc., are shown in an approximate way only. The Contractor shall determine the exact location of all existing equipment before commencing work.
4. Power outages caused by demolition that affect other areas shall be held to a minimum. Shutdowns shall be coordinated with the users and the owner. Night, weekend and/or Holiday time required to perform electrical demolition work or new electrical work shall be carried as part of the Contract Cost.

B. Scope

1. The architectural drawings illustrate the full extent of the scope of demolition. Disconnect and make safe all electrical equipment identified for removal on the Electrical plans. The electrical scope may extend beyond the area defined by the architectural demolition limits to fully comply with various requirements of these specifications.
2. The electrical demolition plans and details indicate the general scope and are not intended to show all items to be removed or retained. Devices and equipment located on walls and/or ceilings to be removed shall be disconnected and made

safe. The electrical contractor shall notify the owner's representative of any unanticipated hidden conditions encountered during demolition.

3. The electrical contractor shall circuit trace and label all existing branch circuits and feeders within the area of demolition scope prior to de-energizing and disconnection. All circuits within panelboards identified for removal shall be traced and labeled to ensure that no area outside the demolition scope limit is affected.
4. The electrical contractor shall identify all branch circuits, feeders and system components, which are to remain within the area of demolition scope. There shall be no interruption of service to any area outside the scope limits without approval from the Owner's Representative. Existing equipment to remain shall be left in a code compliant manner.
5. The electrical contractor shall de-energize and remove all conductors and raceways to their points of origin within the area of demolition scope. Items identified for demolition shall not be abandoned in place. Raceways that enter masonry walls and floors shall be cut flush at the surface for patching by others. All circuit breakers associated with the demolition scope shall be de-energized and labeled spare.
6. The electrical contractor shall be responsible for the repair of all systems or building components damaged during the execution of the work. Damage shall include but not be limited to destruction or disposal of items intended to remain or to be salvaged.
7. The electrical contractor shall temporarily support all items to remain that are affected by the demolition of building structural components (walls, ceilings, etc.). Temporarily supported items shall be permanently supported and installed when finalized structures are in place.
8. The existing fire alarm system shall remain fully functional during the entire demolition and construction period. Reuse of existing fire alarm system raceways shall not be allowed. All required system shutdowns shall be coordinated with and approved by the Owner's Representative and the Authority Having Jurisdiction. Demolition of the existing system shall not commence until the new system has been completely installed, tested and approved by the Authority Having Jurisdiction.
9. All demolition scope associated with low voltage systems including but not limited to telephone, data, security, paging, CCTV, etc. shall be included.

C. Disposal

1. All removed items shall be legally disposed of unless identified for reuse. Refer to Part 1 of this specification for requirements for Hazardous Material disposal.
2. The Owner's Representative shall inspect all retained items prior to placement in the identified storage location by the electrical contractor. Selected items will be disposed at no additional cost to the project.

3.01 IDENTIFICATION

A. Nameplates

1. Provide nameplates on all equipment listed in other sections of this specification including but not limited to switchboards, substations, panelboards, transformers, junction and pull boxes, disconnect switches, motor starters and motor control centers, contactors, time clocks, remote control stations, fire alarm panels, smoke detector remote test/alarm stations and fire alarm annunciators.

2. Nameplates shall designate equipment tag number as defined on the drawings, system voltage where applicable, circuit number, device controlled and system function. Refer to typical nameplate detail on the drawings for additional requirements.
 3. Submit a complete list of proposed nameplates prior to order to ensure conformance to design criteria. Submittal shall include nomenclature, size and layout of each tag.
 4. Code 39 shall be the bar code format unless designated differently by the Owner's facility group. The contractor shall create the required bar codes and assign numbers based upon input from the owner's facility group. The contractors shall create a database of all equipment, panels and valves for owner's review and approval.
 5. Samples of stickers together with color schedules shall be submitted during the submittal phase of this project.
- B. Equipment Identification
1. Equipment identification designations shall be taken from equipment schedules and coordinated with the Owner's facility group to assure designations match up with Owner's maintenance management system identification database.

3.02 RACEWAYS AND CONDUIT

A. General

1. Unless specified or shown on Drawings otherwise, install raceways and conduits concealed. Raceways and conduits may be run exposed on unfinished walls and basement ceilings with exposed structure, in mechanical rooms, electric rooms, attics and roof spaces.
2. Run concealed raceways and conduits in as direct lines as possible with minimum number of bends of longest possible radius. Install exposed raceways and conduits parallel to or at right angles to building lines.
3. Raceway and conduit runs shall be mechanically and electrically continuous from supply to outlet. Conduit shall enter and be secured to metallic enclosures with lock nut and bushing inside. Provide additional exterior lock nut for RGS connections. Bushings shall be the bonding type for conduit connections to metallic enclosures with concentric or eccentric knockouts. Lock nuts and bushings will not be required where conduits are screwed into threaded hubs.
4. Size raceways and conduits as required by NEC unless oversized raceways and conduits are shown on the Drawings. Raceways and conduits shall be $\frac{3}{4}$ " minimum.
5. Install conduit systems complete before installation of conductors. Blow through and swab after plaster is finished and dry, and before conductors are installed.
6. Raceways and conduits supports shall be rigidly attached to the building structure utilizing corrosion resistant components suitable for use with the selected raceway or conduit. Refer to the seismic restraint sections of this specification for any additional requirements.
7. Field bending, cutting and threading shall be executed with the proper tools, resulting in bends and shortened conduits and raceways that are equivalent to factory fabricated and purchased components.
8. Provide standoff clips for conduits on exterior and wet location walls.

9. Protect all vertical conduit runs from the entrance of foreign material before installation of conductors and the final closure of the raceway system. All spare conduits (vertical and horizontal runs) shall be sealed with a bushing and appropriate insert to prohibit entrance of debris or vermin. Affix a label that indicates "Spare Conduit to _____" at each seal. Label shall be in accordance with the labeling section of this specification.
- B. Rigid Galvanized Steel (RGS) Conduit
1. RGS may be used for all raceway applications outlined for EMT and PVC. RGS shall be used in locations where subject to accidental damage or abuse and for all above grade exterior applications unless other wiring methods are specified on the drawings. All circuit conductors in excess of 600 V shall be installed in RGS.
 2. RGS shall not be used in corrosive environments.
 3. All RGS fittings shall be threaded. Utilize Erickson couplings where joining two threaded conduits that can not be rotated.
- C. Electrical Metallic Tubing (EMT)
1. EMT may be used for lighting and receptacle branch circuits, telephone, fire alarm, communications, signal and instrumentation circuits and for control circuits. EMT may be used in masonry walls, above hung ceilings, in equipment rooms, in mechanical and electrical chases and closets, in exposed locations along ceilings or walls above normal traffic level and where not subject to accidental damage or abuse.
 2. EMT shall not be used in exposed applications below 8 feet above finished floor or in exterior or damp/wet/corrosive locations. Electrical, telephone and communications closets are considered exempt from this restriction and EMT may be installed below 8' AFF in this application only. EMT shall not be installed underground, in slabs on grade, in exterior locations, in hazardous areas, or for circuits operating at more than 600 V.
- D. Polyvinyl Chloride (PVC) Non-metallic Conduit
1. PVC may be used for installation in concrete or direct burial applications where not subject to damage. PVC may be used in corrosive environments where specifically allowed on the drawings.
 2. PVC shall not be used for penetrations from concrete slabs. Transition to RGS shall be made a minimum of 2" below the slab finished surface, prior to penetration.
 3. All connections shall utilize solvent and glue in accordance with the recommendations of the conduit manufacturer.
- E. Miscellaneous Conduit Fittings
1. Expansion/Deflection Fittings: Raceways and conduit buried or secured rigidly on opposite sides of building expansion joints and long runs of exposed conduit subject to expansion and contraction due to variations in temperature shall have expansion fittings. Raceways and conduit shall cross building expansion joints at right angles. Provide separate external copper bonding jumper secured with grounding straps on each end of fitting. Fittings shall safely deflect and/or expand/contract to twice the distance of potential movement.
 2. Penetrations of all below grade exterior walls and flooring shall require approval by the engineer and architect. Submit proposed penetration points, size openings and penetration methods to engineer and architect. Penetrations shall

utilize sealing fittings appropriately sized for the application. Duct bank penetrations are excluded from this requirement.

3. Sealing Fittings shall be installed wherever conduits pass from warm to cold locations to minimize condensation within the conduit. Sealing fittings shall be installed with RGS penetration of the wall and terminate in a suitably sized junction box.
4. Refer to other specification sections for requirements pertaining to sealing for hazardous atmospheres.

F. Flexible Metallic Conduit

1. Provide flexible metallic conduits for connections to electrical equipment and to equipment furnished under other Divisions that are subject to movement, vibration or misalignment and/or where noise transmission must be eliminated or reduced.
2. Flexible metallic conduit shall be liquid-tight under the following conditions:
 - a. Exterior locations
 - b. Moisture or humidity-laden atmospheres
 - c. Environments where seepage or dripping of water, grease, oil or other fluids is possible. All mechanical equipment rooms and penthouses, kitchens and;
 - d. Corrosive atmospheres

G. Wireways shall be provided where specifically shown on the drawings or where the group mounting of controllers, disconnects, enclosures, etc warrant the use for elimination of multiple short conduit runs. Wireways shall be provided complete with all required appurtenances necessary to have a totally enclosed system rated for the environment. Wireways shall not be installed in any location where subject to accidental damage or abuse.

H. Raceway and Conduit Installation in Concrete Slabs

1. Raceways and conduit may be installed in slabs where specifically allowed on the drawings. Maximum outside diameters of raceways in slabs shall not exceed 1/3 slab thickness. No more than two 3/4" raceways shall cross in floor slab at a single point. Lateral spacing of parallel raceways shall be at least 6" on centers. Submit raceway layout plan for approval to architect and engineer and obtain signoff from the structural engineer of the actual installation before pouring slabs. All in slab installations shall be photographed, with prints and negatives appropriately marked and turned over to the owner at job completion.
2. Raceways and conduit shall not be placed in slabs less than 3" thick.

3.03 WIRE AND CABLE (600V)

- A. Homerun designations on the drawings are diagrammatic only. Install branch circuits and feeders from the power source to the attachment point as required for a complete system. Provide slack wire for connections to equipment installed by others. Refer to schedules and risers where specific conductor and associated raceway sizes are not indicated on the floor plans.
- B. Connect branch circuit homerun with two or three circuits and common neutral only where specifically shown on the drawings. Circuits with common neutrals shall not be connected to the same phase to ensure cancellation of the return current in the neutral conductor.

- C. Install wires and cable in raceways as specified. All conductor sizing is based upon no greater than three current carrying conductors in a conduit. Installation of up to six circuits (no greater than twelve current carrying conductors) in a single conduit will be allowed if the conductor sizing is increased to the required ampacity to accommodate de-rating factors required by the NEC and NFPA 70.
- D. The minimum wire size shall be #12 unless #14 specifically allowed on the drawings for wiring of controls. Branch circuits longer than 75' for 120 V and 175' for 277 V from panel to last outlet shall be increased a minimum of one size above that shown on the drawings to minimize voltage drop to less than 2%.
- E. Conductors shall be identified at all accessible locations in the following manner:
1. Color code secondary service, feeders and branch circuit conductors as follows:

<u>208/120 Volts</u>	<u>Phase</u>	<u>480/277 Volts</u>
Black	A	Brown
Red	B	Orange
Blue	C	Yellow
White	Neutral	Gray
Green	Ground	Green
 2. Provide nonferrous wire markers, embossed or printed to correspond with the Drawings. Labels shall be permanently marked so that the source of the branch circuit or feeder may be readily identified. Hand written labels are not acceptable. Embossed tag equal to 3M Scotch Code STL-TAG or SCS-TM shall be applied with two miniature cable ties or slipped through both end holes. Heat bonded tag equal to 3M Scotch Code SCS-HB shall be permanently affixed with a heat gun.
- F. Cable
1. Flexible Metal Clad (MC) cable may be used in concealed locations for branch circuit wiring.
 2. Conductor color code shall comply with identification requirements as indicated in this Section.
 3. Non Metallic (NM) cable may be used within dwelling units and shall not extend beyond the unit from which it originates. UL listed grommets shall be utilized in all metal studs, through which the NM cable passes and cover the entire opening.
- G. Splices and Terminations
1. No more than twelve splices of current carrying conductors or six circuits, whichever is greater, shall be allowed in a single enclosure or junction box.
 2. Splices and terminations shall be sized to the specified conductor. The insulation shall be cut back with the appropriate tools such that the conductors are not nicked or damaged.
 3. The compression tool shall be appropriate for the installation of the provided lug or butt splice to ensure pressure necessary for a proper connection is applied.
 4. Terminations shall not be stacked or bent unless specifically listed for the application.
- H. Arc-proofing shall be applied to all feeders greater than 100 Amperes where multiple circuits are installed in common enclosures such as handholes, manholes and junction boxes. Apply tape in single, half-lapped layer as required by manufacturer's

recommendations. Secure with strips of red plastic film tape on 208Y/120V conductors and yellow plastic film tape on 408Y/277V conductors.

I. Cable Pulling

1. Pull cables that share conduit at same time into completely installed raceway. Conductors shall not be pulled in raceways with existing wiring.
2. Submit cable pulling calculations for engineers approval prior to all mechanically assisted pulls. Attach pull ropes to conductors with basket-weave grips on pulling eyes. Provide means to measure tension during entire pull. Utilize pulling compounds to lessen friction in accordance with the manufacturer's recommendations.
3. mechanically assisted pulls shall utilize equipment specifically designed for the purpose such as ropes, electric wench, pulleys, etc. The use of a motorized vehicle to assist in a cable pull is prohibited.

3.04 WIRING DEVICES AND PLATES

- A. Branch circuitry shall be attached to all devices using the attachment screw or utilizing back wiring chambers that utilize screws for compressing the connection on the wire. Quick stab features that do not require a positive screw on attachment for the conductor are not acceptable.
- B. Receptacle devices for other than 20 amp, 120 volt, 2-wire, circuits shall be provided with tags indicating voltage characteristics and circuit number of outlet that match the nameplate or engraving required on the faceplate.
- C. Remove the interconnecting tab for receptacles identified for ½ switched applications such that the top is switch controlled and the bottom is constantly energized.
- D. The drawings specify all dimmer sizes based upon full capacity with no heat removal fins removed for ganged applications. Outlet boxes shall be sized to accommodate the specified dimmer at full rating.
- E. All switches/dimmers illustrated together on drawings shall be installed in ganged configuration with single faceplate unless specifically noted otherwise.
- F. Provide metal barriers to separate switches where voltage between adjacent switches exceeds 300 volts.
- G. Adjust all individual occupancy sensor time delays to 15 minutes and set to "manual on" operation. Sensor sensitivity shall be adjusted for 100% coverage of the associated space and to minimize the false sensing from adjoining areas with doors in their normal position.

3.05 OUTLET BOXES

- A. Outlet and switch boxes shall be securely fastened to metal studs with a minimum of two self-tapping screws. Boxes three gang and greater shall be securely fastened to studs on both sides of the box.
- B. Fasteners for mounting boxes in damp or wet locations shall be stainless steel.
- C. Pressed steel boxes shall not be used for exposed surface mounted locations below 8'0" AFF.
- D. Outlet and switch boxes shall not be installed back to back. Stagger box installation to adjacent stud spaces to maintain sound separation between rooms.

- E. Floor boxes shall not be used above grade level in concrete decking without the approval of the structural engineer and architect. Floor slab installations shall not degrade the required structural or fire rating integrity of the floor deck.

3.06 JUNCTION AND PULL BOXES

- A. Junction box covers shall be accessible. Do not install junction boxes above suspended ceilings except where ceiling is removable or where an access panel is provided.
- B. Pull boxes connected to concealed conduits shall be mounted with covers flush with finished wall or ceiling.
- C. Pull boxes exposed to rain or in damp/wet locations shall be weatherproof NEMA 3R unless noted otherwise on the drawings.
- D. No pull box shall be within 2 feet of another.
- E. Provide clamps, grids, cable ties and other non-conductive or combustible appurtenances to secure cables. No cable shall be unsupported for more than 30". Cables shall not touch or be unsupported within 1" of the box cover.
- F. Each junction and pull box shall have a suitable laminated plastic nameplate with white cut letters identifying power source, voltage and driven load of the associated branch circuits or feeders.
- G. Submit box sizing calculations to confirm all box dimensions are in accordance with code requirements with product data prior to installation.

3.07 LIGHTING FIXTURES

- A. Lamps
 - 1. Lamps of the type, wattage, and voltage rating indicated shall be delivered to the project in the original cartons and installed in the fixtures just prior to the completion of the project.
 - 2. Lamps shall be handled with cotton gloves to avoid finger print markings.
 - 3. Florescent lamps on dimmed circuits shall be "seasoned" by operating for at least 100 hours at full intensity to render lamp impurities inert.
 - 4. Incandescent and tungsten halogen lamps shall not be operated other than for initial testing, before final inspection.
- B. Fixtures
 - 1. General
 - a. Do not install fixtures until work of other trades that may damage fixtures is completed.
 - b. Where seismic requirements are specified herein, fixtures shall be supported as shown or specified.
 - c. Handling of reflectors shall be done only with cotton gloves to avoid imprinting fingerprints on reflective surfaces.
 - 2. Accessories
 - a. Installation and support of fixtures shall as a minimum be in accordance with the NFPA 70 and manufacturer's recommendations.
 - b. Accessories such as straps, mounting plates, nipples, or brackets shall be provided for proper installation.

- c. Open type fluorescent fixtures with exposed lamps shall have a wire-basket type guard.
3. Suspended and Pendant Fixtures
- a. Suspended fixtures shall be provided with adjustable swivel hangers in order to ensure a plumb installation.
 - b. Single unit suspended fluorescent fixtures shall have twin-stem hangers.
 - c. Multiple unit or continuous-row fluorescent units shall have a tubing or stem for wiring at one point, and a tubing or rod suspension provided for each length of chassis including one at each end. Maximum distance between adjacent tubing or stems shall be 10 feet.
 - d. Provide threaded rod to rigidly support the weight of the fixture independently of the ceiling support system. Threaded rod shall be concealed where fixture installed in an area with suspended ceilings. Support luminaries on a minimum of two points (one at each end) to prevent rotation. Threaded rod, pendants or factory supplied fixture accessories (such as rods or chains) 4 feet or longer excluding fixture, shall be braced to limit swinging. Bracing shall be 3 directional, 120 degrees apart.
 - e. Branch circuitry shall be routed to the outlet box utilizing the wiring methods outlined on the drawings and as described in these specifications. Flexible raceway may be installed to each fixture from an overhead junction where concealed above a ceiling. Fixture to fixture wiring installation is allowed only when fixtures are installed end to end in a continuous run.
4. Ceiling Fixtures
- a. Ceiling fixtures shall be coordinated with and suitable for installation in, on, or from the suspended or gypsum wallboard ceiling provided under other sections of these specifications. Provide plaster frames for fixtures recessed in gypsum board or a plaster ceiling. Recessed fixtures shall have adjustable fittings to permit alignment with ceiling panels.
 - b. Recessed fixtures installed in fire-resistive type of suspended ceiling construction shall have the same fire rating as the ceiling or shall be provided with fireproofing boxes having materials of the same fire rating as the ceiling panels, in conformance with UL-03.
 - c. Provide safety chain to support the weight of the fixture independently of the ceiling support system. Support luminaries on a minimum of two points (one at each end) to structural support.
5. Support
- a. Do not suspend or support lighting fixtures, threaded rod and safety chains from hung ceiling, conduit or duct. Support fixtures with threaded rod and safety chain from structural members only. Provide supplemental steel (factory fabricated channel equal to Unistrut) where required to span structural steel members.
 - b. Provide supplemental steel below ducts where fixture locations coincide with HVAC duct or mechanical piping runs and access to structure is inhibited.
 - c. Supplemental steel shall be rigidly supported from structure. Where suspension is required, support supplemental steel with threaded rods to

structure. Sizing of all supplemental support components is the responsibility of the contractor.

3.08 FIRE ALARM

A. Installation

1. All interconnections shall be installed in accordance with the manufacturer's system wiring diagrams.
2. Final connections, panel start up, program, editing, and testing shall be conducted by qualified personnel with one of the following qualifications:
 - a. Factory trained and certified by the equipment manufacturer.
 - b. National Institute of Certification in Engineering Technologies (NICET) or IMSA fire alarm certified.
 - c. Trained and qualified by an organization listed by a national testing laboratory for the servicing of fire alarm systems.
3. Provide UL certification of the installation by a UL certified testing company.
4. The control panel manufacturer's representative shall be present to supervise panel start up, program, editing and all tests.
5. A dedicated circuit connection for supplying power to each building fire alarm panel shall be provided. The power supply shall be equipped with a UL listed locking mechanism and identified with a red "FIRE ALARM CIRCUIT CONTROL" label.
6. Labels
 - a. All panels, terminal cabinets and annunciators shall be labeled with the Red plastic nameplates in accordance with other sections of this specification.
 - b. Remote Alarm Indicators and Remote Test and Alarm Stations shall be labeled with the Red plastic nameplates in accordance with other sections of this specification. The label shall indicate the device monitored and associated mechanical equipment tag or room designation where applicable.
 - c. All detectors shall be labeled with its assigned address on both the detector housing and the base with a black on clear typed label equal to Kroy 0.375 Industrial UV. The base address shall be legible without removal of the detector. The detector address shall be concealed when placed into the base.
 - d. Provide an engraved brass nameplate at the exterior beacon, mounted on the weatherproof box, indicating "BUILDING FIRE ALARM SYSTEM IN ALARM".
7. Wiring
 - a. Wiring for the fire alarm system shall not be installed in conduits, junction boxes, or outlet boxes with conductors of lighting and power systems.
 - b. Wiring for the fire alarm system shall be installed in conduit with limitations as outlined in Section 3.02 of this specification. The use of MC cable shall follow the guidelines provided in Section 3.03 of this specification. Exposed plenum rated wire/cable and/or fire alarm low energy cable will not be accepted.

- c. Minimum wire sizes shall be as follows:
 - 1) Addressable loop wiring shall utilize minimum #16 AWG.
 - 2) Notification appliance circuits shall utilize minimum #14 AWG.
 - 3) Network communications wiring shall be a solid conductor non-shielded #16 twisted pair minimum.
 - d. All junction boxes shall be sprayed red and labeled "Fire Alarm". Conduit couplings shall be spray painted red prior to installation.
 - e. Connections and splices shall be made using screw terminal blocks. No more than one conductor shall be installed under any screw terminal. The uses of wire nut type connectors are prohibited in the system.
 - f. All circuit conductors entering or leaving any mounting box, outlet box enclosure or cabinet shall be labeled in accordance with the wiring diagram. Labeling and color coding shall be consistent throughout the conductor run.
 - g. Wiring within any enclosure shall be readily accessible without removing any component parts.
 - h. No more than half loudspeaker/strobes or horn/strobes serving any floor or zone shall be connected to same circuit. Adjacent devices shall be alternately wired between circuits.
 - i. The fire alarm equipment manufacturer's representative shall be present for the connection of wiring to the control panel.
8. Control Panel
- a. The control panel and its assorted components shall be mounted so that no part of the enclosing cabinet is less than 12 inches nor more than 78 inches above the finished floor.
 - b. All manually operable controls shall be between 36 inches to 42 inches above the finished floor.
9. Detectors
- a. Detectors placement shall be in accordance with NFPA 72 requirements and recommendations.
 - b. Detectors shall be at least 12 inches from any part of any lighting fixture and at least 3 feet from diffusers of air handling systems.
 - c. Each detector shall be provided with appropriate mounting hardware as required by its mounting location.
 - d. Smoke detectors shall not be installed until the building has been thoroughly cleaned. Dust covers shall be installed over all smoke detectors until final testing commences. All detectors, which indicate reduced sensitivity due to dirty condition, shall be cleaned prior to commencement of final cleaning.
 - e. Detectors shall be provided with wire guard cages where subjected to physical abuse, such as in gymnasiums.
10. Notification Appliances
- a. Notification appliances shall be mounted in accordance with NFPA 72.

- b. Coordinate final quantity, location and power settings of audible notification appliances with ambient sound levels and interior finishes to comply with minimum & maximum sound pressure level requirements as follows:
 - 1) Total sound pressure level produced by combining ambient with all audible notification appliances operating shall not exceed 110dBA at the minimum hearing distance.
 - 2) An average ambient sound pressure level of 105dBA shall require the use of visible notification appliances.
 - 3) Unless otherwise permitted by NFPA 72, minimum sound pressure level produced by audible notification appliances shall be 15 dBA above the average ambient sound level or 5 dBA above the maximum sound level having a duration of at least 60 seconds., whichever is greater, measured 5-ft above the floor.
- 11. Coordinate the proper frequencies and channels of the Radio Masterbox as required by the Northhampton fire department system. Pay all associated charges.

B. Testing

- 1. The Contractor shall notify the Owner's Representative 10 business days before the tests are to be conducted. The tests shall be performed in accordance with the approved test procedures in the presence of the Owner's Representative. The Contractor shall furnish all instruments and personnel required for the tests.
- 2. Preliminary Tests
 - a. The Contractor shall perform insulation testing (megger), continuity and loop resistance checks on all system conductors to determine that the system is free from grounded, shorted, or open circuits. These tests shall be conducted prior to the installation of fire alarm equipment. Loop resistance measurement shall verify that the loop resistance does not exceed the manufacturers specified limits. Corrections shall be made and the system shall be retested to assure if deficiencies are found.
 - b. Measure air flow with pressure sensor at each duct smoke detector sampling port, at the lowest design air flow of the duct system. Sampling air flow shall exceed smoke detector manufacturer's requirements.
 - c. The Contractor shall perform complete functional and operational performance tests. Testing shall include verification that the circuits and components are electrically supervised and operate as intended. Coordinate functional testing with Elevator and HVAC contractor where applicable to verify function of all control interfaces such as elevator recall and air handling unit shutdowns.
 - d. A written report detailing the results of the preliminary tests shall accompany the request for Final Acceptance Test. The written Preliminary Test Report shall be submitted with:
 - 1) Copy of FACP printer output verifying proper operation of each device in alarm or trouble, time stamped throughout the testing process.
 - 2) The Operations and Maintenance Manual for the system.
 - 3) The record (as-built) drawings.

3. Final Acceptance Test

a. The Fire Alarm System, other systems and equipment associated with the fire alarm system and accessory equipment shall be tested in accordance with NFPA 72. Verification of system completion shall be documented with a fully executed copy of the Record of Completion per NFPA 72 Figure 4.5.2.1. The listed tests in NFPA 72 Table 10.4.2.2 shall be conducted and documented with an executed copy of Figure 10.6.3.2 as well as manufacturer and job specific procedures to verify that the circuits and components are electrically supervised and operate as intended. The test shall include but shall not be limited to the following:

- 1) Visual inspection of all wiring connections.
- 2) Test of each function of the control panel.
- 3) Test of each circuit in both trouble and normal modes.
- 4) Tests of each alarm initiating device in both normal and trouble conditions. Remove each device from its base to test the supervisory feature.
- 5) Tests of each control circuit and device.
- 6) Tests of each alarm notification appliance. Open the wiring at the midpoint of the circuit to test the wiring supervisory feature. Provide copy of FACP printer output verifying proper operation. Verify each device's audible and visual output.
- 7) Tests of the primary and secondary power supplies and associated loss of each.
- 8) Complete operational tests under emergency power supply.
- 9) Ground fault monitoring circuit function.
- 10) Measurement of sound pressure levels throughout the protected space. Provide background and evacuation signal sound levels on the floor plan submitted with device address and tap settings.

C. Maintenance Contract

1. The contractor shall include as part of their base bid the cost of a one-year test and inspection contract, to be held by the company which shall certify the completed installation. The contract shall provide for quarterly inspections in accordance with NFPA72 and local requirements. Any equipment found to be defective during the warrantee period shall be replaced by the contractor at no additional charge to the Owner.

D. Training

1. Training course shall be provided for the operations and maintenance staff. The course shall be conducted in the building where the system is installed or as designated by the Owner's Representative. The training period shall consist of one training day (8 hours per day) and shall start after the system is functionally completed but prior to final acceptance tests. The instructions shall cover all of the items contained in the operating and maintenance instructions.

3.09 FIRE ALARM – MODIFICATIONS TO EXISTING SYSTEMS

A. Installation

1. All interconnections shall be installed in accordance with the manufacturer's system wiring diagrams.

2. The firm who holds the existing system maintenance contract shall perform final connections, programming, and testing. The contractor shall carry all costs associated with final connections, programming and testing.
3. The contractor shall carry all costs associated with disabling connections to the municipal loop during final connections and testing.
4. Provide UL certification of the installation by a UL certified testing company.
5. A dedicated circuit connection for supplying power to each new building fire alarm panel shall be provided. The power supply shall be equipped with a UL listed locking mechanism and identified with a red "FIRE ALARM CIRCUIT CONTROL" label.
6. Labels
 - a. All new panels, terminal cabinets and annunciators shall be labeled with the Red plastic nameplates in accordance with other sections of this specification.
 - b. New Remote Alarm Indicators and Remote Test and Alarm Stations shall be labeled with the Red plastic nameplates in accordance with other sections of this specification. The label shall indicate the device monitored and associated mechanical equipment tag or room designation where applicable.
 - c. All new detectors shall be labeled with assigned address on both the detector housing and the base with a black on clear typed label equal to Kroy 0.375 Industrial UV. The base address shall be legible without removal of the detector. The detector address shall be concealed when placed into the base.
7. Wiring
 - a. Wiring for the fire alarm system shall not be installed in conduits, junction boxes, or outlet boxes with conductors of lighting and power systems.
 - b. Wiring for the fire alarm system shall be installed in conduit with limitations as outlined in Section 3.02 of this specification. The use of MC cable shall follow the guidelines provided in Section 3.03 of this specification. Exposed plenum rated wire/cable and/or fire alarm low energy cable will not be accepted.
 - c. Minimum wire sizes shall be as follows:
 - 1) Addressable loop wiring shall utilize minimum #16 AWG.
 - 2) Notification appliance circuits shall utilize minimum #14 AWG.
 - d. All junction boxes shall be sprayed red and labeled "Fire Alarm". Conduit couplings shall be spray painted red prior to installation.
 - e. Connections and splices shall be made using screw terminal blocks. No more than one conductor shall be installed under any screw terminal. The uses of wire nut type connectors are prohibited in the system.
 - f. All circuit conductors entering or leaving any mounting box, outlet box enclosure or cabinet shall be labeled in accordance with the wiring diagram. Labeling and color-coding shall be consistent throughout the conductor run.
 - g. Wiring within any enclosure shall be readily accessible without removing any component parts.

- b. Measure air flow with pressure sensor at each duct smoke detector sampling port, at the lowest design air flow of the duct system. Sampling air flow shall exceed smoke detector manufacturer's requirements.
- c. The Contractor shall perform complete functional and operational performance tests. Testing shall include verification that the circuits and components are electrically supervised and operate as intended. Coordinate final testing with the Elevator and HVAC contractors where applicable to verify function of all control interfaces such as elevator recall and air handler shutdowns.
- d. A written report shall be submitted detailing the results of the preliminary tests shall accompany the request for Final Acceptance Test. The written Preliminary Test Report shall be submitted with:
 - 1) Copy of FACP printer output verifying proper operation of each device in alarm or trouble, time stamped throughout the testing process.
 - 2) The Operations and Maintenance Manual for the system.
 - 3) The revised record (as-built) drawings.
- e. Reacceptance testing shall be performed in accordance with NFPA 72 10.4.1.2 where applicable (testing of 10% of existing devices not affected by scope of work, etc.).

3. Final Acceptance Test

- a. The Fire Alarm System modifications, other systems and equipment associated with the fire alarm system modifications and new accessory equipment shall be tested in accordance with NFPA 72. Verification of system completion shall be documented with a fully executed copy of the Record of Completion per NFPA 72 Figure 4.5.2.1. The listed tests in NFPA 72 Table 10.4.2.2 shall be conducted and documented with an executed copy of Figure 10.6.3.2 as well as manufacturer and job specific procedures to verify that the circuits and components are electrically supervised and operate as intended. The test shall include but shall not be limited to the following:
 - 1) Visual inspection of all new wiring connections.
 - 2) Test of each function of new panels.
 - 3) Test of each circuit into which new devices have been added in both trouble and normal modes.
 - 4) Tests of each circuit associated with new alarm initiating device in both normal and trouble conditions. Open the circuits at each alarm-initiating device to test the wiring supervisory feature.
 - 5) Tests of each new control circuit and device.
 - 6) Tests of each circuit associated with new alarm notification appliance. Open the circuit at each notification appliance to test the wiring supervisory feature. Provide copy of FACP printer output verifying proper operation (alarm, trouble, etc.) for each device with time stamp enabled throughout the testing process.
 - 7) Tests of the primary and secondary power supplies of new panels and associated loss of each.
 - 8) Complete operational tests under emergency power supply.

- 9) Ground fault monitoring circuit function.
- 10) Measurement of sound pressure levels in all areas within the scope of this project. Provide background and evacuation signal sound levels on the floor plans submitted with device address and tap settings.

END OF SECTION