PROJECT MANUAL

FOR

COURTHOUSE – NEW FIRE ALARM SYSTEM

TALLAHASSEE, FLORIDA

100% CONSTRUCTION DOCUMENTS
OWNER REVIEW

PEG # 212-116

SET NO._____

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LEON COUNTY, FLORIDA
COURTHOUSE: NEW FIRE ALARM SYSTEM
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APPENDIX A

[Reference: Spec Section 16721]

UNIT PRICING LIST

[Each Bidder shall provide the following Unit Pricing Information]

ITEM NO.	UNIT PRICE TO INCLUDE: L, M, O, & P	DESCRIPTION (All Items Per Specifications)
1	$	Fire Alarm Pull Station w/outlet box, 50' of fire alarm cable & conduit.
2	$	Ceiling Mounted Smoke Detector w/outlet box, 50' of fire alarm & conduit.
3	$	Duct Type Smoke Detector w/remote indicator and shutdown relay w/50' of fire alarm cable and conduit.
4	$	Ceiling mounted recessed speaker/strobe, with Housing box, 50' of fire alarm cable and conduit.
5	$	Wall Mounted speaker/strobe w/outlet box, 50' of fire alarm cable and conduit.
6	$	Ceiling mounted heat detector w/outlet box, 50' of fire alarm cable and conduit.
7	$	Fire Alarm Shutdown Relay, box, 50' of fire alarm cable and conduit.
8	$	Sprinkler Flow Switch, 50' of fire alarm cable and Conduit.
9	$	Sprinkler Tamper Switch, 50' of fire alarm cable and Conduit.
10	$	Door hold open device, outlet box, relay, 50' of fire alarm cable and conduit.
11	$	24"x36" Fire/Smoke damper with Fire Alarm connections 50' of Fire Alarm cable and conduit.
12	$	2-Hour Fire Rated hinged door access hatch with locking provisions 36"x36".

SECTION 01010 - SUMMARY OF WORK

PART 1 - GENERAL

RELATED DOCUMENTS

Drawings and general provisions of the Contract, including General and Supplementary Conditions and other Division-1 Specification Sections, apply to this Section.

PROJECT DESCRIPTION

The Project consists of providing a complete new voice evacuation multiplex addressable Fire Alarm System for the Leon County Courthouse, as shown on Contract Documents as prepared by Pinnacle Engineering Group, P.A., Consulting Engineers.

The Work includes purchasing, receiving, off-loading, storing, installing, new fire alarm equipment, conduits/conductors, controls, fire alarm devices, electrical components, and other components, equipment and materials as indicated.

The Contractor shall provide all labor, materials, and modifications in connection with the installation of fire alarm equipment, conduits/conductors, equipment, etc. The Contractor shall complete all work in accordance with the requirements of the specifications and shall comply with all applicable local and state codes and standards.

The Bidder, prior to furnishing a price, shall verify all existing conditions and examine all areas which in any way will affect the completion of this work. The Bidder shall report to the Engineer, in writing, any condition which will prevent the installation of any system or equipment in this building, minimum ten (10) days prior to bid.

The Work includes testing and inspections as identified in Florida Building Code and NFPA and adjustments and submission of reports.

The Work includes demolition and disposal of materials, equipment and items as indicated. Regular clean up and returning work areas to pre-work conditions or improved conditions as indicated is also required. Provide all shoring and bracing and protect all existing systems to remain. Protect existing roofs, floors, etc. to remain.

The Work involves coordinating with Authorities Having Jurisdiction for certifying compliance with all local and State requirements. The work includes obtaining all permits, paying all fees & costs, and filing all permit applications required by Authorities Having Jurisdiction.

The Work includes coordination with owner and all existing conditions so that all materials, equipment, parts, etc. are provided and installed in an organized and timely manner. The Contractor must schedule all work in advance with owner so as not to interfere with the daily routine of the Courthouse staff.

The Work includes removal, storage and reinstallation of ceiling, ceiling grids, light fixtures, etc. The work includes repairs to walls, ceilings, floors, etc that are disturbed as part of this work. All disturbed items shall be repaired to match as nearly as possible the finish, color, etc of the existing building components.

All products, materials, and labor shall be warranted by this contractor for a period of one (1) year after Substantial Completion date.

The Work includes connection/coordination with the existing Johnson Controls energy management and control system and installing new components as required for interface/ operation. The work includes testing and calibrating the energy management control system. The work also includes training the Owner's Maintenance Staff to operate the modified control system. The work also includes associated electrical work. The work includes the installation of sensors and other necessary control components (material and labor) for a fully functional direct digital control system. Work includes installation of interface relays, and surge suppression/ isolation systems. Work also includes updating computer graphics at the Central Workstation.

The Contractor shall visit the site and notify engineer in writing minimum 7 days prior to bid of any discrepancies or conflicts in performing work as indicated.

All work shall be accomplished using new materials except as specified herein. Guarantee on materials and workmanship shall be one year from day of acceptance.

The electrical portion of this project shall include all work shown in the Contract documents and required to meet Code for a fully operational Fire Alarm System.

This contractor is responsible for maintaining in operation the existing Fire Alarm System until the new Fire Alarm System is operational and approved by authority having jurisdiction. Fire watches maybe acceptable by Owner for short outage time spans. Coordinate exact durations and times with Owner.

CONTRACTOR USE OF PREMISES

Facility Rules: The Contractor and sub-tier contractors shall at all times conform to all facility rules and regulations including but not limited to: Site access and Identifcation requirements, dress codes, smoking policies, non-fraternization, and safety requirements.

Contractor and subcontractor employees will have to be cleared by security (for badges, background checks, etc.) prior to beginning work.

General: Limit use of the premises to construction activities in areas indicated; allow for Owner occupancy and use by the public.

Confine operations to areas within Contract limits indicated. Portions of the site beyond areas in which construction operations are indicated are not to be disturbed.

Keep driveways and entrances serving the premises clear and available to the Owner and staff traffic at all times. Do not use these areas for parking or storage of materials. Schedule deliveries to minimize space and time requirements for storage of materials and equipment on site. These activities must be coordinated with Owner's facilities staff.

Burial of Waste Materials: Do not dispose of organic and hazardous material on site, either by burial or by burning. The Contractor will dispose of waste material off-site and in a lawful manner. Coordinate with Owner for disposal of reusable material and equipment.

The Contractor and Sub-Contractors shall not dispose of their waste in the Owner's waste disposal system.

Use of the Existing Buildings: Maintain the existing buildings in a weather-tight condition throughout the construction period. Repair damage caused by construction operations. Take all precautions necessary to protect the buildings and their occupants during the construction period.

At no time shall the Contractor or sub-tier contractors create any conditions that diminish the life safety requirements of NFPA or the Florida Building Code.

OWNER OCCUPANCY

Full Owner Occupancy: The Owner will occupy the site and existing buildings during the entire construction period. Cooperate with and coordinate all work with the Owner during construction operations to minimize conflicts and facilitate Owner usage. Perform the Work so as not to interfere with the Owner's operations. Include in the bid all costs associated with premium time; coordinate with Owner on work hours and scheduling and lead time required for relocation of clients, prior to submitting a bid.

MISCELLANEOUS PROVISIONS

Minor Materials and Work: Minor materials and work not specifically mentioned herein but necessary for the proper completion of the specified work shall be furnished without additional cost to the Owner. It is the Contractor's responsibility to visit the site and examine all conditions affecting the work, and to include in the bid all costs associated with performing the work for a complete operational system.

Unforeseen Major Repairs: Should deteriorated materials of a major nature be uncovered in the course of the work, it shall be brought to the attention of the Owner prior to initiating work. Repairs will be made by the Owner in a timely manner so as to prevent excessive delay in completion of the Contract. No allowance for additional Contract completion time shall be allowed in conjunction with said repairs. Should equipment prove to be beyond repair within the time constraints of the Contract, an adjustment will be requested by the Contractor as indicated in the General Conditions of the Contract and in accordance with the terms of the Contract.

Existing Work: Where existing work is changed or removed, or where new work adjoins, connects or abuts existing work, the existing work shall be altered as necessary and connected in a substantial and workmanshiplike manner. All new work shall match, as nearly as practicable, the existing adjoining and/or adjacent similar work. Operations affecting existing work shall be conducted with care not to damage work in place; and all existing work damaged by such operations shall be rectified or replaced without additional expense to the Owner.

License: All work shall be performed under direct supervisions of a licensed Contractor holding an active Florida license in the disciplines involved.

Welding: No welding will be allowed inside the buildings of this project. Welding will be allowed in designated areas outside the building only. Soldering inside the building shall be kept to a bare minimum. Coordinate with Owner to disable fire alarm while soldering is in progress.

PROJECT IDENTIFICATION

Name of the Project: "Leon County Courthouse, New Fire Alarm System, Tallahassee, FL."

Contract Documents: Indicate work of Contract and related provisions of the project which may include, but are not necessarily limited to, the following:

- Existing conditions and restrictions.
- Coordination with existing work.
- Requirements for Owner to occupy facility during the construction phase. Down times must be coordinated with the Owner and must be held to the absolute minimum.

- Premium time may be required. The Contractor shall include in his bid the cost of all premium time. Coordinate with Owner for building and site access requirements, utility outage limitations and requirements, street closing requirements, and other issues which may necessitate off-hour work.

Phasing: Insofar as possible, the Contractor shall phase and schedule the work so as to minimize interference with the Owner's activity. The site and buildings will be occupied during the course of the work. Prior to beginning any work, the Contractor shall meet with the Owner so that an approved schedule and sequence of work may be arranged. The Contractor's schedule of work submitted to the Owner shall show the sequence in which the work will be performed in accordance with the priorities and provisions specified below.

1. Interruption of Utility Services, HVAC, Electrical, and Fire Protection Systems: Interruptions shall be kept to a minimum and be at such times and durations as approved by the Owner. No interruption shall occur unless scheduled with the Owner and approved in advance as to time and duration of such interruption.

2. As approved by the Owner, certain work may be rescheduled to allow the Contractor unhindered access to equipment, utility rooms and other areas where work must be accomplished, provided that the Contractor forwards requests in advance. Contractor shall ensure prior to such request that all items and materials required for the work have been delivered to the site and stored there.

Project Coordination:

The Contractor is responsible for coordinating with all sub-tier contractors and suppliers, delegation of work/scope to same, to ensure all work requirements and responsibilities: equipment, materials, accessories, installation, hook-up, testing, reporting, and the like are distributed and performed and the cost of these responsibilities is included in the Bid to provide a complete, fully operating project installation.

PART 2 – PRODUCTS (Not applicable)

PART 3 – EXECUTION (Not Applicable)

END OF SECTION 01010

SECTION 01045 – CUTTING AND PATCHING

PART 1 - GENERAL

RELATED DOCUMENTS

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

SUMMARY

This Section specifies administrative and procedural requirements for cutting and patching.

Refer to other Sections for specific requirements and limitations applicable to cutting and patching individual parts of the Work.

Requirements of this Section apply to fire alarm and electrical installations. Refer to Division 16 Sections for other requirements and limitations applicable to cutting and patching for fire alarm and electrical installations.

SUBMITTALS

Cutting and Patching Proposal: Where approval of procedures for cutting and patching is required before proceeding, submit a proposal describing procedures well in advance of the time cutting and patching will be performed and request approval to proceed. Include the following information, as applicable, in the proposal:

Describe the extent of cutting and patching required and how it is to be performed; indicate why it cannot be avoided.

Describe anticipated results in terms of changes to existing construction; include changes to structural elements and operating components as well as changes in the building's appearance and other significant visual elements.

List products to be used and firms or entities that will perform Work.

Indicate dates when cutting and patching is to be performed.

List utilities that will be disturbed or affected, including those that will be relocated and those that will be temporarily out-of-service. Indicate how long service will be disrupted.

Where cutting and patching involves addition of reinforcement to structural elements, submit details and engineering calculations to show how reinforcement is integrated with the original structure.

Approval by the Engineer to proceed with cutting and patching does not waive the Architect's/Engineer's right to later require complete removal and replacement of a part of the Work found to be unsatisfactory.

QUALITY ASSURANCE

Requirements for Structural Work: Do not cut and patch structural elements in a manner that would reduce their load-carrying capacity or load-deflection ratio.

Obtain approval of the cutting and patching proposal before cutting and patching the following structural elements:

Foundation construction
Bearing and retaining walls
Structural concrete
Structural steel
Lintels
Timber and primary wood framing
Structural decking
Stair systems
Miscellaneous structural metals
Exterior curtain wall construction
Equipment supports
Piping, ductwork, vessels and equipment
Structural systems of special construction

Operational and Safety Limitations: Do not cut and patch operating elements or safety related components in a manner that would result in reducing their capacity to perform as intended, or result in increased maintenance, or decreased operational life or safety.

Obtain approval of the cutting and patching proposal before cutting and patching the following operating elements or safety related systems:

Shoring, bracing, and sheeting
Primary operational systems and equipment
Air or smoke barriers
Water, moisture, or vapor barriers
Membranes and flashings
Fire protection systems
Noise and vibration control elements and systems
Control systems
Communication systems
Conveying systems
Electrical wiring systems
Special construction

Visual Requirements: Do not cut and patch construction exposed on the exterior or in occupied spaces, in a manner that would, in the Engineer's opinion, reduce the building's aesthetic qualities, or result in visual evidence of cutting and patching. Remove and replace Work cut and patched in a visually unsatisfactory manner.
If possible retain the original installer or fabricator to cut and patch the following categories of exposed Work, or if it is not possible to engage the original installer or fabricator, engage another recognized experienced and specialized firm:

Processed concrete finishes
Stonework and stone masonry
Ornamental metal
Matched-veneer woodwork
Preformed metal panels
Window wall system
Stucco and ornamental plaster
Acoustical ceilings
Terrazzo

Finished wood flooring.
Fluid-applied flooring.
Carpeting.
Aggregate wall coating.
Wall covering.
HVAC enclosures, cabinets or covers.

PART 2 - PRODUCTS

MATERIALS

Use materials that are identical to existing materials. If identical materials are not available or cannot be used where exposed surfaces are involved, use materials that match existing adjacent surfaces to the fullest extent possible with regard to visual effect. Use materials whose installed performance will equal or surpass that of existing materials.

Plaster: Comply with ASTM C 842.

Base Coat: Ready-mixed, sand aggregate gypsum plaster base.

Finish Coat: Ready-mixed gypsum finish plaster.

PART 3 - EXECUTION

INSPECTION

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

Before proceeding, meet at the site with parties involved in cutting and patching, including fire alarm and electrical trades. Review areas of potential interference and conflict. Coordinate procedures and resolve potential conflicts before proceeding.

PREPARATION

Temporary Support: Provide temporary support of Work to be cut.

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

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

Take all precautions necessary to avoid cutting existing pipe, conduit or ductwork serving the building, but scheduled to be removed or relocated until provisions have been made to bypass them.

PERFORMANCE

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

Cut existing construction to provide for installation of other components or performance of other construction activities and the subsequent fitting and patching required to restore surfaces to their original condition.

Cutting: Cut existing construction using methods least likely to damage elements to be retained or adjoining construction. Where possible review proposed procedures with the original installer; comply with the original installer's recommendations.

In general, where cutting is required use hand or small power tools designed for sawing or grinding, not hammering and chopping. Cut holes and slots neatly to size required with minimum disturbance of adjacent surfaces. Temporarily cover openings when not in use.

To avoid marring existing finished surfaces, cut or drill from the exposed or finished side into concealed surfaces.

Cut through concrete and masonry using a cutting machine such as carborundum saw or diamond core drill.

Comply with requirements of applicable Sections of Division-2 where cutting and patching requires excavating and backfilling.

By-pass utility services such as pipe or conduit, before cutting, where services are shown or required to be removed, relocated or abandoned. Cut-off pipe or conduit in walls or partitions to be removed. Cap, valve or plug and seal the remaining portion of pipe or conduit to prevent entrance of moisture or other foreign matter after by-passing and cutting.

Patching: Patch with durable seams that are as invisible as possible. Comply with specified tolerances.

Where feasible, inspect and test patched areas to demonstrate integrity of the installation.

Restore exposed finishes of patched areas and extend finish restoration into retained adjoining construction in a manner that will eliminate evidence of patching and refinishing.

Where removal of walls or partitions extends one finished area into another, patch and repair floor and wall surfaces in the new space to provide an even surface of uniform color and appearance. Remove existing floor and wall coverings and replace with new materials, if necessary to achieve uniform color and appearance.

Where patching occurs in a smooth painted surface, extend final paint coat over entire unbroken surface containing the patch, after the patched area has received primer and second coat.

Patch, repair or re-hang existing ceilings as necessary to provide an even plane surface of uniform appearance.

Plaster Installation: Comply with manufacturer's instructions and install thickness and coats as indicated.

Unless otherwise indicated provide 3-coat Work.

Finish gypsum plaster with smooth-troweled finish. Sand lightly to remove trowel marks and arises.

Cut, patch, point-up and repair plaster to accommodate other construction and to restore cracks, dents and imperfections.

CLEANING

Thoroughly clean areas and spaces where cutting and patching is performed or used as access. Remove completely paint, mortar, oils, putty and items of similar nature. Thoroughly clean piping, conduit and similar features before painting or other finishing is applied. Restore damaged pipe covering to its original condition.

END OF SECTION 01045

SECTION 01200 – PROJECT MEETINGS

PART 1 - GENERAL

SUMMARY

This section specifies administrative and procedural requirements for meetings including but not limited to:

Pre-Bid Meeting
Pre-Construction Conference.
Progress Meetings.

A Mandatory Pre-Bid Meeting will be held: _____ on _____ at _____.

PRE-CONSTRUCTION CONFERENCE

A pre-construction conference and organizational meeting will be held at the Project site. Required attendees will be notified as to the date and time. Minutes of the meeting shall be prepared and distributed by the Construction Manager (or Prime Contractor).

Attendees: The Owner, Construction Manager (or Prime Contractor), Engineer and their consultants, the Contractor and his superintendent, major subcontractors, equipment manufacturers or representatives and other concerned parties shall each be represented at the conference by persons familiar with and authorized to conclude matters relating to the Work.

Agenda: Discuss items of significance that could affect progress including such topics as:

Construction schedule.
Work sequencing.
Designation of responsible personnel.
Procedures for processing field decisions and Change Orders.
Procedures for processing Applications for Payment.
Distribution of Contract Documents.
Submittal of Shop Drawings, Product Data and Samples.
Preparation of record documents.
Use of the premises.
Office, Work and storage areas.
Equipment deliveries and priorities.
Safety procedures.
First aid.
Security.
Special Conditions.
Dress Codes.
Rules and Regulations for Contractor and Subcontractors.
Housekeeping.
Working hours.

PROGRESS MEETINGS

The Contractor's Construction Manager (or Prime Contractor) will conduct progress meetings at the Project site at regularly scheduled intervals. The Construction Manager (or Prime Contractor)

will schedule the meeting dates. Minutes of meeting will be prepared and distributed by the Construction Manager (or Prime Contractor).

Attendees: In addition to representatives of the Owner, Construction Manager (or Prime Contractor), and Engineer, each subcontractor, supplier or other entity concerned with current progress or involved in planning, coordination or performance of future activities shall be represented at these meetings by persons familiar with the project and authorized to conclude matters relating to progress.

Agenda: Review and correct or approve minutes of the previous progress meeting. Review other items of significance that could affect progress. Include topics for discussion as appropriate to the current status of the Project.

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

Review the present and future needs of each entity present, including such items as:

Interface requirements.
Time.
Sequences.
Deliveries.
Off-site fabrication problems.
Access.
Site utilization.
Temporary facilities and services.
Hours of Work.
Hazards and risks.
Housekeeping.
Quality and Work Standards.
Change Orders.
Documentation of information for payment requests.

Reporting: No later than 10 days after each progress meeting the Construction Manager shall distribute copies of minutes of the meeting to each party present and to other parties who should have been present. Include a brief summary, in narrative form of progress since the previous meeting and report.

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

END OF SECTION 01200

SECTION 01300 - SUBMITTALS

PART 1 - GENERAL

RELATED DOCUMENTS

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

SUMMARY

This Section specifies administrative and procedural requirements for submittals required for performance of the Work, including;

- Contractor's construction schedule.
- Shop Drawings.
- Product Data.
- Special Reports.

Administrative Submittals: Refer to other Division-1 Sections and other Contract Documents for requirements for administrative submittals. Such submittals include, but are not limited to:

- Permits.
- Applications for payment.
- Performance and payment bonds.
- Insurance certificates.
- List of Subcontractors.

Submittals for prior approval of alternate manufacturers shall be presented a minimum of 14 days prior to bid date. If alternate manufacturers are acceptable to Engineer, then an addendum will be issued. Requests submitted within 7 days of bid will be rejected.

SUBMITTAL PROCEDURES

Coordination: Coordinate preparation and processing of submittals with performance of construction activities. Transmit each submittal sufficiently in advance of performance of related construction activities to avoid delay.

Coordinate each submittal with fabrication, purchasing, testing, delivery, other submittals and related activities that require sequential activity.

Coordinate transmittal of different types of submittals for related elements of the Work so processing will not be delayed by the need to review submittals concurrently for coordination.

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

Processing: Allow sufficient review time so that installation will not be delayed as a result of the time required to process submittals, including time for resubmittals.

Allow two weeks for initial review. Allow additional time if processing must be delayed to permit coordination with subsequent submittals. The Engineer will promptly advise the Contractor when a submittal being processed must be delayed for coordination.

If an intermediate submittal is necessary, process the same as the initial submittal.

Allow two weeks for reprocessing each submittal.

No extension of Contract Time will be authorized because of failure to transmit submittals to the Engineer sufficiently in advance of the Work to permit processing.

Submittal Preparation: Place a permanent label or title block on each submittal for identification. Indicate the name of the entity that prepared each submittal on the label or title block.

Provide a space approximately 4" x 5" on the label or beside the title block on Shop Drawings to record the Contractor's review and approval markings and the action taken.

Include the following information on the label for processing and recording action taken.

Project name.
Date.
Name and address of Engineer.
Name and address of Contractor.
Name and address of subcontractor.
Name and address of supplier.
Name of manufacturer.
Number and title of appropriate Specification Section.
Drawing number and detail references, as appropriate.

Submittal Transmittal: Package each submittal appropriately for transmittal and handling. Transmit each submittal from Contractor to Engineer using a transmittal form. Submittals received from sources other than the Contractor will be returned without action.

On the transmittal Record relevant information and requests for data. On the form, or separate sheet, record deviations from Contract Document requirements, including all variations and limitations. Include Contractor's certification that information complies with Contract Document requirements.

CONTRACTOR'S CONSTRUCTION SCHEDULE

Schedule: Prepare a fully developed, Contractor's construction schedule. Submit within 5 days of the date established for "Commencement of the Work", but prior to the pre-construction conference.

Secure time commitments for performing critical elements of the Work from parties involved. Coordinate each element on the schedule with other construction activities; include minor elements involved in the sequence of the Work. Show each activity in proper sequence. This construction schedule must not interfere with courthouse operations, be mutually agreeable with the owner, and any revisions to the schedule must also be agreed to by the owner.

Coordinate the Contractor's construction schedule with the subcontractors, submittal schedule, payment requests and other schedules.

Indicate completion in advance of the date established for Substantial Completion. Indicate Substantial Completion on the schedule to allow time for the Engineer's procedures necessary for certification of Substantial Completion.

Indicate periods of shutdowns. Coordinate with Owner.

Distribution: Print and distribute copies to the Engineer, Owner, subcontractors, and other parties required to comply with scheduled dates. Post copies in the Project area.

When revisions are made, distribute to the same parties and post in the same locations. Delete parties from distribution when they have completed their assigned portion of the Work and are no longer involved in construction activities.

Schedule Updating: Revise the schedule after each meeting or activity, where revisions have been recognized or made. Issue the updated schedule concurrently with report of each meeting.

SHOP DRAWINGS

Submit newly prepared information, drawn to accurate scale. Highlight, encircle, or otherwise indicate deviations from the Contract Documents. Do not reproduce Contract Documents or copy standard information as the basis of Shop Drawings. Standard information prepared without specific reference to the Project is not considered Shop Drawings.

Shop Drawings include fabrication and installation drawings, setting diagrams, schedules, patterns, templates and similar drawings. Include the following information:

Dimensions.
Identification of products and materials included.
Compliance with specified standards.
Notation of coordination requirements.
Notation of dimensions established by field measurement.

Submittal: Submit 6 blue- or black-line prints for the Engineer's review; five will be returned.

Do not use Shop Drawings without an appropriate final stamp indicating action taken in connection with construction.

PRODUCT DATA

Collect Product Data into a single submittal for each element of construction or system. Product Data includes printed information such as manufacturer's installation instructions, catalog cuts, roughing-in diagrams and templates, standard wiring diagrams and performance curves. Where Product Data must be specially prepared because standard printed data is not suitable for use, submit as "Shop Drawings."

Mark each copy to show applicable choices and options. Where printed Product Data includes information on several products, some of which are not required, mark copies to indicate the applicable information. Include the following information:

Manufacturer's printed recommendations.
Compliance with recognized trade association standards.
Compliance with recognized testing agency standards.
Application of testing agency labels and seals.
Notation of dimensions verified by field measurement.
Notation of coordination requirements.

Submittals: Submit 6 copies of each required submittal; the Engineer will retain one, and will return the other marked with action taken and corrections or modifications required.

Distribution: Furnish copies of final submittal to installers, subcontractors, suppliers, manufacturers, fabricators, and others required for performance of construction activities. Show distribution on transmittal forms.

Do not proceed with installation until an applicable copy of Product Data is in the installer's possession.

Do not permit use of unmarked copies of Product Data in connection with construction.

ENGINEER'S ACTION

Except for submittals for record, information or similar purposes, where action and return is required or requested, the Engineer will review each submittal, mark to indicate action taken, and return promptly.

Compliance with specified characteristics is the Contractor's responsibility.

Action Stamp: The Engineer will stamp each submittal with a uniform, self-explanatory action stamp. The stamp will be appropriately marked, as follows, to indicate the action taken:

Final Unrestricted Release: Where submittals are marked "Reviewed,/No Exceptions Taken" that part of the Work covered by the submittal may proceed provided it complies with requirements of the Contract Documents; final acceptance will depend upon that compliance.

Final-But-Restricted Release: When submittals are marked "Furnish as Corrected /No Resubmission Required," that part of the Work covered by the submittal may proceed provided it complies with notations or corrections on the submittal and requirements of the Contract Documents; final acceptance will depend on that compliance.

Returned for Resubmittal: When submittal is marked "Rejected or Revise and Resubmit," do not proceed with that part of the Work covered by the submittal, including purchasing, fabrication, delivery, or other activity. Revise or prepare a new submittal in accordance with the notations; resubmit without delay. Repeat if necessary to obtain a different action mark.

Do not permit submittals marked "Rejected" or "Revise and Resubmit" to be used at the Project site, or elsewhere where Work is in progress.

Other Action: Where a submittal is primarily for information or record purposes, special processing or other activity, the submittal will be returned, marked "Action Not Required".

SPECIAL REPORTS:

General: Except as otherwise indicated, submit special reports directly to the Owner within one day of occurrence requiring special report, with copy to others affected by occurrence.

Reporting Accidents: Prepare and submit reports of significant accidents, at site and anywhere else work is in progress. Record and document data and actions; comply with industry standards. For this purpose, a significant accident is defined to include events where personal injury is sustained, or property loss of substance is sustained, or where the event posed a significant threat of loss or personal injury.

PART 2 - PRODUCTS (Not Applicable).

PART 3 - EXECUTION (Not Applicable).

END OF SECTION 01300

SECTION 01700 - PROJECT CLOSEOUT

PART 1 - GENERAL

RELATED DOCUMENTS

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

SUMMARY

This Section specifies administrative and procedural requirements for project closeout, including but not limited to:

Inspection procedures.
Submittal of warranties.
Final cleaning.

Closeout requirements for specific construction activities are included in the appropriate Sections of the specifications.

SUBSTANTIAL COMPLETION

Preliminary Procedures: Before requesting inspection for certification of Substantial Completion, complete the following: (List exceptions in the request).

In the Application for Payment that coincides with, or first follows, the date Substantial Completion is claimed, show 100 percent completion for the portion of the Work claimed as substantially complete. Include supporting documentation for completion as indicated in these Contract Documents and a statement showing an accounting of changes to the Contract Sum.

If 100 percent completion cannot be shown, include a list of incomplete items, the value of incomplete construction, and reasons the Work is not complete.

Advise Owner of pending insurance change-over requirements.

Submit specific warranties, workmanship bonds, maintenance agreements, final certifications and similar documents.

Obtain and submit releases enabling the Owner unrestricted use of the Work and access to services and utilities; include operating certificates and similar releases.

Submit record drawings, maintenance manuals, final project photographs, damage or settlement survey, property survey, and similar final record information.

Deliver tools, spare parts, extra stock, and similar items.

Make final change-over of permanent locks and transmit keys to the Owner. Advise the Owner's personnel of change-over in security provisions.

Complete start-up testing of systems, and instruction of the Owner's operating and maintenance personnel. Discontinue or change over and remove temporary facilities from the site, along with construction tools, mock-ups, and similar elements.

Complete final clean up requirements, including touch-up painting. Touch-up and otherwise repair and restore marred exposed finishes.

Inspection Procedures: On receipt of a request for inspection, the Engineer will either proceed with inspection or advise the Contractor of unfilled requirements. The Engineer will prepare the Certificate of Substantial Completion following inspection, or advise the Contractor of construction that must be completed or corrected before the certificate will be issued.

The Engineer will repeat inspection when requested and assured that the Work has been substantially completed. The contractor will be responsible for the engineer's fee for all final inspections requested except for the first final inspection.

Results of the completed inspection will form the basis of requirements for final acceptance.

FINAL ACCEPTANCE

Preliminary Procedures: Before requesting final inspection for certification of final acceptance and final payment, complete the following: (List exceptions in the request).

Submit the final payment request with releases and supporting documentation not previously submitted and accepted. Include certificates of insurance for products and completed operations where required.

Submit an updated final statement, accounting for final additional changes to the Contract Sum.

Submit a certified copy of the Engineer's final inspection list of items to be completed or corrected, stating that each item has been completed or otherwise resolved for acceptance, and the list has been endorsed and dated by the Engineer. Submit consent of surety to final payment.

Submit a final liquidated damages settlement statement.

Submit evidence of final, continuing insurance coverage complying with insurance requirements.

Reinspection Procedure: The Engineer will reinspect the Work upon receipt of notice that the Work, including inspection list items from earlier inspections, has been completed, except items whose completion has been delayed because of circumstances acceptable to the Engineer.

Upon completion of reinspection, the Engineer will prepare a certificate of final acceptance, or advise the Contractor of work that is incomplete or of obligations that have not been fulfilled but are required for final acceptance.

If necessary, reinspection will be repeated. The contractor will be responsible for the cost of all reinspections.

PART 2 - PRODUCTS (Not Applicable)

PART 3 - EXECUTION

CLOSEOUT PROCEDURES

Operating and Maintenance Instructions: Arrange for each installer of equipment that requires regular maintenance to meet with the Owner's personnel to provide instruction in proper

operation and maintenance. Provide instruction by manufacturer's representatives. Include a detailed review of the following items:

Maintenance manuals.
Record documents.
Spare parts and materials.
Tools.
Lubricants.
Identification systems.
Control sequences.
Hazards.
Cleaning.
Warranties and bonds.
Maintenance agreements and similar continuing commitments.

As part of instruction for operating equipment, demonstrate the following procedures:

Start-up.
Shutdown.
Emergency operations.
Safety procedures.
Economy and efficiency adjustments.
Effective energy utilization.

Provide to the Engineer a written record of the training including date of training, personnel present, equipment reviewed and topics discussed.

Provide to the Owner one electronic copy of O&M manuals (pdf format) and five (5) hard copies.

FINAL CLEANING

General: General cleaning during construction is required.

Cleaning: Employ experienced workers or professional cleaners for final cleaning. Clean each surface or unit to the condition expected in a normal, commercial building cleaning and maintenance program. Comply with manufacturer's instructions.

Remove labels that are not permanent labels.

Clean the site of rubbish, litter and other foreign substances. Sweep areas broom clean; remove stains, spills and other foreign deposits.

Removal of Protection: Remove temporary protection and facilities installed for protection of the Work during construction.

Compliance: Comply with regulations of authorities having jurisdiction and safety standards for cleaning. Do not burn waste materials. Do not bury debris or excess materials on the Owner's property. Do not discharge volatile, harmful or dangerous materials into drainage systems. Remove waste materials from the site and dispose of in a lawful manner.

Where extra materials of value remain after completion of associated Work and have become the Owner's property, arrange for disposition of these materials as directed by the owner.

END OF SECTION 01700

SECTION 01720 - PROJECT RECORD DOCUMENTS

PART 1 - GENERAL

RELATED DOCUMENTS

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

SUMMARY

This Section specifies administrative and procedural requirements for Project Record Documents.

The contractor shall provide a complete set of as-built documents.

As a minimum the following project Record Documents are required:

Marked-up copies of Shop Drawings.
Newly prepared Drawings.
Record information on Work that is recorded only schematically.
Product data

Specific record copy requirements that expand requirements of this Section are included in the individual Sections of the specification.

General project closeout requirements are included in Section "Project Closeout."

In addition to other requirements, complete record drawings shall be provided in AutoCAD 2010 format on CD rom disk.

Maintenance of Documents: Store record documents apart from Contract Documents used for construction. Do not permit Project Record Documents to be used for construction purposes. Maintain record documents in good order, and in a clean, dry, legible condition. Make documents available at all times for inspection by the Engineer.

RECORD DRAWINGS

Mark-up Procedure: During the construction period, maintain a set of blue- or black-line white-prints of Shop Drawings for Project Record Document purposes.

Mark these Drawings to indicate the actual installation where the installation varies appreciably from the installation shown originally. Give particular attention to information on concealed elements which would be difficult to identify or measure and record later. Items required to be marked include but are not limited to:

Dimensional changes to the Drawings.
Revisions to details shown on the Drawings.
Revisions to routing of conduits and control wiring.
Revisions to electrical circuitry.
Actual equipment locations.
Locations of concealed internal utilities.
Changes made by Change Order.
Details not on original Drawings.

Mark completely and accurately record prints of Shop Drawings, whichever is most capable of showing actual conditions.

Mark record sets with red erasable colored pencil; use other colors to distinguish between changes for different categories of the Work at the same location.

Mark important additional information which was either shown schematically or omitted from original Drawings.

Note construction change directive numbers, alternate numbers, Change Order numbers and similar identification.

Responsibility for Markup: Where feasible, the individual or entity who obtained record data, whether the individual or entity is the installer, subcontractor, or similar entity, is required to prepare the mark-up on record Drawings.

Accurately record information in an understandable Drawing technique.

Record data as soon as possible after it has been obtained. In the case of concealed installations, record and check the mark-up prior to concealment.

At time of Substantial Completion, submit record Drawings to Engineer for Owner's records. Organize into sets, bind and label sets for Owner's continued use.

Newly Prepared Record Drawings: Prepare new Drawings instead of following procedures specified for preparation of record Drawings where new Drawings are required by a Change Order issued as a result of acceptance of an alternate, substitution, or other modification, and the Engineer determines that the Shop Drawings are not suitable to show the actual installation.

RECORD PRODUCT DATA

During the construction period, maintain one copy of each Product Data submittal for Project Record Document purposes.

Mark Product Data to indicate the actual product installation where the installation varies substantially from that indicated in Product Data submitted. Include significant changes in the product delivered to the site, and changes in manufacturer's instructions and recommendations for installation.

Give particular attention to information on concealed products and installations that cannot be readily identified and recorded later.

Note related Change Orders and mark-up of record Drawings, where applicable.
Upon completion of mark-up, submit a complete set of record Product Data to the Engineer for the Owner's records.

Where record Product Data is required as part of maintenance manuals, submit marked-up Product Data as an insert in the manual, instead of submittal as record Product Data.

In addition to the above deliverables, this contractor shall provide (minimum 5 sets) As-Built drawings, approved shop drawings and maintenance manuals in CD (Compact Disk) format to the Engineer.

PART 2 - PRODUCTS (not applicable)

PART 3 - EXECUTION

RECORDING

Post changes and modifications to the Documents as they occur. Do not wait until the end of the Project. The Engineer will periodically review record documents to assure compliance with this requirement.

END OF SECTION 01720

SECTION 01730 - OPERATING AND MAINTENANCE DATA

PART 1 - GENERAL

RELATED DOCUMENTS

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

SUMMARY

This Section specifies administrative and procedural requirements for operating and maintenance manuals including the following:

Preparation and submittal of operating and maintenance manuals for equipment;

Instruction of the Owner's operating personnel in operation and maintenance of equipment.

Special operating and maintenance data requirements for specific pieces of equipment or building operating systems are included in the appropriate Sections of the specification.

General closeout requirements are included in Section "Project Closeout."

QUALITY ASSURANCE

Maintenance Manual Preparation: In preparation of Maintenance Manuals, use personnel thoroughly trained and experienced in operation and maintenance of the equipment or system involved.

Instructions for the Owner's Personnel: For instruction of the Owner's operating and maintenance personnel, use experienced instructors thoroughly trained and experienced in the operation and maintenance of the building equipment or system involved.

SUBMITTALS

Submittal Schedule: Comply with the following schedule for submittal of operating and maintenance manuals.

Before Substantial Completion, when the installation is nominally complete, submit two draft copies of each manual to the Engineer for review. Include a complete index or table of contents of each manual.

The Engineer will return one copy of the draft with comments within fifteen days of receipt.

Submit one copy of data in final form at least fifteen days before final inspection. This copy will be returned within fifteen days after final inspection, with comments.

After final inspection make corrections or modifications to comply with the Engineers comments. Submit the specified number of copies (minimum 5 sets) of each approved manual to the Engineer within fifteen days of receipt of the Engineer's comments.

Form of Submittal: Prepare operating and maintenance manuals in the form of an instructional manual for use by the Owner's operating personnel.

Binders: For each manual, provide heavy-duty, commercial quality, durable 3-ring vinyl covered loose-leaf binders, in thickness necessary to accommodate contents, sized to receive 8-1/2" by 11" paper. Provide a clear plastic sleeve on the spine, to hold labels describing the contents. Provide pockets in the covers to receive folded sheets.

Dividers: Provide heavy paper dividers with celluloid covered tabs for each separate Section. Mark each tab to indicate contents. Provide a typed description of the product and major parts of equipment included in the Section on each divider.

Text Material: Where written material is required as part of the manual use the manufacturer's standard printed material, or if it is not available, specially prepared data, neatly typewritten, on 8-1/2" by 11".

Drawings: Where drawings or diagrams are required as part of the manual, provide reinforced punched binder tabs on the drawings and bind in with the text.

If drawings are too large to be used practically as a fold-out, place the drawing, neatly folded, in the front or rear pocket of the binder. Insert a typewritten page indicating the drawing title, description of contents and drawing location at the appropriate location in the manual.

Electronic: Scan or convert operating and maintenance manual materials to PDF format in addition to five (5) hard paper copies. PDF files shall be copied onto compact discs, arranged in a way that mirrors the hard copy.

MANUAL CONTENT

In each manual include information specified in the individual Specification Section, and the following information for each major component of building equipment and its controls:

General equipment description
Design factors and assumptions
Copies of applicable Shop Drawings and Product Data

Equipment identification, including:
- Name of manufacturer
- Model number
- Serial number of each component
- Operating instructions
- Emergency instructions
- Complete wiring diagrams and schematics
- Complete troubleshooting guide
- Inspection and test procedures
- Maintenance procedures and schedules
- Precautions against improper use and maintenance
- Copies of warranties
- Repair instructions including spare parts listing
- Sources of required maintenance materials and related services
- Manual Index

Organize each manual into separate Sections for each piece of related equipment. As a minimum each manual shall contain a title page, a table of contents, copies of Product Data, supplemented by drawings and written text, and copies of each warranty, bond and service Contract issued.

Title Page: Provide a title page in a transparent plastic envelope as the first sheet of each manual. Provide the following information:

Subject matter covered by the manual
Name and address of the Project
Date of submittal
Name, address, and telephone number of the Contractor
Name and address of the Engineer

Table of Contents: After the Title Page, include a typewritten table of contents for each volume, arranged systematically according to the Project Manual format. Include a list of each product included, identified by product name or other appropriate identifying symbol and indexed to the content of the volume.

General Information: Provide a general information Section immediately following the Table of Contents, listing each product included in the manual, identified by product name. Under each product, list the name, address, and telephone number of the Subcontractor or installer, and the maintenance contractor. List a local source for replacement parts and equipment.

Product Data: Where manufacturer's standard printed data is included in the manuals, include only sheets that are pertinent to the part or product installed. Mark each sheet to identify each part or product included in the installation. Where more than one item in a tabular format is included, identify each item, using appropriate references from the Contract Documents. Identify data that is applicable to the installation and delete references to information that is not applicable.

Written Text: Where manufacturer's standard printed data is not available, and information is necessary for proper operation and maintenance of equipment or systems, or it is necessary to provide additional information to supplement data included in the manual, prepare written text to provide necessary information. Organize the text in a consistent format under separate headings for different procedures. Where necessary, provide a logical sequence of instruction for each operating or maintenance procedure.

Drawings: Provide specially prepared drawings where necessary to supplement manufacturer's printed data to illustrate the relationship of component parts of equipment or systems, or to provide control or flow diagrams. Coordinate these drawings with information contained in Project Record Drawings to assure correct illustration of the completed installation.

Do not use original Project Record Documents as part of the Operating and Maintenance Manuals.

Warranties, Bonds and Service Contracts: Provide a copy of each warranty, bond or service contract in the appropriate manual for the information of the Owner's operating personnel. Provide written data outlining procedures to be followed in the event of product failure. List circumstances and conditions that would affect validity of the warranty or bond.

EQUIPMENT MAINTENANCE MANUAL

Submit three copies of each completed manual on equipment in final form, to the Engineer for distribution. Provide one compact disc with drawings and manual information in PDF format.

Refer to Specification Sections for additional requirements on operating and maintenance of the various pieces of equipment.

Equipment: Provide the following information for each piece of equipment.

Description: Provide a complete description of each unit and related component parts, including the following:

Equipment
Operating characteristics
Limiting conditions
Performance curves
Engineering data and tests
Complete nomenclature and number of replacement parts

Manufacturer's Information: For each manufacturer of a piece of equipment provide the following:

Printed operating and maintenance instructions.

Assembly drawings and diagrams indicating all components within the system. List of items recommended to be stocked as spare parts.

Include name, address and phone number of local vendor, local service representative and technical support organization.

Maintenance Procedures: Provide information detailing essential maintenance procedures, including the following:

Routine operations
Trouble-shooting guide
Disassembly, repair and reassembly
Adjusting and checking

Operating Procedures: Provide information on equipment operating procedures, including the following:

Start-up procedures
Equipment or system break-in
Routine and normal operating instructions
Regulation and control procedures
Instructions on stopping
Shut-down and emergency instructions
Required sequences for electric or electronic systems
Special operating Instructions

Schedule: Provide complete information in the equipment manual on products specified in Division 16.

INSTRUCTIONS OF THE OWNER'S PERSONNEL

Prior to final inspection, instruct the Owner's personnel in operation, adjustment, and maintenance of products and equipment. Provide instruction at mutually agreed upon times.

Use operation and maintenance manuals for each piece of equipment or system as the basis of instruction. Review contents in detail to explain all aspects of operation and maintenance.

All training shall be conducted at the facility. If training is to be conducted at any other facility, the contractor shall pay all costs associated with sending the facility's personnel to the training facility to include meals, lodging and transportation costs.

PART 2 – PRODUCTS (Not Applicable)

PART 3 – EXECUTION (Not Applicable)

END OF SECTION 01730

SECTION 16010 - BASIC ELECTRICAL REQUIREMENTS

PART 1 - GENERAL

RELATED DOCUMENTS

Drawings and general provisions of Contract, including General and Supplementary Conditions and Division 1 Specification Sections, apply to this and the other sections of Division 16.

CODES AND STANDARDS

All work shall comply with applicable provisions of the following codes and standards:

NFPA 70, 2008	National Electrical Code
NFPA 72, 2007	Standard for Installation, Maintenance and Use of Local Protective Signaling Systems (National Fire Alarm Code)
NFPA 99, 2005	Standard for Health Care Facilities
NFPA 101, 2009	Life Safety Code
NFPA 110, 2005	Standard for Emergency and Standby Power Systems
2007	State Fire Prevention Code
2010	Florida Building Code
January 1, 1994	Florida Americans with Disabilities Accessibility Implementation Act (October 1, 1993) as described in Accessibility Requirements Manual, Department of Community Affairs (October 1, 1997).
NFPA 1, 2005	Uniform Fire Code, 2005 edition, as adopted within Rule Chapter 69A-60, F.A.C., entitled "2007 edition of the Florida Fire Prevention Code".

SUMMARY

This Section includes general administrative and procedural requirements for electrical installations. The following administrative and procedural requirements are included in this Section to expand the requirements specified in Division 1:

Submittals.
Coordination drawings.
Record documents.
Maintenance manuals.
Rough-ins.
Electrical installations.
Cutting and patching.

Related Sections: The following sections contain requirements that relate to this section:

Division 16 Section "BASIC ELECTRICAL MATERIALS AND METHODS," for materials and methods common to the remainder of Division 16, plus general related specifications including:

Access to electrical installations.

Excavation for electrical installations within the building boundaries and from building to utility connections.

SUBMITTALS

General: Follow the procedures specified in Division 1 Section "SUBMITTALS."

Increase, by the quantity listed below, the number of electrical related shop drawings, product data, and samples submitted, to allow for required distribution plus two copies of each submittal required, which will be retained by the Electrical Consulting Engineer.

Shop Drawings – Initial Submittal: 1 additional blue- or black-line prints.

Shop Drawings – Final Submittal: 1 additional blue- or black-line prints.

Product Data: 1 additional copy of each item.

Samples: 1 addition as set.

Additional copies may be required by individual sections of these Specifications.

COORDINATION DRAWINGS

Prepare coordination drawings in accordance with Division 1 Section "PROJECT COORDINATION," to a scale of 1/4"=1'-0" or larger; detailing major elements, components, and systems of electrical equipment and materials in relationship with other systems, installations, and building components. Indicate locations where space is limited for installation and access and where sequencing and coordination of installations are of importance to the efficient flow of the Work, including (but not necessarily limited to) the following:

Indicate the proposed locations of major raceway systems, equipment, and materials. Include the following:

Clearances for servicing equipment, including space for equipment disassembly required for periodic maintenance.

Exterior wall and foundation penetrations.

Fire-rated wall and floor penetrations.

Equipment connections and support details.

Sizes and location of required concrete pads and bases.

Indicate scheduling, sequencing, movement, and positioning of large equipment into the building during construction.

Prepare floor plans, elevations, and details to indicate penetrations in floors, walls, and ceilings and their relationship to other penetrations and installations.

Prepare reflected ceiling plans to coordinate and integrate installations, air outlets and inlets, light fixtures, communications systems components, sprinklers, and other ceiling-mounted devices.

RECORD DOCUMENTS

Prepare record documents. Indicate installed conditions for:

Major raceway systems, size and location, for both exterior and interior; locations of control devices; distribution and branch electrical circuitry; and fuse and circuit breaker size and arrangements.

Equipment locations (exposed and concealed), dimensioned from prominent building lines.

Approved substitutions, Contract Modifications, and actual equipment and materials installed.

MAINTENANCE MANUALS

Prepare maintenance manuals. Include the following information for equipment items:

Description of function, normal operating characteristics and limitations, performance curves, engineering data and tests, and complete nomenclature and commercial numbers of replacement parts.

Manufacturer's printed operating procedures to include start-up, break-in, and routine and normal operating instructions; regulation, control, stopping, shutdown, and emergency instructions; and summer and winter operating instructions.

Maintenance procedures for routine preventative maintenance and troubleshooting; disassembly, repair, and reassembly; aligning and adjusting instructions.

Servicing instructions and lubrication charts and schedules.

DELIVERY, STORAGE, AND HANDLING

Deliver products to the project properly identified with names, model numbers, types, grades, compliance labels, and other information needed for identification.

PART 2 - PRODUCTS (Not Applicable).

PART 3 - EXECUTION

ROUGH-IN

Verify final locations for rough-ins with field measurements and with the requirements of the actual equipment to be connected.

ELECTRICAL INSTALLATIONS

General: Sequence, coordinate, and integrate the various elements of electrical systems, materials, and equipment. Comply with the following requirements:

Coordinate electrical systems, equipment, and materials installation with other building components.

Verify all dimensions by field measurements.

Arrange for chases, slots, and openings in other building components during progress of construction, to allow for electrical installations.

Coordinate the installation of required supporting devices and sleeves to be set in poured-in-place concrete and other structural components, as they are constructed.

Sequence, coordinate, and integrate installations of electrical materials and equipment for efficient flow of the Work. Give particular attention to large equipment requiring positioning prior to closing in the building.

Where mounting heights are not detailed or dimensioned, install systems, materials, and equipment to provide the maximum headroom possible.

Coordinate connection of electrical systems with exterior underground and overhead utilities and services. Comply with requirements of governing regulations, franchised service companies, and controlling agencies. Provide required connection for each service.

Install systems, materials, and equipment to conform with approved submittal data, including coordination drawings, to greatest extent possible. Conform to arrangements indicated by the Contract Documents, recognizing that portions of the Work are shown only in diagrammatic form. Where coordination requirements conflict with individual system requirements, refer conflict to the Engineer.

Install systems, materials, and equipment level and plumb, parallel and perpendicular to other building systems and components, where installed exposed in finished spaces.

Install electrical equipment to facilitate servicing, maintenance, and repair or replacement of equipment components. As much as practical, connect equipment for ease of disconnecting, with minimum of interference with other installations.

Install access panel or doors where units are concealed behind finished surfaces.

Install systems, materials, and equipment giving right-of-way priority to systems required to be installed at a specified slope.

CUTTING AND PATCHING

General: Perform cutting and patching in accordance with Division 1 Section "CUTTING AND PATCHING." In addition to the requirements specified in Division 1, the following requirements apply:

Perform cutting, fitting, and patching of electrical equipment and materials required to:

Uncover Work to provide for installation of ill-timed Work.

Remove and replace defective Work.

Remove and replace Work not conforming to requirements of the Contract Documents.

Remove samples of installed Work as specified for testing.

Install equipment and materials in existing structures.

Upon written instructions from the Architect, uncover and restore Work to provide for Architect observation of concealed Work.

Cut, remove, and legally dispose of selected electrical equipment, components, and materials as indicated, including but not limited to removal of electrical items indicated to be removed and items made obsolete by the new Work.

Protect the structure, furnishings, finishes, and adjacent materials not indicated or scheduled to be removed.

Provide and maintain temporary partitions or dust barriers adequate to prevent the spread of dust and dirt to adjacent areas.

Protection of Installed Work: During cutting and patching operations, protect adjacent installations.

Patch existing finished surfaces and building components using new materials matching existing materials and experienced Installers. Installers' qualifications refer to the materials and methods required for the surface and building components being patched.

Patch finished surfaces and building components using new materials specified for the original installation and experienced Installers. Installers' qualifications refer to the materials and methods required for the surface and building components being patched.

CONDUIT PENETRATIONS OF SMOKE TIGHT WALLS

Installations with less than 1/2" gap between conduit and wall opening shall be sealed all around with drywall joint compound (no tape) conforming to NFPA/FBC criteria.

Installations with greater than 1/2" gap between conduit and wall opening shall be closed with a drywall blow-out patch and sealed with drywall joint compound (no tape) conforming to NFPA/FBC.

END OF SECTION 16010

SECTION 16050 - BASIC ELECTRICAL MATERIALS AND METHODS

PART 1 - GENERAL

RELATED DOCUMENTS

Drawings and general provisions of Contract, including General and Supplementary Conditions and Division 1 Specification Sections, apply to this Section.

Requirements specified in Division 16 Section "Basic Electrical Requirements" apply to this Section.

SUMMARY

This Section includes limited scope general construction materials and methods for application with electrical installations as follows:

Selective demolition including:

Nondestructive removal of materials and equipment for reuse or salvage as indicated.

Dismantling electrical materials and equipment made obsolete by these installations.

Miscellaneous metals for support of electrical materials and equipment.

Wood grounds, nailers, blocking, fasteners, and anchorage for support of electrical materials and equipment.

Joint sealers for sealing around electrical materials and equipment; and for sealing penetrations in fire and smoke barriers, floors, and foundation walls.

Access panels and doors in walls, ceilings, and floors for access to electrical materials and equipment.

DEFINITIONS

The following definitions apply to excavation operations:

Additional Excavation: Where excavation has reached required subgrade elevations, if unsuitable bearing materials are encountered, continue excavation until suitable bearing materials are reached. The Contract Sum may be adjusted by an appropriate Contract Modification.

Subbase: as used in this Section refers to the compacted soil layer used in pavement systems between the subgrade and the pavement base course material.

3Subgrade: as used in this Section refers to the compacted soil immediately below the slab or pavement system.

Unauthorized excavation consists of removal of materials beyond indicated subgrade elevations or dimensions without specific direction from the Architect.

SUBMITTALS

General: Submit the following in accordance with Conditions of Contract and Division 1 Specification Sections.

Product data for the following products:

Access panels and doors.
Joint sealers.

Shop drawings detailing fabrication and installation for metal fabrications, and wood supports and anchorage for electrical materials and equipment.

Coordination drawings for access panel and door locations in accordance with Division 16 Section "Basic Electrical Requirements."

Samples of joint sealer, consisting of strips of actual products showing full range of colors available for each product.

Welder certificates, signed by Contractor, certifying that welders comply with requirements specified under "Quality Assurance" article of this Section.

Schedules indicating proposed methods and sequence of operations for selective demolition prior to commencement of Work. Include coordination for shut-off of electrical service, and details for dust and noise control.

Coordinate sequencing with construction phasing and Owner occupancy specified in Division 1 Section "Summary of Work."

QUALITY ASSURANCE

Installer Qualifications: Engage an experienced Installer for the installation and application joint sealers, access panels, and doors.

Qualify welding processes and welding operators in accordance with AWS D1.1 "Structural Welding Code - Steel."

Certify that each welder has satisfactorily passed AWS qualification tests for welding processes involved and, if pertinent, has undergone recertification.

Fire-Resistance Ratings: Where a fire-resistance classification is indicated, provide access door assembly with panel door, frame, hinge, and latch from manufacturer listed in the UL "Building Materials Directory" for rating shown.

Provide UL Label on each fire-rated access door.

DELIVERY, STORAGE, AND HANDLING

Deliver joint sealer materials in original unopened containers or bundles with labels informing about manufacturer, product name and designation, color, expiration period for use, pot life, curing time, and mixing instructions for multi-component materials.

Store and handle joint sealer materials in compliance with the manufacturers' recommendations to prevent their deterioration and damage.

PROJECT CONDITIONS

Conditions Affecting Selective Demolition: The following project conditions apply:

Protect adjacent materials indicated to remain. Install and maintain dust and noise barriers to keep dirt, dust, and noise from being transmitted to adjacent areas. Remove protection and barriers after demolition operations are complete.

Locate, identify, and protect electrical services passing through demolition area and serving other areas outside the demolition limits. Maintain services to areas outside demolition limits. When services must be interrupted, install temporary services for affected areas.

Conditions Affecting Demolition: The following project conditions apply:

Maintain and protect existing building services which transit the area affected by selective demolition.

Protect structures, utilities, sidewalks, pavements, and other facilities from damage caused by settlement, lateral movement, undermining, washout, and other hazards created by demolition operations.

Existing Utilities: Locate existing utilities in demolition areas. If utilities are to remain, support and protect services during demolition operations.

Use of explosives is not permitted.

Environmental Conditions: Apply joint sealers under temperature and humidity conditions within the limits permitted by the joint sealer manufacturer.

SEQUENCE AND SCHEDULING

Coordinate the shut-off and disconnection of electrical service with the Owner and the utility company.

Notify the Engineer at least 10 days prior to commencing demolition operations.

PART 2 - PRODUCTS

ACCESS DOORS

Steel Access Doors and Frames: Factory-fabricated and assembled units, complete with attachment devices and fasteners ready for installation. Joints and seams shall be continuously welded steel, with welds ground smooth and flush with adjacent surfaces.

Frames: 16-gage steel, with a 1" wide exposed perimeter flange for units installed in unit masonry, pre-cast, or cast-in-place concrete, ceramic tile, or wood paneling.

For installation in masonry, concrete, ceramic tile, or wood paneling: 1" wide-exposed perimeter flange and adjustable metal masonry anchors.

For gypsum wallboard or plaster: perforated flanges with wallboard bead.

For full-bed plaster applications: galvanized expanded metal lath and exposed casing bead, welded to perimeter of frame.

Flush Panel Doors: 14-gage sheet steel, with concealed spring hinges or concealed continuous piano hinge set to open 175 degrees; factory-applied prime paint.

Fire-Rated Units: Insulated flush panel doors, with continuous piano hinge and self-closing mechanism.

Locking Devices: Flush, screwdriver-operated cam locks.

Locking Devices: Where indicated, provide 5-pin or 5-disc type cylinder locks, individually keyed; provide 2 keys.

Available Manufacturers: Subject to compliance with requirements, manufacturers offering products which may be incorporated in the Work include, but are not limited to, the following:

Bar-Co., Inc.
J. L. Industries.
Karp Associates, Inc.
Milcor Div. Inryco, Inc.
Nystrom, Inc.

PART 3 - EXECUTION

SELECTIVE DEMOLITION

General: Demolish, remove, demount, and disconnect abandoned electrical materials and equipment indicated to be removed and not indicated to be salvaged or saved.

Materials and Equipment To Be Salvaged: Remove, demount, and disconnect existing materials and equipment indicated to be removed and salvaged, and deliver materials and equipment to the location designated for storage.

Disposal and Cleanup: Remove from the site and legally dispose of demolished materials and equipment not indicated to be salvaged.

Electrical Materials and Equipment: Demolish, remove, demount, and disconnect the following items:

Inactive and obsolete raceway systems, controls, and fixtures.

Raceways embedded in floors, walls, and ceilings may remain if such materials do not interfere with new installations. Remove materials above accessible ceilings.

Perform cutting and patching required for demolition in accordance with Division 1 Section "Cutting and Patching."

ERECTION OF METAL SUPPORTS AND ANCHORAGE

Cut, fit, and place miscellaneous metal fabrications accurately in location, alignment, and elevation to support and anchor electrical materials and equipment.

Field Welding: Comply with AWS "Structural Welding Code."

ERECTION OF WOOD SUPPORTS AND ANCHORAGE

Cut, fit, and place wood grounds, nailers, blocking, and anchorage accurately in location, alignment, and elevation to support and anchor electrical materials and equipment.

Select fastener sizes that will not penetrate members where opposite side will be exposed to view or will receive finish materials. Make tight connections between members. Install fasteners without splitting wood members.

Attach to substrates as required to support applied loads.

APPLICATION OF JOINT SEALERS

General: Comply with joint sealer manufacturers' printed application instructions applicable to products and applications indicated, except where more stringent requirements apply.

Comply with recommendations of ASTM C 962 for use of elastomeric joint sealants.

Comply with recommendations of ASTM C 790 for use of acrylic-emulsion joint sealants.

Tooling: Immediately after sealant application and prior to time shinning or curing begins, tool sealants to form smooth, uniform beads; to eliminate air pockets; and to ensure contact and adhesion of sealant with sides of joint. Remove excess sealants from surfaces adjacent to joint. Do not use tooling agents that discolor sealants or adjacent surfaces or are not approved by sealant manufacturer.

Installation of Fire-Stopping Sealant: Install sealant, including forming, packing, and other accessory materials, to fill openings around electrical services penetrating floors and walls, to provide fire-stops with fire-resistance ratings indicated for floor or wall assembly in which penetration occurs. Comply with installation requirements established by testing and inspecting agency.

INSTALLATION OF ACCESS DOORS

Set frames accurately in position and securely attached to supports, with face panels plumb and level in relation to adjacent finish surfaces.

Adjust hardware and panels after installation for proper operation.

END OF SECTION 16050

SECTION 16100 - RACEWAYS, BOXES, AND CABINETS

PART 1 - GENERAL

RELATED DOCUMENTS

Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 1 Specification Sections, apply to this Section.

Refer to specification section 16010 for sealing requirements of smoke wall conduit penetrations.

SUMMARY

This Section includes raceways, fittings, boxes, enclosures, and cabinets for electrical wiring.

Raceways include the following:

- Rigid metal conduit.
- Intermediate metal conduit.
- Electrical metallic tubing (EMT).
- Flexible metal conduit.
- Liquidtight flexible conduit.
- Wireway.
- Surface raceways.

Boxes, enclosures, and cabinets include the following:

- Device boxes.
- 2Floor boxes.
- Outlet boxes.
- Pull and junction boxes.
- Cabinets and hinged cover enclosures.

Minimum size conduit shall be ¾".

Related Sections: The following Sections contain requirements that relate to this Section:

- Division 7 Section "Firestopping."
- Division 16 Section "Supporting Devices" for raceway and box supports.
- Division 16 Section "Cable Trays."
- Division 16 Section "Underfloor Raceways."
- Division 16 Section "Wiring Devices" for devices installed in boxes and floor box service fittings.

SUBMITTALS

General: Submit the following according to the Conditions of the Contract and Division 1 Specification Sections.

Product data for surface raceway, wireway and fittings, floor boxes, hinged cover enclosures, and cabinets.

Shop drawings for nonstandard boxes, enclosures, and cabinets. Include layout drawings showing components and wiring.

QUALITY ASSURANCE

Comply with NFPA 70 "National Electrical Code" for components and installation.

Listing and Labeling: Provide products specified in this Section that are listed and labeled.

The Terms "Listed and Labeled": As defined in the "National Electrical Code," Article 100.

Listing and Labeling Agency Qualifications: A "Nationally Recognized Testing Laboratory" (NRTL) as defined in OSHA Regulation 1910.7.

Comply with NECA: "Standard of Installation."

Coordinate layout and installation of raceway and boxes with other construction elements to ensure adequate headroom, working clearance, and access.

PART 2 - PRODUCTS

MANUFACTURERS

Available Manufacturers: Subject to compliance with requirements, manufacturers offering Products that may be incorporated in the Work include, but are not limited to, the following:

Manufacturers: Subject to compliance with requirements, provide Products by of one of the following:

Metal Conduit and Tubing:
- Alflex Corp.
- Allied Tube and Conduit, Grinnell Co.
- Anamet, Inc., Anaconda Metal Hose.
- Anixter Brothers, Inc.
- Carol Cable Co., Inc.
- Cole-Flex Corp.
- Flexcon, Inc., Coleman Cable Systems, Inc.
- Monogram Co., AFC.
- Spiraduct, Inc.
- Triangle PWC, Inc.
- Wheatland Tube Co.

Conduit Bodies and Fittings:
- American Electric, Construction Materials Group.
- Carlon.
- Emerson Electric Co., Appleton Electric Co.
- General Signal, O-Z/Gedney Unit.
- Hubbell, Inc., Killark Electric Manufacturing Co.
- Scott Fetzer Company, Adalet-PLM.
- Spring City Electrical Manufacturing Co.

Wireway:
- Hoffman Engineering Co.
- Keystone/Rees, Inc.
- Square D Co.

Surface Metal Raceway:
Airey-Thompson Co., Inc., A-T Power Systems.
American Electric, Construction Materials Group.
Butler Manufacturing Co., Walker Division.
The Wiremold Co., Electrical Sales Division.

Boxes, Enclosures, and Cabinets:
American Electric, FL Industries.
Butler Manufacturing Co., Walker Division.
Cooper Industries, Midwest Electric.
Electric Panelboard Co., Inc.
Erickson Electrical Equipment Co.
General Signal, O-Z/Gedney.
Hoffman Engineering Co., Federal-Hoffman, Inc.
Hubbell Inc., Killark Electric Manufacturing Co.
Parker Electrical Manufacturing Co.
Raco, Inc., Hubbell Inc.
Robroy Industries, Inc., Electrical Division.
Scott Fetzer Company, Adalet-PLM.
Spring City Electrical Manufacturing Co.
Square D Co.
Thomas & Betts Corp.
Woodhead Industries, Inc., Daniel Woodhead Co.

METAL CONDUIT AND TUBING

Rigid Steel Conduit: ANSI C80.1.

Intermediate Metal Conduit: ANSI C80.6.

Electrical Metallic Tubing and Fittings: ANSI C80.3 with compression-type fittings.

Flexible Metal Conduit: Aluminum.

Flexible Metal Conduit: Zinc-coated steel.

Liquidtight Flexible Metal Conduit: Flexible steel conduit with PVC jacket.

Fittings: NEMA FB 1, compatible with conduit/tubing materials.

WIREWAYS

Material: Sheet metal sized and shaped as indicated.

Fittings and Accessories: Include couplings, offsets, elbows, expansion joints, adapters, hold-down straps, end caps, and other fittings to match and mate with wireway as required for complete system.

Select features where not otherwise indicated, as required to complete wiring system and to comply with NEC.

Wireway Covers: Hinged type.

Finish: Manufacturer's standard enamel finish.

SURFACE RACEWAY

Types, sizes, and channels as indicated and required for each application, with fittings that match and mate with raceway.

Surface Metal Raceway: Galvanized steel with snap-on covers. Finish with manufacturer's standard prime coating suitable for painting.

OUTLET AND DEVICE BOXES

Sheet Metal Boxes: NEMA OS 1.

Cast Metal Boxes: NEMA FB 1, type FD, cast feralloy box with gasketed cover.

PULL AND JUNCTION BOXES

Small Sheet Metal Boxes: NEMA OS 1.

Cast Metal Boxes: NEMA FB 1, cast aluminum with gasketed cover.

CABINETS AND ENCLOSURES

Hinged Cover Enclosures: NEMA 250, steel enclosure with continuous hinge cover and flush latch. Finish inside and out with manufacturer's standard enamel.

Cabinets: NEMA 250, type 1, galvanized steel box with removable interior panel and removable front, finished inside and out with manufacturer's standard enamel. Hinged door in front cover with flush latch and concealed hinge. Key latch to match panelboards. Include metal barriers to separate wiring of different systems and voltage, and include accessory feet where required for freestanding equipment.

PART 3 - EXECUTION

EXAMINATION

Examine surfaces to receive raceways, boxes, enclosures, and cabinets for compliance with installation tolerances and other conditions affecting performance of the raceway system. Do not proceed with installation until unsatisfactory conditions have been corrected.

WIRING METHODS

Outdoors: Use the following wiring methods:

Exposed: Rigid or intermediate metal conduit.

Concealed: Rigid or intermediate metal conduit.

Connection to Vibrating Equipment (including transformers and hydraulic, pneumatic, or electric solenoid or motor-driven equipment): Liquidtight flexible metal conduit.

Boxes and Enclosures: NEMA Type 3R or Type 4.

Indoors: Use the following wiring methods:

Connection to Vibrating Equipment (including transformers and hydraulic, pneumatic, or electric solenoid or motor-driven equipment): Flexible metal conduit, except in wet or damp locations use liquidtight flexible metal conduit.

Damp or Wet Locations: Rigid steel conduit.

Exposed: Electrical metallic tubing.

Concealed: Electrical metallic tubing, intermediate metal conduit.

Boxes and Enclosures: NEMA Type 1, except in damp or wet locations use NEMA Type 4, stainless steel.

INSTALLATION

Install raceways, boxes, enclosures, and cabinets as indicated, according to manufacturer's written instructions.

Conceal conduit and EMT, unless otherwise indicated, within finished walls, ceilings, and floors.

Keep raceways at least 6 inches (150 mm) away from parallel runs of flues and steam or hot water pipes. Install horizontal raceway runs above water and steam piping.

Install raceways level and square and at proper elevations. Provide adequate headroom.

Complete raceway installation before starting conductor installation.

Support raceway as specified in Division 16 Section "Supporting Devices."

Use temporary closures to prevent foreign matter from entering raceway.

Protect stub-ups from damage where conduits rise through floor slabs. Arrange so curved portion of bends is not visible above the finished slab.

Make bends and offsets so the inside diameter is not reduced. Unless otherwise indicated, keep the legs of a bend in the same plane and the straight legs of offsets parallel.

Use raceway fittings compatible with raceway and suitable for use and location. For intermediate steel conduit, use threaded rigid steel conduit fittings, except as otherwise indicated.

Run concealed raceways with a minimum of bends in the shortest practical distance considering the type of building construction and obstructions, except as otherwise indicated.

Raceways Embedded in Slabs: Install in middle third of the slab thickness where practical, and leave at least 1 inch (25 mm) concrete cover.

Secure raceways to reinforcing rods to prevent sagging or shifting during concrete placement.

Space raceways laterally to prevent voids in the concrete.

Run conduit larger than 1-inch trade size parallel to or at right angles to main reinforcement; when at right angles to reinforcement, place conduit close to slab support.

Install exposed raceways parallel to or at right angles to nearby surfaces or structural members, and follow the surface contours as much as practical.

Run parallel or banked raceways together, on common supports where practical.

Make bends in parallel or banked runs from same center line to make bends parallel. Use factory elbows only where they can be installed parallel; otherwise, provide field bends for parallel raceways.

Join raceways with fittings designed and approved for the purpose and make joints tight.

Make raceway terminations tight. Use bonding bushings or wedges at connections subject to vibration. Use bonding jumpers where joints cannot be made tight.

Use insulating bushings to protect conductors.

Terminations: Where raceways are terminated with locknuts and bushings, align the raceway to enter squarely, and install the locknuts with dished part against the box. Where terminations cannot be made secure with one locknut, use two locknuts, one inside and one outside the box.

Where terminating in threaded hubs, screw the raceway or fitting tight into the hub so the end bears against the wire protection shoulder. Where chase nipples are used, align the raceway so the coupling is square to the box, and tighten the chase nipple so no threads are exposed.

Install pull wires in empty raceways. Use No. 14 AWG zinc-coated steel or monofilament plastic line having not less than 200-lb (90 kg) tensile strength. Leave not less than 12 inches (300 mm) of slack at each end of the pull wire.

Where conduits enter or leave hazardous locations.

Where conduits pass from warm locations to cold locations, such as the boundaries of refrigerated spaces and air- conditioned spaces.

Where otherwise required by the NEC.

Stub-Up Connections: Extend conduits through concrete floor for connection to freestanding equipment with an adjustable top or coupling threaded inside for plugs, and set flush with the finished floor. Extend conductors to equipment with rigid steel conduit; flexible metal conduit may be used 6 inches (150 mm) above the floor. Where equipment connections are not made under this Contract, install screwdriver-operated threaded flush plugs flush with floor.

Flexible Connections: Use maximum of 6 feet (1830 mm) of flexible conduit for recessed and semi-recessed lighting fixtures; for equipment subject to vibration, noise transmission, or movement; and for all motors. Use liquidtight flexible conduit in wet or damp locations. Install separate ground conductor across flexible connections.

Install nonferrous conduit or tubing for circuits operating above 60 Hz. Where aluminum raceway is installed for such circuits and it passes through concrete, install in a nonmetallic sleeve.

Surface Metal Raceway: Install a separate green ground conductor in raceway from the junction box supplying the raceway to receptacle or fixture ground terminals.

Select each surface metal raceway outlet box to which a lighting fixture is attached to be of sufficient diameter to provide a seat for the fixture canopy.

Where a surface metal raceway is used to supply a fluorescent lighting fixture having central stem suspension with a backplate and a canopy (with or without extension ring), the backplate and canopy will serve as the outlet box and no separate outlet box need be provided.

Provide surface metal raceway outlet box, in addition to the backplate and canopy, at the feed-in location of each fluorescent lighting fixture having end stem suspension.

Where a surface metal raceway extension is made from an existing outlet box on which a lighting fixture is installed (provide a backplate slightly smaller than the fixture canopy), no additional surface mounted outlet box need be installed.

Install hinged cover enclosures and cabinets plumb. Support at each corner.

Provide grounding connections for raceway, boxes, and components as indicated and instructed by manufacturer. Tighten connectors and terminals, including screws and bolts, according to equipment manufacturer's published torque-tightening values for equipment connectors. Where manufacturer's torquing requirements are not indicated, tighten connectors and terminals according to tightening torques specified in UL Standard 486A.

PROTECTION

Provide final protection and maintain conditions, in a manner acceptable to manufacturer and Installer, to ensure that coatings, finishes, and cabinets are without damage or deterioration at Substantial Completion.

Repair damage to galvanized finishes with zinc-rich paint recommended by manufacturer.

CLEANING

Upon completion of installation of system, including outlet fittings and devices, inspect exposed finish. Remove burrs, dirt, and construction debris and repair damaged finish, including chips, scratches, and abrasions.

END OF SECTION 16100

SECTION 16120 - WIRES AND CABLES

PART 1 - GENERAL

RELATED DOCUMENTS

Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 1 Specification Sections, apply to this Section.

SUMMARY

This Section includes building wires and cables and associated splices, connectors, and terminations for wiring systems rated 600 volts and less.

All Feeders and Branch Circuits shall include an equipment grounding conductor sized per NEC 250.122.

Related Sections: The following Sections contain requirements that relate to this Section:

Division 16 Section "Supporting Devices" for supports and anchors for fastening cable directly to building finishes.

Division 16 Section "Electrical Identification" for insulation color coding and wire and cable markers.

SUBMITTALS

General: Submit the following according to the Conditions of the Contract and Division 1 Specification Sections.

Field test reports indicating and interpreting test results relative to compliance with performance requirements of testing standard.

QUALITY ASSURANCE

Testing Firm Qualifications: In addition to the requirements specified in Division 1 Section "Quality Control Services," an independent testing firm shall meet OSHA criteria for accreditation of testing laboratories, Title 29, Part 1907, or shall be a full member company of the International Electrical Testing Association (NETA).

> Testing Firm's Field Supervisor Qualifications: A person currently certified by the NETA National Institute for Certification in Engineering Technologies to supervise on-site testing specified in Part 3.

Comply with NFPA 70 "National Electrical Code" for components and installation.

Listing and Labeling: Provide products specified in this Section that are listed and labeled.

> The Terms "Listed and Labeled": As defined in the "National Electrical Code," Article 100.
>
> Listing and Labeling Agency Qualifications: A "Nationally Recognized Testing Laboratory" (NRTL) as defined in OSHA Regulation 1910.7.

SEQUENCING AND SCHEDULING

Coordination: Coordinate layout and installation of cable with other installations.

Revise locations and elevations from those indicated as required to suit field conditions and as approved by the Architect.

DELIVERY, STORAGE, AND HANDLING

Deliver wire and cable according to NEMA WC-26.

PART 2 - PRODUCTS

MANUFACTURERS

Available Manufacturers: Subject to compliance with requirements, manufacturers offering products that may be incorporated in the Work include, but are not limited to, the following:

Manufacturers: Subject to compliance with requirements, provide products by one of the following:

Wires and Cables:
American Insulated Wire Corporation, Leviton Mfg. Co.
Brand-Rex Cable Systems, Brintec Corp.
Carol Cable Company, Inc.
Senator Wire & Cable Co.
Southwire Co.

Connectors for Wires and Cables:
AFC, Monogram Co.
AMP, Inc.
Anderson, Square D Co.
Electrical Products Division, 3M Co.
O-Z/Gedney Unit, General Signal.

BUILDING WIRES AND CABLES

UL-listed building wires and cables with conductor material, insulation type, cable construction, and rating as specified in Part 3 "Applications" Article.

Thermoplastic Insulation: Conform to NEMA WC 5.

Solid conductor for 10 AWG and smaller; stranded conductor for larger than 10 AWG.

CONNECTORS AND SPLICES

UL-listed factory-fabricated wiring connectors of size, ampacity rating, material, and type and class for application and for service indicated. Select to comply with Project's installation requirements and as specified in Part 3 "Applications" Article.

PART 3 - EXECUTION

EXAMINATION

Examine raceways and building finishes to receive wires and cables for compliance with installation tolerances and other conditions. Do not proceed with installation until unsatisfactory conditions have been corrected.

APPLICATIONS

Feeders: Type THHN/THWN, copper conductor, in raceway.

Branch Circuits: Type THHN/THWN, copper conductor, in raceway.

Fire Alarm Circuits: Power-limited fire protective signalling circuit cable.

Fire Alarm Circuits: Type THHN/THWN, copper conductor, in raceway.

Class 1 Control Circuits: Type THHN/THWN, copper conductor, in raceway.

Class 2 Control Circuits: Power-limited tray cable, in cable tray.

Class 2 Control Circuits: Power-limited cable, concealed in building finishes.

Class 2 Control Circuits: Type THHN/THWN, copper conductor, in raceway.

INSTALLATION

Install wires and cables as indicated, according to manufacturer's written instructions and the NECA "Standard of Installation."

Remove existing wire from raceway before pulling in new wire and cable.

Pull conductors into raceway simultaneously where more than one is being installed in same raceway.

Use pulling compound or lubricant where necessary; compound used must not deteriorate conductor or insulation.

Use pulling means; including fish tape, cable, rope, and basket-weave wire/cable grips that will not damage cables or raceway.

Install exposed cable, parallel and perpendicular to surfaces or exposed structural members, and follow surface contours where possible.

Conductor Splices: Keep to minimum.

Install splices and tapes that possess equivalent or better mechanical strength and insulation ratings than conductors being spliced.

Use splice and tap connectors that are compatible with conductor material.

Wiring at Outlets: Install with at least 12 inches (300 mm) of slack conductor at each outlet. Connect outlets and components to wiring and to ground as indicated and instructed by manufacturer. Tighten connectors and terminals, including screws and bolts, according to equipment manufacturer's published torque-tightening values for equipment connectors. Where

manufacturer's torquing requirements are not indicated, tighten connectors and terminals according to tightening torques specified in UL Standard 486A.

FIELD QUALITY CONTROL

Testing Firm: Provide the services of a qualified independent testing firm to perform specified field quality-control testing.

Testing: Upon installation of wires and cables and before electrical circuitry has been energized, demonstrate product capability and compliance with requirements.

> Procedures: Perform each visual and mechanical inspection and electrical test stated in NETA Standard ATS, Section 7.3.1. Certify compliance with test parameters.

Correct malfunctioning products at site, where possible, and retest to demonstrate compliance; otherwise, remove and replace with new units, and retest.

END OF SECTION 16120

SECTION 16140 - WIRING DEVICES

PART 1 - GENERAL

RELATED DOCUMENTS

Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 1 Specification Sections, apply to this Section.

SUMMARY

This Section includes various types of receptacles, connectors, switches, and finish plates.

SUBMITTALS

Submit the following according to the Conditions of the Contract and Division 1 Specification Sections.

Product data for each product specified.

Samples of devices and device plates for color selection and evaluation of technical features.

Operation and maintenance data for materials and products specified in this Section to include in the "Operating and Maintenance Manual" specified in Division 1.

QUALITY ASSURANCE

Comply with NFPA 70 "National Electrical Code" for devices and installation.

Listing and Labeling: Provide products that are listed and labeled for their applications and installation conditions and for the environments in which installed.

The Terms "Listed" and "Labeled": As defined in the "National Electrical Code," Article 100.

Listing and Labeling Agency Qualifications: A "Nationally Recognized Testing Laboratory" (NRTL) as defined in OSHA Regulation 1910.7.

COORDINATION

Wiring Devices for Owner Furnished Equipment: Match devices to plug connectors for Owner-furnished equipment.

Cord and Plug Sets: Match cord and plug sets to equipment requirements.

PART 2 - PRODUCTS

MANUFACTURERS

Available Manufacturers: Subject to compliance with requirements, manufacturers offering products that may be incorporated in the Work include, but are not limited to, the following:

Manufacturers: Subject to compliance with requirements, provide products by one of the following:

Wiring Devices:
- Arrow Hart Div., Cooper Industries.
- Bryant Electric, Inc.
- Challenger Electrical Equipment Co.
- Eagle Electric Mfg. Co., Inc.
- General Electric Co.
- Hubbell Inc.
- Killark Electrical Mfg. Co.
- Leviton Mfg. Co., Inc.
- Pass & Seymour/Legrand.
- Pyle-National Co.
- Slater Electric, Inc.

Wiring Devices for Hazardous (Classified) Locations:
- Crouse-Hinds Electrical Construction.
- Killark Electrical Mfg. Co.
- Pyle-National Co.

Multi-Outlet Assemblies:
- Airey-Thompson Co., Inc.
- Dual-Lite.
- Isoduct Energy Systems.
- Kellems Div., Hubbell, Inc.
- Wiremold Co.

Poke-Through, Floor Service Outlets, and Telephone/Power Poles:
- American Electric.
- Hubbell, Inc.
- Pass & Seymour/LeGrand.
- Square D Co.
- Walker Div., Butler Mfg. Co.
- Wiremold Co.

WIRING DEVICES

Comply with NEMA Standard WD 1, "General Purpose Wiring Devices."

Enclosures: NEMA 1 equivalent, except as otherwise indicated.

Color: Ivory except as otherwise indicated or required by Code.

Receptacles, Straight-Blade and Locking Type: Comply with UL Standard 498, "Electrical Attachment Plugs and Receptacles," heavy-duty grade except as otherwise indicated.

Receptacles, Straight-Blade, Hospital Grade: Listed and labeled for compliance with Hospital Grade of UL Standard 498, "Electrical Attachment Plug and Receptacle," and Federal Specification W-C-598.

Receptacles, Straight-Blade, Special Features: Comply with the basic requirements specified above for straight-blade receptacles of the class and type indicted, and with the following additional requirements:

Ground-Fault Circuit Interrupter (GFCI) Receptacles: UL Standard 943, "Ground Fault Circuit Interrupters," feed- through type, with integral NEMA 5-20R duplex receptacle arranged to protect connected downstream receptacles on the same circuit. Design units for installation in a 2-3/4-inch (70-mm) deep outlet box without an adapter.

Isolated Ground Receptacles: Equipment grounding contacts are connected only to the green grounding screw terminal of the device and have inherent electrical isolation from the mounting strap.

Devices: Listed and labeled as isolated ground receptacles.

Isolation Method: Integral to the receptacle construction and not dependent on removable parts.

Transient-Voltage Surge-Suppressor (TVSS) Receptacles: Duplex type, NEMA 5-20R configuration, with integral transient-voltage surge protection in a minimum of 3 modes: line-to-ground, line-to-neutral, and neutral-to-ground; listed as complying with UL Standard 1449 "Transient Voltage Surge Suppressors."

Surge Protection Components: Multiple metal-oxide varistors, rated for 500 V transient suppression voltage nominal clamp level and minimum single transient pulse energy dissipation of 140 J, line-to- neutral, and 70 J, line-to-ground and neutral-to- ground.

Active Protection Indication: A light visible in the face of the device indicates the state of the device as "active" or "no longer active."

Identification: Distinctive marking on face of device denotes transient-voltage surge-suppressor type unit.

Receptacles, Industrial Heavy-Duty: Conform to NEMA Standard PK 4 "Plugs, Receptacles, and Cable Connectors of the Pin and Sleeve Type for Industrial Use."

Receptacles in Hazardous (Classified) Locations: Comply with NEMA Standard FB 11 "Plugs, Receptacles, and Connectors of the Pin and Sleeve Type for Hazardous Locations" and UL Standard 1010 "Receptacle-Plug Combinations for Use in Hazardous (Classified) Locations."

Pendant Cord/Connector Devices: Matching, locking type, plug and plug receptacle body connector, NEMA L5-20P and L5-20R, heavy- duty grade.

Bodies: Nylon with screw-open cable-gripping jaws and provision for attaching external cable grip.

External Cable Grip: Woven wire mesh type made of high- strength galvanized-steel wire strand and matched to cable diameter and with attachment provision designed for the corresponding connector.

Cord and Plug Sets: Match voltage and current ratings and number of conductors to requirements of the equipment being connected.

Cord: Rubber-insulated, stranded copper conductors, with type SOW-A jacket. Grounding conductor has green insulation. Ampacity is equipment rating plus 30 percent minimum.

Plug: Male configuration with nylon body and integral cable- clamping jaws. Match to cord and to receptacle type intended for connection.

Snap Switches: Quiet-type a.c. switches, NRTL listed and labeled as complying with UL Standard 20 "General Use Snap Switches," and with Federal Specification W-S-896.

Combination Switch and Receptacle: Both devices in a single gang unit with plaster ears and removable tab connector that permits separate or common feed connection.

Switch: 20 ampere, 120-277 V a.c.

Receptacle: NEMA configuration 5-15R.

Snap Switches in Hazardous (Classified) Locations: Comply with UL Standard 894, "Switches for Use in Hazardous (Classified) Locations."

Wall Plates: Single and combination types that mate and match with corresponding wiring devices. Features include the following:

Color: Matches wiring device except as otherwise indicated.

Plate-Securing Screws: Metal with heads colored to match plate finish.

Material for Finished Spaces: Ivory plastic, except as otherwise indicated.

PART 3 - EXECUTION

INSTALLATION

Install devices and assemblies plumb and secure.

Install wall plates when painting is complete.

Arrangement of Devices: Except as otherwise indicated, mount flush, with long dimension vertical, and grounding terminal of receptacles on top. Group adjacent switches under single, multi-gang wall plates.

Protect devices and assemblies during painting.

Adjust locations at which floor service outlets and telephone/power service poles are installed to suit the indicated arrangement of partitions and furnishings.

IDENTIFICATION

Comply with Division 16 Section "Electrical Identification."

Switches: Where 3 or more switches are ganged, and elsewhere where indicated, identify each switch with approved legend engraved on wall plate.

Receptacles: Identify the panelboard and circuit number from which served. Use machine-printed, pressure-sensitive, abrasion-resistant label tape on face of plate and durable wire markers or tags within outlet boxes.

GROUNDING

Isolated Ground Receptacles: Connect to isolated grounding conductor routed to designated isolated equipment ground terminal of electrical system.

FIELD QUALITY CONTROL

Testing: Test wiring devices for proper polarity and ground continuity. Operate each operable device at least 6 times.

Check TVSS receptacle indicating lights for normal indication.

Test ground-fault circuit interrupter operation with both local and remote fault simulations according to manufacturer recommendations.

Replace damaged or defective components.

CLEANING

General: Internally clean devices, device outlet boxes, and enclosures. Replace stained or improperly painted wall plates or devices.

END OF SECTION 16140

SECTION 16142 - ELECTRICAL CONNECTIONS FOR EQUIPMENT

PART 1 - GENERAL

RELATED DOCUMENTS:

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

This section is a Division-16 Basic Electrical Materials and Methods section, and is part of each Division-15 and -16 section making reference to electrical connections for equipment specified herein.

DESCRIPTION OF WORK:

Extent of electrical connections for equipment is indicated by drawings and schedules. Electrical connections are hereby defined to include connections used for providing electrical power to equipment.

Applications of electrical power connections specified in this section include the following:

To resistive heaters.
From electrical source to motor starters.
To grounds including earthing connections.

Junction boxes and disconnect switches required for connecting motors and other electrical units of equipment are specified in applicable Division-16 sections, and are work of this section.

Raceways and wires/cables required for connecting motors and other electrical units of equipment are specified in applicable Division-16 sections, and are work of this section.

Refer to other Division-16 sections for junction boxes and disconnect switches required for connecting motors and other electrical units of equipment; not work of this section.

Refer to Division-15 sections for control system wiring; not work of this section.

Refer to sections of other Divisions for specific individual equipment power requirements, not work of this section.

QUALITY ASSURANCE:

Manufacturers: Firms regularly engaged in manufacture of electrical connectors and terminals, of types and ratings required, and ancillary connection materials, including electrical insulating tape, soldering fluxes, and cable ties, whose products have been in satisfactory use in similar service for not less than 5 years.

Installer's Qualifications: Firms with at least 2 years of successful installation experience with projects utilizing electrical connections for equipment similar to that required for this project.

NEC Compliance: Comply with applicable requirements of NEC as to type products used and installation of electrical power connections (terminals and splices), for junction boxes, motor starters, and disconnect switches.

IEEE Compliance: Comply with Std 241, "IEEE Recommended Practice for Electric Power Systems in Commercial Buildings" pertaining to connections and terminations.

ANSI Compliance: Comply with applicable requirements of ANSI/NEMA and ANSI/EIA standards pertaining to products and installation of electrical connections for equipment.

UL Compliance: Comply with UL Std 486A, "Wire Connectors and Soldering Lugs for Use With Copper Conductors" including, but not limited to, tightening of electrical connectors to torque values indicated. Provide electrical connection products and materials which are UL-listed and labeled.

ETL Compliance: Provide electrical connection products and materials which are ETL-listed and labeled.

SUBMITTALS:

Product Data: Submit manufacturer's data on electrical connections for equipment products and materials.

DELIVERY, STORAGE, AND HANDLING:

Deliver electrical connection products wrapped in proper factory-fabricated type containers.

Store electrical connection products in original cartons and protect from weather, construction traffic and debris.

Handle electrical connection products carefully to prevent breakage, denting, and scoring finish.

PART 2 - PRODUCTS

ACCEPTABLE MANUFACTURERS:

Available Manufacturers: Subject to compliance with requirements, manufacturers offering products which may be incorporated in the work include, but are not limited to, the following:

Adalet-PLM Div, Scott and Fetzer Co.
Allen-Stevens Conduit Fittings Corp.
AMP Incorported.
Appleton Electric Co.
Arrow-Hart Div, Crouse-Hinds Co.
Atlas Technologies, Inc.
Bishop Div, General Signal Corp.
Burndy Corporation.
Eagle Electric Mfg Co., Inc.
Electroline Mfg Co.
Gardner Bender, Inc.
General Electric Co. Gould, Inc.
Gould, Inc.
Harvey Hubbell Inc.
Ideal Industries, Inc.
Pyle National Co.
Reliable Electric Co.
Square D Company.

Thomas and Betts Corp.

MATERIALS AND COMPONENTS

General: For each electrical connection indicated, provide complete assembly of materials, including but not necessarily limited to, pressure connectors, terminals (lugs), electrical insulating tape, electrical solder, electrical soldering flux, heat-shrinkable insulating tubing, cable ties, solderless wire-nuts, and other items and accessories as needed to complete splices and terminations of types indicated.

Metal Conduit, Tubing and Fittings:

General: Provide metal conduit, tubing and fittings of types, grades, sizes and weights (wall thicknesses) indicated for each type service. Where types and grades are not indicated, provide proper selection as determined by Installer to fulfill wiring requirements and comply with NEC requirements for raceways. Provide products complying with Division-16 basic electrical materials and methods section "Raceways", and in accordance with the following listing of metal conduit, tubing and fittings:

Rigid steel conduit.
Rigid metal conduit fittings.
Electrical metallic tubing.
EMT fittings.
Flexible metal conduit.
Flexible metal conduit fittings.
Liquid-tight flexible metal conduit.
Liquid-tight flexible metal conduit fittings.

Wires, Cables, and Connectors:

General: Provide wires, cables, and connectors complying with Division-16 basic electrical materials and methods section "Wires and Cables".

Wires/Cables: Unless otherwise indicated, provide wires/cables (conductors) for electrical connections which match, including sizes and ratings, of wires/cables which are supplying electrical power. Provide copper conductors with conductivity of not less than 98% at 20 deg. C (68 deg. F).

Connectors and Terminals: Provide electrical connectors and terminals which mate and match, including sizes and ratings, with equipment terminals and are recommended by equipment manufacturer for intended applications.

Electrical Connection Accessories: Provide electrical insulating tape, heat-shrinkable insulating tubing and boots, electrical solder, electrical soldering flux, wirenuts, and cable ties as recommended for use by accessories manufacturers for type services indicated.

PART 3 - EXECUTION

INSPECTION:

Inspect area and conditions under which electrical connections for equipment are to be installed and notify Contractor in writing of conditions detrimental to proper completion of the work. Do

not proceed with the work until unsatisfactory conditions have been corrected in a manner acceptable to Installer.

INSTALLATION OF ELECTRICAL CONNECTIONS:

Install electrical connections as indicated; in accordance with equipment manufacturer's written instructions and with recognized industry practices, and complying with applicable requirements of UL, NEC and NECA's "Standard of Installation" to ensure that products fulfill requirements.

Coordinate with other work, including wires/cables, raceway and equipment installation, as necessary to properly interface installation of electrical connections for equipment with other work.

Connect electrical power supply conductors to equipment conductors in accordance with equipment manufacturer's written instructions and wiring diagrams. Mate and match conductors of electrical connections for proper interface between electrical power supplies and installed equipment.

Cover splices with electrical insulating material equivalent to, or of greater insulation resistivity rating, than electrical insulation rating of those conductors being spliced.

Prepare cables and wires, by cutting and stripping covering armor, jacket, and insulation properly to ensure uniform and neat appearance where cables and wires are terminated. Exercise care to avoid cutting through tapes which will remain on conductors. Also avoid "ringing" copper conductors while skinning wire.

Trim cables and wires as short as practicable and arrange routing to facilitate inspection, testing and maintenance.

Tighten connectors and terminals, including screws and bolts, in accordance with equipment manufacturers published torque tightening values for equipment connectors. Accomplish tightening by utilizing proper torquing tools, including torque screwdriver, beam-type torque wrench, and ratchet wrench with adjustable torque settings. Where manufacturer's torquing requirements are not available, tighten connectors and terminals to comply with torquing values contained in UL's 486A.

Provide flexible conduit for motor connections, and other electrical equipment connections, where subject to movement and vibration.

Provide liquid-tight flexible conduit for connection of motors and other electrical equipment where subject to movement and vibration, and also where connections are subjected to one or more of the following conditions:

Exterior location.
Moist or humid atmosphere where condensate can be expected to accumulate.
Water spray.
Dripping oil, grease, or water.

Fasten identification markers to each electrical power supply wire/cable conductor which indicates their voltage, phase and feeder number in accordance with Division-16 section "Electrical Identification". Affix markers on each terminal conductor, as close as possible to the point of connection.

FIELD QUALITY CONTROL

Upon completion of installation of electrical connections, and after circuitry has been energized with rated power source, test connections to demonstrate capability and compliance with requirements. Ensure that direction of rotation of each motor fulfills requirement. Correct malfunctioning units at site, then retest to demonstrate compliance.

END OF SECTION 16142

SECTION 16190 - SUPPORTING DEVICES

PART 1 - GENERAL

RELATED DOCUMENTS

Drawings and general provisions of Contract, including General and Supplementary Conditions and Division 1 Specification Sections, apply to this Section.

Requirements of the following Division 16 Sections apply to this section:

Basic Electrical Requirements
Basic Electrical Materials and Methods

SUMMARY

This Section includes secure support from the building structure for electrical items by means of hangers, supports, anchors, sleeves, inserts, seals, and associated fastenings.

Related Sections: The following Sections contain requirements that relate to this Section:

Division 5 Section "Metal Fabrications" for requirements for miscellaneous metal items involved in supports and fastenings.

Division 7 Section "Joint Sealers" for requirements for firestopping at sleeves through walls and floors that are fire barriers.

Refer to other Division 16 sections for additional specific support requirements that may be applicable to specific items.

SUBMITTALS

General: Submit the following in accordance with Conditions of Contract and Division 1 Specification Sections.

Product data for each type of product specified.

Hanger and support schedule showing manufacturer's figure number, size, spacing, features, and application for each required type of hanger, support, sleeve, seal, and fastener to be used.

Shop drawings indicating details of fabricated products and materials.

Engineered Design consisting of details and engineering analysis for supports for the following items:

QUALITY ASSURANCE

Electrical Component Standard: Components and installation shall comply with NFPA 70 "National Electrical Code."

Electrical components shall be listed and labeled by UL, ETL, CSA, or other approved, nationally recognized testing and listing agency that provides third-party certification follow-up services.

PART 2 - PRODUCTS

MANUFACTURERS

Available Manufacturers: Subject to compliance with requirements, manufacturers offering products that may be incorporated in the Work include, but are not limited to, the following:

Manufacturers: Subject to compliance with requirements, provide products by the following:

Slotted Metal Angle and U-Channel Systems:
- Allied Tube & Conduit
- American Electric
- B-Line Systems, Inc.
- Cinch Clamp Co., Inc.
- GS Metals Corp.
- Haydon Corp.
- Kin-Line, Inc.
- Unistrut Diversified Products

Conduit Sealing Bushings:
- Bridgeport Fittings, Inc.
- Cooper Industries, Inc.
- Elliott Electric Mfg. Corp.
- GS Metals Corp.
- Killark Electric Mfg. Co.
- Madison Equipment Co.
- L. E. Mason Co.
- O-Z/Gedney
- Producto Electric Corp.
- Raco, Inc.
- Red Seal Electric Corp.
- Spring City Electrical Mgf. Co.
- Thomas & Betts Corp.

COATINGS

Coating: Supports, support hardware, and fasteners shall be protected with zinc coating or with treatment of equivalent corrosion resistance using approved alternative treatment, finish, or inherent material characteristic. Products for use outdoors shall be hot-dip galvanized.

MANUFACTURED SUPPORTING DEVICES

Raceway Supports: Clevis hangers, riser clamps, conduit straps, threaded C-clamps with retainers, ceiling trapeze hangers, wall brackets, and spring steel clamps.

Fasteners: Types, materials, and construction features as follows:

Expansion Anchors: Carbon steel wedge or sleeve type.

Toggle Bolts: All steel springhead type.

Powder-Driven Threaded Studs: Heat-treated steel, designed specifically for the intended service.

Conduit Sealing Bushings: Factory-fabricated watertight conduit sealing bushing assemblies suitable for sealing around conduit, or tubing passing through concrete floors and walls. Construct seals with steel sleeve, malleable iron body, neoprene sealing grommets or rings, metal pressure rings, pressure clamps, and cap screws.

Cable Supports for Vertical Conduit: Factory-fabricated assembly consisting of threaded body and insulating wedging plug for nonarmored electrical cables in riser conduits. Provide plugs with number and size of conductor gripping holes as required to suit individual risers. Construct body of malleable-iron casting with hot-dip galvanized finish.

U-Channel Systems: 16-gage steel channels, with 9/16-inch-diameter holes, at a minimum of 8 inches on center, in top surface. Provide fittings and accessories that mate and match with U-channel and are of the same manufacture.

FABRICATED SUPPORTING DEVICES

General: Shop- or field-fabricated supports or manufactured supports assembled from U-channel components.

Steel Brackets: Fabricated of angles, channels, and other standard structural shapes. Connect with welds and machine bolts to form rigid supports.

Pipe Sleeves: Provide pipe sleeves of one of the following:

Sheet Metal: Fabricate from galvanized sheet metal; round tube closed with snaplock joint, welded spiral seams, or welded longitudinal joint. Fabricate sleeves from the following gage metal for sleeve diameter noted:

3-inch and smaller: 20-gage.
4-inch to 6-inch: 16-gage.
over 6-inch: 14-gage.

Steel Pipe: Fabricate from Schedule 40 galvanized steel pipe.

PART 3 - EXECUTION

INSTALLATION

Install supporting devices to fasten electrical components securely and permanently in accordance with NEC requirements.

Coordinate with the building structural system and with other electrical installation.

Raceway Supports: Comply with the NEC and the following requirements:

Conform to manufacturer's recommendations for selection and installation of supports.

Strength of each support shall be adequate to carry present and future load multiplied by a safety factor of at least four. Where this determination results in a safety allowance of less than 200 lbs, provide additional strength until there is a minimum of 200 lbs safety allowance in the strength of each support.

Install individual and multiple (trapeze) raceway hangers and riser clamps as necessary to support raceways. Provide U-bolts, clamps, attachments, and other hardware necessary for hanger assembly and for securing hanger rods and conduits.

Support parallel runs of horizontal raceways together on trapeze-type hangers.

Support individual horizontal raceways by separate pipe hangers. Spring steel fasteners may be used in lieu of hangers only for 1-1/2-inch and smaller raceways serving lighting and receptacle branch circuits above suspended ceilings only. For hanger rods with spring steel fasteners, use 1/4-inch-diameter or larger threaded steel. Use spring steel fasteners that are specifically designed for supporting single conduits or tubing.

Space supports for raceways in accordance with Table I of this section. Space supports for raceway types not covered by the above in accordance with NEC.

Support exposed and concealed raceway within 1 foot of an unsupported box and access fittings. In horizontal runs, support at the box and access fittings may be omitted where box or access fittings are independently supported and raceway terminals are not made with chase nipples or threadless box connectors.

In vertical runs, arrange support so the load produced by the weight of the raceway and the enclosed conductors is carried entirely by the conduit supports with no weight load on raceway terminals.

Vertical Conductor Supports: Install simultaneously with installation of conductors.

Miscellaneous Supports: Support miscellaneous electrical components as required to produce the same structural safety factors as specified for raceway supports. Install metal channel racks for mounting cabinets, panelboards, disconnects, control enclosures, pull boxes, junction boxes, transformers, and other devices.

In open overhead spaces, cast boxes threaded to raceways need not be supported separately except where used for fixture support; support sheet metal boxes directly from the building structure or by bar hangers. Where bar hangers are used, attach the bar to raceways on opposite sides of the box and support the raceway with an approved type of fastener not more than 24 inches from the box.

Sleeves: Install in concrete slabs and walls and all other fire-rated floors and walls for raceways and cable installations. For sleeves through fire rated-wall or floor construction, apply UL-listed firestopping sealant in gaps between sleeves and enclosed conduits and cables in accordance with "Fire Resistant Joint Sealers" requirement of Division 7 Section "Joint Sealers."

Conduit Seals: Install seals for conduit penetrations of slabs on grade and exterior walls below grade and where indicated. Tighten sleeve seal screws until sealing grommets have expanded to form watertight seal.

Fastening: Unless otherwise indicated, fasten electrical items and their supporting hardware securely to the building structure, including but not limited to conduits, raceways, cables, cable trays, busways, cabinets, panelboards, transformers, boxes, disconnect switches, and control components in accordance with the following:

Fasten by means of wood screws or screw-type nails on wood, toggle bolts on hollow masonry units, concrete inserts or expansion bolts on concrete or solid masonry, and machine screws, welded threaded studs, or spring-tension clamps on steel. Threaded studs driven by a powder charge and provided with lock washers and nuts may be used instead of expansion bolts and machine or wood screws. Do not weld conduit, pipe straps, or items other than threaded studs to steel structures. In partitions of light steel construction, use sheet metal screws.

Holes cut to depth of more than 1-1/2 inches in reinforced concrete beams or to depth of more than 3/4 inch in concrete shall not cut the main reinforcing bars. Fill holes that are not used.

Ensure that the load applied to any fastener does not exceed 25 percent of the proof test load. Use vibration- and shock-resistant fasteners for attachments to concrete slabs.

TESTS

Test pull-out resistance of one of each type, size, and anchorage material for the following fastener types:

Expansion anchors.

Toggle bolts.

Powder-driven threaded studs.

Provide all jacks, jigs, fixtures, and calibrated indicating scales required for reliable testing. Obtain the structural Engineer's approval before transmitting loads to the structure. Test to 90 percent of rated proof load for fastener. If fastening fails test, revise all similar fastener installations and retest until satisfactory results are achieved.

TABLE I: SPACING FOR RACEWAY SUPPORTS

Raceway Size (Inches)	No. of Conductors in Run	Location	Maximum Spacing of Size Supports (Feet) RMC&IMC*	EMTRNC
HORIZONTAL RUNS				
1/2,3/4	1 or 2	Flat ceiling or wall.	5	53
1/2,3/4	1 or 2	Where it is difficult to provide supports except at intervals fixed by the building construction.	7	7...
1/2,3/4	3 or more	Any location.	7	7...
1/2-1	3 or more	Any location.		
1 & larger	1 or 2	Flat ceiling or wall.	6	6...
1 & larger	1 or 2	Where it is difficult to provide supports except at intervals fixed by the building construction.	10	10...
1 & larger	3 or more	Any location.	10	10...
Any	....	Concealed.	10	10...
VERTICAL RUNS				
1/2,3/4	....	Exposed.	7	7...
1,1-1/4	....	Exposed.	8	8...
1-1/2 & larger	....	Exposed.	10	10...
Up to 2	....	Shaftway.	14	10...
2-1/2	....	Shaftway.	16	10...
3 & larger	....	Shaftway.	20	10...
Any	....	Concealed.	10	10...

* Maximum spacings for IMC above apply to straight runs only. Otherwise the maximums for EMT apply.

Abbreviations: EMT Electrical metallic tubing.
IMC Intermediate metallic conduit.
RMC Rigid metallic conduit.

END OF SECTION 16190

SECTION 16195 – ELECTRICAL IDENTIFICATION

PART 1 - GENERAL

RELATED DOCUMENTS

Drawings and general provisions of Contract, including General and Supplementary Conditions and Division 1 Specification Sections, apply to this Section.

Requirements of the following Division 16 Sections apply to this section:

Basic Electrical Requirements.
Basic Electrical Materials and Methods.

SUMMARY

This Section includes identification of electrical materials, equipment, and installations. It includes requirements for electrical identification components including but not limited to the following:

Identification labeling for raceways, cables, and conductors.
Operational instruction signs.
Warning and caution signs.
Equipment labels and signs.

Related Sections: The following Sections contain requirements that relate to this Section:

Division 9 Section "Painting" for related identification requirements.

Division 16 Section "Wires and Cables" for requirements for color coding of conductors for phase identification.

Refer to other Division 16 sections for additional specific electrical identification associated with specific items.

SUBMITTALS

General: Submit the following in accordance with Conditions of Contract and Division 1 Specification Sections.

Product Data for each type of product specified.

Schedule of identification nomenclature to be used for identification signs and labels.

Samples of each color, lettering style, and other graphic representation required for identification materials; samples of labels and signs.

QUALITY ASSURANCE

Electrical Component Standard: Components and installation shall comply with NFPA 70 "National Electrical Code."

ANSI Compliance: Comply with requirements of ANSI Standard A13.1, "Scheme for the Identification of Piping Systems," with regard to type and size of lettering for raceway and cable labels.

PART 2 - PRODUCTS

MANUFACTURERS

Available Manufacturers: Subject to compliance with requirements, manufacturers offering products that may be incorporated in the Work include, but are not limited to, the following:

Manufacturers: Subject to compliance with requirements, provide products by the following:

American Labelmark Co.
Calpico, Inc.
Cole-Flex Corp.
Emed Co., Inc.
George-Ingraham Corp.
Ideal Industries, Inc.
Kraftbilt
LEM Products, Inc.
Markal Corp.
National Band and Tag Co.
Panduit Corp.
Radar Engineers Div., EPIC Corp.
Seton Name Plate Co.
Standard Signs, Inc.
W. H. Brady, Co.

ELECTRICAL IDENTIFICATION PRODUCTS

Adhesive Marking Labels for Raceway and Metal-clad Cable: Pre-printed, flexible, self-adhesive labels with legend indicating voltage and service (Life Safety, Critical, Normal Lighting, Power, Light, Power d.c., Air Conditioning, Communications, Control, Fire).

Label Size: as follows:

Raceways 1-Inch and Smaller: 1-1/8 inches high by 4 inches long.

Raceways Larger than 1-Inch: 1-1/8 inches high by 8 inches long.

Color: Black legend on orange background.

Colored Adhesive Marking Tape for Raceways, Wires, and Cables: Self-adhesive vinyl tape not less than 3 mils thick by 1 inch to 2 inches in width.

Pretensioned Flexible Wraparound Colored Plastic Sleeves for Raceway and Cable Identification: Flexible acrylic bands sized to suit the raceway diameter and arranged to stay in place by pre-tensioned gripping action when coiled around the raceway or cable.

Wire/Cable Designation Tape Markers: Vinyl or vinyl-cloth, self-adhesive, wraparound, cable/conductor markers with preprinted numbers and letter.

Engraved, Plastic-Laminated Labels, Signs, and Instruction Plates: Engraving stock melamine plastic laminate, 1/16-inch minimum thick for signs up to 20 square inches, or 8 inches in length; 1/8-inch thick for larger sizes. Engraved legend in white letters on black face and punched for mechanical fasteners.

Baked-Enamel Warning and Caution Signs for Interior Use: Preprinted aluminum signs, punched for fasteners, with colors, legend, and size appropriate to the location.

Exterior Metal-Backed Butyrate Warning and Caution Signs: Weather- resistant, nonfading, preprinted cellulose acetate butyrate signs with 20-gage, galvanized steel backing, with colors, legend, and size appropriate to the location. Provide 1/4-inch grommets in corners for mounting.

Fasteners for Plastic-Laminated and Metal Signs: Self-tapping stainless steel screws or number 10/32 stainless steel machine screws with nuts and flat and lock washers.

Cable Ties: Fungus-inert, self-extinguishing, one-piece, self-locking nylon cable ties, 0.18-inch minimum width, 50-lb minimum tensile strength, and suitable for a temperature range from minus 50 deg F to 350 deg F. Provide ties in specified colors when used for color coding.

PART 3 - EXECUTION

INSTALLATION

Lettering and Graphics: Coordinate names, abbreviations, colors, and other designations used in electrical identification work with corresponding designations specified or indicated. Install numbers, lettering, and colors as approved in submittals and as required by code.

Install identification devices in accordance with manufacturer's written instructions and requirements of NEC.

Sequence of Work: Where identification is to be applied to surfaces that require finish, install identification after completion of finish work.

CONDUIT IDENTIFICATION

Identify high-voltage feeder conduits (over 600 V) by words "DANGER-HIGH VOLTAGE" in black letters 2 inches high, stenciled at 10-foot intervals over continuous painted orange background.

The following areas shall be identified:

On entire floor area directly above conduits running beneath and within 12 inches of a basement or ground floor that is in contact with earth or is framed above unexcavated space.

On wall surfaces directly external to conduits run concealed within wall.

On all accessible surfaces of concrete envelope around conduits in vertical shafts, exposed at ceilings or concealed above suspended ceilings.

On entire surface of exposed conduits.

Apply identification to areas as follows:

Clean surface of dust, loose material, and oily films before painting.

Prime surfaces: For galvanized metal, use single- component acrylic vehicle coating formulated for galvanized surfaces. For concrete masonry units, use heavy-duty acrylic resin block filler. For concrete surfaces, use clear alkali-resistant alkyd binder-type sealer.

Apply one intermediate and one finish coat of orange silicone alkyd enamel.

Apply primer and finish materials in accordance with manufacturer's instructions.

Identify Raceways of Certain Systems with Color Banding: Band exposed or accessible raceways of the following systems for identification. Bands shall be pretensioned, snap-around colored plastic sleeves, colored adhesive marking tape, or a combination of the two. Make each color band 2 inches wide, completely encircling conduit, and place adjacent bands of two-color markings in contact, side by side. Install bands at changes in direction, at penetrations of walls and floors, and at 10-foot maximum intervals in straight runs. Apply the following colors:

Fire Alarm System: Red
Security System: Blue and Yellow
Life Safety: Yellow
Equipment: Green
Telephone System: Green and Yellow
Normal Power: Blue
Critical Power: Orange

Identify Junction, Pull, and Connection Boxes: Identify with colored paint identical to raceways. (Fire Alarm = red, Life Safety = yellow, Equipment = green, Critical = orange, etc.). Provide nameplate on each cover with circuit and panel designation.

Conductor Color Coding: Provide color coding for secondary service, feeder, and branch circuit conductors throughout the project secondary electrical system as follows:

208/120 Volts	Phase	277/480 Volts
Black	A	Yellow
Red	B	Brown
Blue	C	Orange
White	Neutral	Natural Gray
Green	Ground	Green

Use conductors with color factory-applied the entire length of the conductors except as follows:

The following field-applied color-coding methods may be used in lieu of factory-coded wire for sizes larger than No. 10 AWG:

Apply colored, pressure-sensitive plastic tape in half-lapped turns for a distance of 6 inches from terminal points and in boxes where splices or taps are made. Apply the last two laps of tape with no tension to prevent possible unwinding. Use 1-inch-wide tape in colors as specified. Do not obliterate cable identification markings by taping. Tape locations may be adjusted slightly to prevent such obliteration.

In lieu of pressure-sensitive tape, colored cable ties may be used for color identification. Apply three ties of specified color to each wire at each terminal or splice point starting 3 inches from the terminal and spaced 3 inches apart. Apply with a special tool or pliers, tighten for snug fit, and cut off excess length.

Power Circuit Identification: Securely fasten identifying metal tags or aluminum wraparound marker bands to cables, feeders, and power circuits in vaults, pull boxes, junction boxes, manholes, and switchboard rooms with 1/4-inch steel letter and number stamps with legend to correspond with designations on Drawings. If metal tags are provided, attach them with approximately 55-lb test monofilament line or one-piece self-locking nylon cable ties.

Tag or label conductors as follows:

Future Connections: Conductors indicated to be for future connection or connection under another contract with identification indicating source and circuit numbers.

Multiple Circuits: Where multiple branch circuits or control wiring or communications/signal conductors are present in the same box or enclosure (except for three-circuit, four-wire home runs), label each conductor or cable. Provide legend indicating source, voltage, circuit number, and phase for branch circuit wiring. Phase and voltage of branch circuit wiring may be indicated by mean of coded color of conductor insulation. For control and communications/ signal wiring, use color coding or wire/cable-marking tape at terminations and at intermediate locations where conductors appear in wiring boxes, troughs, and control cabinets. Use consistent letter/number conductor designations throughout on wire/cable marking tapes.

Match identification markings with designations used in panelboards shop drawings, Contract Documents, and similar previously established identification schemes for the facility's electrical installations.

Apply warning, caution, and instruction signs and stencils as follows:

Install warning, caution, or instruction signs where required by NEC, where indicated, or where reasonably required to assure safe operation and maintenance of electrical systems and of the items to which they connect. Install engraved plastic-laminated instruction signs with approved legend where instructions or explanations are needed for system or equipment operation. Install butyrate signs with metal backing for outdoor items.

Emergency Operating Signs: Install engraved laminate signs with white legend on red background with minimum 3/8-inch high lettering for emergency instructions on power transfer, load shedding, or other emergency operations,

Install equipment/system circuit/device identification as follows:

Apply equipment identification labels of engraved plastic-laminate on each major unit of electrical equipment in building, including central or master unit of each electrical system. This includes communication/signal/alarm systems, unless unit is specified with its own self-explanatory identification. Except as otherwise indicated, provide single line of text, with 1/2-inch-high lettering on 1-1/2-inch-high label (2-inch-high where two lines are required), white lettering in black field. Text shall match terminology and numbering of the Contract Documents and shop drawings. Apply labels for each unit of the following categories of electrical equipment.

Panelboards, electrical cabinets, and enclosures. Access doors and panels for concealed electrical items. Electrical switchgear and switchboards.

Electrical substations
Motor control centers
Motor starters
Pushbutton stations
Power transfer equipment

Contactors
Remote-controlled switches
Dimmers
Control devices
Transformers
Inverters

Rectifiers
Frequency converters
Battery racks
Power generating units
Telephone switching equipment
Clock/program master equipment
Call system master station
TV/audio monitoring master station
Fire alarm master station or control panel
Security monitoring master station or control panel

Apply circuit/control/item designation labels of engraved plastic laminate for disconnect switches, breakers, pushbuttons, pilot lights, motor control centers, and similar items for power distribution and control components above, except panelboards and alarm/signal components, where labeling is specified elsewhere. For panelboards, provide framed, typed circuit schedules with explicit description and identification of items controlled by each individual breaker.

Install labels at locations indicated and at locations for best convenience of viewing without interference with operation and maintenance of equipment.

END OF SECTION 16195

SECTION 16452 - GROUNDING

PART 1 - GENERAL

RELATED DOCUMENTS

Drawings and general provisions of Contract, including General and Supplementary Conditions and Division 1 Specification Sections, apply to this Section.

Requirements of the following Division 16 Sections apply to this Section:

Basic Electrical Requirements
Basic Electrical Materials and Methods

SUMMARY

This Section includes solid grounding of electrical systems and equipment. It includes basic requirements for grounding for protection of life, equipment, circuits, and systems. Grounding requirements specified in this Section may be supplemented in other sections of these Specifications.

SUBMITTALS

General: Submit the following in accordance with Conditions of Contract and Division 1 Specification Sections.

Product data for ground rods, connectors and connection materials, and grounding fittings.

Field-testing organization certificate, signed by the Contractor, certifying that the organization performing field tests complies with the requirements specified in Quality Assurance below.

Report of field tests and observations certified by the testing organization.

QUALITY ASSURANCE

Listing and Labeling: Provide products specified in this Section that are listed and labeled. The terms "listed" and "labeled" shall be defined as they are in the National Electrical Code, Article 100.

Listing and Labeling Agency Qualifications: A "Nationally Recognized Testing Laboratory" (NRTL) as defined in OSHA Regulation 1910.7.

Field-Testing Organization Qualifications: To qualify for acceptance, the independent testing organization must demonstrate, based on evaluation of organization-submitted criteria conforming to ASTM E 699 that it has the experience and capability to conduct satisfactorily the testing indicated.

Electrical Component Standard: Components and installation shall comply with NFPA 70, "National Electrical Code" (NEC).

UL Standard: Comply with UL 467, "Grounding and Bonding Equipment."

PART 2 - PRODUCTS

MANUFACTURERS

Available Manufacturers: Subject to compliance with requirements, manufacturers offering products that may be incorporated in the Work include, but are not limited to, the following:

Manufacturers: Subject to compliance with requirements, provide products by the following:

Anixter Bros., Inc.
Bashlin Industries, Inc.
Buckingham Mfg. Co.
A. B. Chance Co.
Dossert Corp.
Engineered Products Co.
Erico Products, Inc.
Galvan Industries, Inc.
GB Electrical, Inc.
General Machine Products Co., Inc.
Hastings Fiber Glass Products, Inc.
Ideal Industries, Inc.
Kearney-National.
McGill Mfg.
O-Z/Gedney Co.
Raco, Inc.
Thomas & Betts Corp.
W. H. Salisbury & Co.
Utilco Co.

GROUNDING AND BONDING PRODUCTS

Products: Of types indicated and of sizes and ratings to comply with NEC. Where types, sizes, ratings, and quantities indicated are in excess of NEC requirements, the more stringent requirements and the greater size, rating, and quantity indications govern.

Conductor Materials: Copper.

WIRE AND CABLE CONDUCTORS

General: Comply with Division 16 Section "Wires and Cables." Conform to NEC Table 8, except as otherwise indicated, for conductor properties, including stranding.

Equipment Grounding Conductor: Green insulated.

Grounding Electrode Conductor: Stranded cable.

Bare Copper Conductors: Conform to the following:

Solid Conductors: ASTM B-3.

Assembly of Stranded Conductors: ASTM B-8.

Tinned Conductors: ASTM B-33.

MISCELLANEOUS CONDUCTORS

Ground Bus: Bare annealed copper bars of rectangular cross section.

Braided Bonding Jumpers: Copper tape, braided No. 30 gage bare copper wire, terminated with copper ferrules.

Bonding Strap Conductor/Connectors: Soft copper, 0.05 inch thick and 2 inches wide, except as indicated.

CONNECTOR PRODUCTS

General: Listed and labeled as grounding connectors for the materials used.

Pressure Connectors: High-conductivity-plated units.

Bolted Clamps: Heavy-duty units listed for the application.

Exothermic Welded Connections: Provided in kit form and selected for the specific types, sizes, and combinations of conductors and other items to be connected.

Aluminum-To-Copper Connections: Bimetallic type, conforming to UL 96, "Lighting Protection Components," or UL 467.

PART 3 - EXECUTION

APPLICATION

Equipment Grounding Conductor Application: Comply with NEC Article 250 for sizes and quantities of equipment grounding conductors, except where larger sizes or more conductors are indicated.

Install separate insulated equipment grounding conductors with circuit Conductors for the following in addition to those locations where required by Code:

Feeders and branch circuits.
Lighting circuits.
Receptacle Circuits.
Single-phase motor or appliance circuits.
Three-phase motor or appliance branch circuits.

Signal and Communications: For telephone, alarm, and communication systems, provides a #4 AWG minimum green insulated copper conductor in raceway from the grounding electrode system to each terminal cabinet or central equipment location.

Separately derived systems required by NEC to be grounded shall be grounded in accordance with NEC 250.30.

Common Ground Bonding With Lightning Protection System: Bond electric power system ground directly to lightning protection system grounding conductor at closest point to electric service grounding electrode. Use bonding conductor sized same as system ground conductor and installed in conduit.

INSTALLATION

General: Ground electrical systems and equipment in accordance with NEC requirements except where the Drawings or Specifications exceed NEC requirements.

Ground Rods: Locate a minimum of one-rod length from each other and at least the same distance from any other grounding electrode. Interconnect ground rods with bare conductors buried at least 30 inches below grade. Connect bare-cable ground conductors to ground rods by means of exothermic welds except as otherwise indicated. Make these connections without damaging the copper coating or exposing the steel. Use 3/4-inch by 10-ft. ground rods except as otherwise indicated. Drive rods until tops are 6 inches below finished floor or final grade except as otherwise indicated.

Metallic Water Service Pipe: Provide insulated copper ground conductors, sized as indicated, in conduit from the building main service equipment, or the ground bus, to main metallic water service entrances to the building. Connect ground conductors to the main metallic water service pipes by means of ground clamps. Where a dielectric main water fitting is installed, connect the ground conductor to the street side of the fitting. Do not install a grounding jumper around dielectric fittings. Bond the ground conductor conduit to the conductor at each end.

Braided-Type Bonding Jumpers: Install to connect ground clamps on water meter piping to bypass water meters electrically. Use elsewhere for flexible bonding and grounding connections.

Route grounding conductors along the shortest and straightest paths possible without obstructing access or placing conductors where they may be subjected to strain, impact, or damage, except as indicated.

Bond interior metal piping systems and metal air ducts to equipment ground conductors of pumps, fans, electric heaters, and air cleaners serving individual systems.

CONNECTIONS

General: Make connections in such a manner as to minimize possibility of galvanic action or electrolysis. Select connectors, connection hardware, conductors, and connection methods so metals in direct contact will be galvanically compatible.

Use electroplated or hot-tin-coated materials to assure high conductivity and make contact points closer in order of galvanic series.

Make connections with clean bare metal at points of contact.

Aluminum to steel connections shall be with stainless steel separators and mechanical clamps.

Aluminum to galvanized steel connections shall be with tin- plated copper jumpers and mechanical clamps.

Coat and seal connections involving dissimilar metals with inert material such as red lead paint to prevent future penetration of moisture to contact surfaces.

Exothermic Welded Connections: Use for connections to structural steel and for underground connections except those at test wells. Install at connections to ground rods and plate electrodes. Comply with manufacturer's written recommendations. Welds that are puffed up or that show convex surfaces indicating improper cleaning are not acceptable.

Terminate insulated equipment grounding conductors for feeders and branch circuits with pressure-type grounding lugs. Where metallic raceways terminate at metallic housings without mechanical and electrical connection to the housing, terminate each conduit with a grounding bushing. Connect grounding bushings with a bare grounding conductor to the ground bus in the

housing. Bond electrically non-continuous conduits at both entrances and exits with grounding bushings and bare grounding conductors.

Tighten grounding and bonding connectors and terminals, including screws and bolts, in accordance with manufacturer's published torque tightening values for connectors and bolts. Where manufacturer's torquing requirements are not indicated, tighten connections to comply with torque tightening values specified in UL 486A and UL 486B.

Connections at Test Wells: Use compression-type connectors on conductors and make bolted- and clamped-type connections between conductors and ground rods.

Compression-Type Connections: Use hydraulic compression tools to provide the correct circumferential pressure for compression connectors. Use tools and dies recommended by the manufacturer of the connectors. Provide embossing die code or other standard method to make a visible indication that a connector has been adequately compressed on the ground conductor.

Moisture Protection: Where insulated ground conductors are connected to ground rods or ground buses, insulate the entire area of the connection and seal against moisture penetration of the insulation and cable.

FIELD QUALITY CONTROL

Independent Testing Organization: Arrange and pay for the services of a qualified independent electrical testing organization to perform tests described below.

Tests: Subject the completed grounding system to a meager test at each location where a maximum ground resistance level is specified, at service disconnect enclosure ground terminal, and at ground test wells. Measure ground resistance without the soil being moistened by any means other than natural precipitation or natural drainage or seepage and without chemical treatment or other artificial means of reducing natural ground resistance. Perform tests by the 2-point method in accordance with Section 9.03 of IEEE 81, "Guide for Measuring Earth Resistivity, Ground Impedance and Earth Surface Potentials of a Grounding System."

Ground/resistance maximum values shall be as follows:

Equipment rated 500 kVA and less: 5 Ohms
Equipment rated 500 kVA to 1000 kVA: 5 Ohms
Equipment rated over 1000 kVA: 3 Ohms

Deficiencies: Where ground resistances exceed specified values, and if directed, modify the grounding system to reduce resistance values. Where measures are directed that exceed those indicated the provisions of the Contract, covering changes will apply.

Report: Prepare test reports, certified by the testing organization, of the ground resistance at each test location. Include observations of weather and other phenomena that may affect test results. Describe measures taken to improve test results.

CLEANING AND ADJUSTING

Restore surface features at areas disturbed by excavation and reestablish original grades except as otherwise indicated. Where sod has been removed, replace it as soon as possible after backfilling is completed. Restore areas disturbed by trenching, storing of dirt, cable laying, and other Work to their original condition. Include necessary top soiling, fertilizing, liming, seeding, sodding, sprigging, or mulching. Perform such Work in accordance with Division 2

Section "Landscape Work." Maintain disturbed surfaces. Restore vegetation in accordance with Section "Landscape Work." Restore disturbed paving as indicated.

END OF SECTION 16452

SECTION 16460 – DRY TYPE TRANSFORMERS

PART 1 – GENERAL

RELATED DOCUMENTS

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

SUMMARY

This Section includes general-purpose and specialty dry-type transformers with windings rated 600V or less.

SUBMITTALS

General: Submit the following according to the Conditions of the Contract Specification Sections.

Product data for each product specified, including dimensioned plans, sections, and elevations. Show minimum clearances and installed features and devices.

Wiring diagrams of products differentiating between manufacturer- installed and field-installed wiring.

Product certificates signed by manufacturers certifying that their products comply with the specified requirements.

Qualification data for firms and persons specified in the "Quality Assurance" Article to demonstrate their capabilities and experience. Include a list of relevant completed projects with project names and addresses, and names and addresses of the respective Architects and Owners.

Product Test Reports: Certified copies of manufacturer's design and routine factory tests required by the referenced standards.

Sound Level Test Reports: Certified copies of manufacturer's sound level tests applicable to equipment for this Project.

Operation and maintenance data for materials and products to include in the "Operating and Maintenance Manual" specified in Division 01.

Field test reports of tests and inspections conducted according to Part 3 of this Section.

QUALITY ASSURANCE

Manufacturer Qualifications: Firms experienced in manufacturing components that comply with the requirements of these Specifications and that have a record of successful in-service performance.

Field-Testing Agency Qualifications: To qualify for acceptance, an independent testing agency must demonstrate, based on evaluation of agency-submitted criteria conforming to ASTM E 699, that it has the experience and capability to satisfactorily conduct the testing indicated.

Comply with NFPA 70 National Electrical Code.

Comply with IEEE C2 National Electrical Safety Code.

Listing and Labeling: Products are listed and labeled.

The Terms "Listed" and "Labeled": As defined in the "National Electrical Code," Article 100.

Listing and Labeling Agency Qualifications: A "Nationally Recognized Testing Laboratory" (NRTL) as defined in OSHA Regulation 1910.7.

DELIVERY, STORAGE, AND HANDLING

Temporary Heating: Apply temporary heat according to manufacturer's recommendations within the enclosure of each ventilated type unit throughout periods during which equipment is not energized and is not in a space that is continuously under normal control of temperature and humidity.

PART 2 - PRODUCTS

MANUFACTURERS

Manufacturers: Subject to compliance with requirements, provide products by the following:

Transformers:
Acme Electric Corp.
General Electric Co.
Hevi-Duty Electric.
Siemens Energy & Automation, Inc.
Square D Co.
R.E. Uptegraff Mfg. Co.
Cutler-Hammer/Westinghouse Electric Corp.

TRANSFORMERS, GENERAL

Transformers: Factory-assembled and -tested, air-cooled units of types specified, designed for 60-Hz service.

Cores: Grain-oriented, nonaging silicon steel.

Coils: Continuous windings without splices except for taps.

Internal Coil Connections: Brazed or pressure type.

GENERAL-PURPOSE, DRY-TYPE TRANSFORMERS

Comply with NEMA Standard ST 20 "Dry-Type Transformers for General Applications."

Transformers: Two-winding type, 3-phase units using 1 coil per phase in primary and secondary. Transformers shall be non-linear rated K-13 minimum.

Windings: All copper.

Low Sound Level Units: Minimum of 3 dBA less than NEMA ST 20 standard sound levels when factory tested according to IEEE Standard C57.12.91, "Test Code for Dry-Type Distribution and

Power Transformers."

Features and Ratings: As follows:

Enclosure: Indoor, ventilated, drip proof.

Insulation Class: 185 deg C or 220 deg C class for transformers 15 kVA or smaller; 220 deg C class for transformers larger than 15 kVA.

Insulation Temperature Rise: 80 deg C maximum rise above 40 deg C.

Taps: For transformers 3 kVA and larger, full capacity taps in high-voltage winding are as follows:

15 kVA through 500 kVA: Six 2.5-percent taps, 2 above and 4 below rated high voltage.

Accessories: The following accessory items are required:

Electrostatic Shielding: Insulated metallic shield between primary and secondary windings.

Connect shield to terminal marked "Shield" for grounding connection.

Capacitance: Arrange shield to provide a maximum of 33 picofarads primary-to-secondary capacitance over a frequency range of 20 Hz to 1 MHz.

Fungus Proofing: Permanent fungicidal treatment for coil and core.

Insulation Class: 185 deg C or 220 deg C class for transformers 15 kVA or smaller; 220 deg C class for transformers larger than 15 kVA.

Taps: Two 5-percent, full-capacity taps, 1 above and 1 below rated high voltage.

CONTROL AND SIGNAL TRANSFORMERS

Comply with NEMA Standard ST 1, "Specialty Transformers," and UL Standard 506, "Specialty Transformers."

Ratings: Continuous duty. Where ratings are not indicated, provide capacity exceeding peak load by 50 percent minimum.

Type: Self-cooled, 2-winding, dry type.

Enclosure: Suitable for the location where installed.

PART 3 - EXECUTION

INSTALLATION

Arrange equipment to provide adequate spacing for access and for cooling air circulation.

Identify transformers and install warning signs according to Division 260553 Section "Electrical Identification."

Tighten electrical connectors and terminals according to manufacturers published torque-tightening values. Where manufacturer's torque values are not furnished, use those specified in UL 486A and UL 486B.

GROUNDING

Ground transformers and systems served by transformers according to Division 260526 Section "Grounding."

FIELD QUALITY CONTROL

Manufacturer's Field Services: Arrange and pay for the services of a factory-authorized service representative to supervise the field assembly and connection of components and pretesting and adjustment of adjustable voltage-regulating units.

Independent Testing Agency: Provide services of an independent electrical testing agency according to the requirements of Division 1 Section "Quality Control Services" to perform tests on installations made under this Section.

Test Objectives: To ensure transformer installation is operational within industry and manufacturer's tolerances, install according to Contract Documents, and suitable for energizing.

Test Labeling: Upon satisfactory completion of tests for each unit, attach a dated and signed "Satisfactory Test" label to the tested component.

Schedule tests and provide notification at least one week in advance of test commencement.

Report: Submit a written report of observations and tests. Report defective materials and workmanship.

Tests: Include the following minimum inspections and tests according to the manufacturer's instructions. Conform to IEEE Standard Test Code C57.12.91 for dry-type units, test method, and data correction factors.

Inspect accessible components for cleanliness, mechanical, and electrical integrity, for presence of damage or deterioration, and to ensure removal of temporary shipping bracing. Do not proceed with tests until deficiencies are corrected.

Include internal inspection through access panels and covers.

Inspect bolted electrical connections for tightness according to manufacturer's published torque values or, where not available, those of UL standards 486A and 486B.

Insulation Resistance: Perform megohmmeter test of primary and secondary winding-to-winding and winding-to-ground. Use a minimum test voltage of 1,000 V d.c. Minimum insulation resistance is 500 megohms.

Duration of Each Test: 10 minutes.

Temperature Correction: Correct results for test temperature deviation from 20 deg C standard.

Testing for Voltage Regulators: Perform same tests and inspections specified above for

transformers. Include functional test throughout operating range of device. Check voltage tolerance, correction speed, and harmonic content of output for stepped changes in source voltage at 35 percent, 70 percent, and 100 percent of rated load.

Test Failures: Correct deficiencies identified by tests and retest. Verify that equipment meets the specified requirements.

ADJUSTING

After completing installation, cleaning, and testing, touch up scratches and mars on finish to match original finish.

Adjust transformer taps to provide optimum voltage conditions at utilization equipment throughout the normal operating cycle of the facility. Record voltages and tap settings to submit with test results.

DEMONSTRATION

Adjustment and Training: Arrange and pay for factory-authorized service representatives to adjust and demonstrate voltage regulators and to conduct related training for Owner's maintenance personnel. Provide a minimum of 4 hours of training that include the following:

Safety precautions.
Features and construction of project equipment.
Voltage adjustment procedures.
Routine inspection and test procedures.
Routine cleaning.
Interpretation of readings of indicating and alarm devices.

Schedule training with at least 7 days' advance notice.

END OF SECTION 16460

SECTION 16470 – PANELBOARDS

PART 1 - GENERAL

RELATED DOCUMENTS

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

Requirements of the following Division Sections apply to this Section:

Basic Electrical Requirements
Basic Electrical Materials and Methods

SUMMARY

This Section includes lighting and power panelboards and associated auxiliary equipment rated 600V or less.

Related Sections: The following Division Sections contain requirements that relate to this Section:

"Overcurrent Protective Devices" for circuit breakers, fusible switches, fuses, and other devices used in panelboards.

"Motor Controllers" for combination starters installed in panelboards.

DEFINITIONS

Load Center: A panelboard with thermal magnetic circuit-breaker branches, primarily of the plug-in type, designed for residential and light commercial projects, operating at 240V and below, available in both single and 3-phase versions, and equipped with combination flush/surface mounting trim.

Overcurrent Protective Device (OCPD): A device operative on excessive current that causes and maintains the interruption of power in the circuit it protects.

SUBMITTALS

General: Submit the following in accordance with Conditions of Contract and Division 01 Specification Sections.

Product data for each type panelboard, accessory item, and component specified.

Shop drawings from manufacturers of panelboards including dimensioned plans, sections, and elevations. Show tabulations of installed devices, major features, and voltage rating. Include the following:

Enclosure type with details for types other than NEMA Type 1.

Bus configuration and current ratings.

Short-circuit current rating of panelboard.

Features, characteristics, ratings, and factory settings of individual protective devices and auxiliary components.

Wiring diagrams detailing schematic diagram including control wiring, and differentiating between manufacturer-installed and field-installed wiring.

Qualification data for field-testing organization certificates, signed by the Contractor, certifying that the organization complies with the requirements specified in Quality Assurance below. Include list of completed projects with project names, addresses, and names of Architect and Owner plus basic organization qualifications data.

Report of field tests and observations certified by the testing organization.

Panel schedules for installation in panelboards. Submit final versions after load balancing.

Maintenance data for panelboard components, for inclusion in Operating and Maintenance Manual specified in Division 1 and in Division 16 Section "Basic Electrical Requirements." Include instructions for testing circuit breakers.

QUALITY ASSURANCE

Listing and Labeling: Provide products specified in this Section that are listed and labeled.

The terms "listed" and "labeled" shall be defined as they are in the National Electrical Code, Article 100.

Listing and Labeling Agency Qualifications: A "Nationally Recognized Testing Laboratory" (NRTL) as defined in OSHA Regulation 1910.7.

Electrical Component Standard: Components and installation shall comply with NFPA 70, "National Electrical Code".

NEMA Standard: Comply with NEMA PB1, "Panelboards".

UL Standards: Comply with UL 61, "Panelboards," and UL 50, "Cabinets and Boxes".

EXTRA MATERIALS

Keys: Furnish six spares of each type for panelboard cabinet locks.

Touch-up Paint for surface-mounted panelboards: One half-pint container.

PART 2 - PRODUCTS

MANUFACTURERS

Manufacturers: Panelboards shall be same manufacturer as switchboards and surge suppression. Subject to compliance with requirements, provide products by the following:

General Electric Co.
Siemens
Square D Co. (Schneider Electric)*

*Basis of design.

PANELBOARDS, GENERAL REQUIREMENTS

Neutral Bus Rating: The neutral bus for each panelboard shall be sized at 100% of main rating, where indicated.

Overcurrent Protective Devices (OCPDs): Provide type, rating, and features as indicated. Comply with Division Section "Overcurrent Protective Devices," with OCPDs adapted to panelboard installation. Tandem circuit breakers shall not be used. Multi-pole breakers shall have common trip.

Enclosures: Cabinets, flush or surface mounted, as indicted. NEMA Type 1 enclosure, except where the following enclosure requirements are indicated.

Front: Secured to box with concealed trim clamps except as indicated. Front for surface-mounted panels shall be same dimensions as box. Fronts for flush panels shall overlap box except as otherwise specified.

Directory Frame: Metal, mounted inside each panel door.

Bus: Hard drawn copper of 98% conductivity.

Main and Neutral Lugs: Compression type.

Equipment Ground Bus: Adequate for feeder and branch-circuit equipment ground conductors. Bonded to box, except for isolated ground bus as indicated.

Service Equipment Approval: Listed for use as service equipment for panelboards having main service disconnect.

Provision for Future Devices: Equip with mounting brackets, bus connections, and necessary appurtenances, for the OCPD ampere ratings indicated for future installation of devices.

Special Features: Provide the following features for panelboards.

> Isolated Equipment Ground Bus: Adequate for branch-circuit equipment ground conductors; insulated from box.
>
> Hinged Front Cover: Entire front trim hinged to box with standard door within hinged trim cover.
>
> Skirt For Surface-Mounted Panels: Same gage and finish as panel front with flanges for attachment to panel, wall, and floor.

Feed-Through Lugs: Sized to accommodate feeders indicated.

Surge Arresters: IEEE C62.11, "Standards for Metal-Oxide Surge Arresters for AC Power Circuits", or IEEE C62.1, "Surge Arresters for Alternating Current Power Circuits".

> Description: Coordinate impulse spark over voltage with system circuit voltage and provide factory mounting with UL- recognized mounting device.

Circuit Breakers Feeding Dorm Rooms / Spaces: Shall be ARC Fault interrupter type.

Circuit Breakers for Switching Lights at Panelboards: Indicated type SWD.

Circuit Breakers for Equipment Marked HACR Type: Indicated HACR type.

Interiors: Provide physical means to prevent installation of more OCPDs than the quantity for which the enclosure was listed.

Main, Neutral, and Ground Lugs and Buses: Have mechanical connectors for conductors.

LIGHTING AND APPLIANCE BRANCH CIRCUIT PANELBOARDS

Branch OCPDs: Bolt-on circuit breakers, replaceable without disturbing adjacent units.

Doors: In panel front, with concealed hinges. Secure with flush catch and tumbler lock, all keyed alike.

DISTRIBUTION PANELBOARDS

Branch-Circuit Breakers: Where OCPDs are indicated to be circuit breakers, use bolt-on breakers except circuit breakers 225-ampere frame size and greater may be plug-in type where individual positive locking device requires mechanical release for removal.

Motor Starter Branches: Conform to Division 26 Section "Motor Controllers" and provide units equipped for panelboard mounting. Include the following accessories and pilot devices as indicated:

Individual control power transformers.
Fuses for control power transformers.
Pilot lights.
Extra interlock contacts.
Pushbuttons.
Selector switches.

Motor Starter Disconnects: Include overcurrent protection as indicated. Mount integral with or, in same panelboard, adjacent to motor starter. Mechanically interlock starter door with disconnect device. Provide auxiliary contacts on disconnect to deenergize control connections to starter.

ACCESSORY COMPONENTS AND FEATURES

Accessory Set: Include tools and miscellaneous items as required for overcurrent protective device test, inspection, maintenance, and operation.

Portable Test Set: Arranged to permit testing of functions of solid-state trip devices without removal from panelboard.

Fungus Proofing: Permanent fungicidal treatment for panelboards interior including OCPDs and other components.

Drip Hood: Provide drip hood to comply with FAMU Design Guidelines pertaining to protection of panelboards in sprinklered locations.

IDENTIFICATION

General: Refer to Division 16 Section "Electrical Identification" for labeling materials.

Panelboard Nameplates: Engraved laminated plastic nameplate for each panelboard mounted with epoxy or industrial cement or industrial adhesive.

PART 3 - EXECUTION

INSTALLATION

General: Install panelboards and accessory items in accordance with NEMA PB 1.1, "General Instructions for Proper Installation, Operation and Maintenance of Panelboards Rated 600 Volts or Less" and manufacturers' written installation instructions.

Mounting Heights: Top of trim 6'-2" above finished floor, except as indicated.

Mounting: Plumb and rigid without distortion of box. Mount flush panels uniformly flush with wall finish.

Circuit Directory: Typed and reflective of final circuit changes required to balance panel loads. Obtain approval before installing.

Install filler plates in unused spaces.

Provision for Future Circuits at Flush Panelboards: Stub four 1" empty conduits from panel into accessible ceiling space or space designated to be ceiling space in future. Stub four 1" empty conduits into raised floor space or below slab other than slabs on grade.

Auxiliary Gutter: Install where a panel is tapped to a riser at an intermediate location.

Wiring in Panel Gutters: Train conductors neatly in groups, bundle, and wrap with wire ties after completion of load balancing.

IDENTIFICATION

Identify field-installed wiring and components and provide warning signs in accordance with Division 26 Section "Electrical Identification".

GROUNDING

Connections: Make equipment grounding connections for panelboards as indicated.

Provide ground continuity to main electrical ground bus indicated.

CONNECTIONS

Tighten electrical connectors and terminals, including grounding connections, in accordance with manufacturers published torque-tightening values. Where manufacturer's torque values are not indicated, use those specified in UL 486A and UL 486B.

FIELD QUALITY CONTROL

Independent Testing Organization: Arrange and pay for the services of an independent electrical testing organization in to perform tests on low-voltage power panelboards and accessories.

Pretesting: Upon completing installation of the system, perform the following preparations for independent tests:

Make insulation resistance tests of panelboard buses, components, and connecting supply, feeder, and control circuits.

Make continuity tests of circuits.

Provide set of Contract Documents to test organization. Include full updating on final system configuration and parameters where they supplement or differ from those indicated in original Contract Documents.

Quality Control Program: Conform to the following:

Procedures: Make field tests and inspections and prepare panelboard for satisfactory operation in accordance with manufacturer's recommendations and these specifications.

Protective Device Ratings and Settings: Verify indicated ratings and settings to be appropriate for final system configuration and parameters. Where discrepancies are found, recommend final protective device ratings and settings. Use accepted ratings or settings to make the final system adjustments.

Visual and Mechanical Inspection: Include the following inspections and related work:

Inspect for defects and physical damage, labeling, and nameplate compliance with requirements of up-to-date drawings and panelboard schedules.

Exercise and perform of operational tests of all mechanical components and other operable devices in accordance with manufacturer's instruction manual.

Check panelboard mounting, area clearances, and alignment and fit of components.

Check tightness of bolted electrical connections with calibrated torque wrench. Refer to manufacturer's instructions for proper torque values.

Perform visual and mechanical inspection and related work for overcurrent protective devices as specified in Division 26 Section "Overcurrent Protective Devices."

Electrical tests: Include the following items performed in accordance with manufacturer's instruction:

Insulation resistance test of buses and portions of control wiring that disconnected from solid-state devices. Insulation resistance less than 100 megohms is not acceptable.

Ground resistance test on system and equipment ground connections.

Test main and subfeed overcurrent protective devices in accordance with Section "Overcurrent Protective Devices."

Retest: Correct deficiencies identified by tests and observations and provide retesting of panelboards by testing organization. Verify by the system tests that the total assembly meets specified requirements.

CLEANING

Upon completion of installation, inspect interior and exterior of panelboards. Remove paint

splatters and other spots, dirt, and debris. Touch up scratches and mars of finish to match original finish.

COMMISSIONING

Balancing Loads: After Substantial Completion, but not more than two months after Final Acceptance, conduct load-balancing measurements and circuit changes as follows:

Perform measurements during period of normal working load as advised by the Owner.

Perform load-balancing circuit changes outside the normal occupancy/working schedule of the facility. Make special arrangements with Owner to avoid disrupting critical 24-hour services such as FAX machines and on-line data processing, computing, transmitting, and receiving equipment.

Recheck loads after circuit changes during normal load period. Record all load readings before and after changes and submit test records.

Tolerance: Difference between phase loads exceeding 20 percent at any one panelboard is not acceptable. Rebalance and recheck as required to meet this minimum requirement.

END OF SECTION 16470

SECTION 16476 - DISCONNECTS AND CIRCUIT BREAKERS

PART 1 - GENERAL

RELATED DOCUMENTS

Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 1 Specification Sections, apply to this Section.

SUMMARY

This Section includes the following:

Feeder and equipment disconnects; and
Enclosed circuit breakers.

Related Sections: The following Sections contain requirements that relate to this Section:

Division 16 Section "Fuses."

SUBMITTALS

General: Submit the following according to the Conditions of the Contract and Division 1 Specification Sections.

Product data for switches, circuit breakers, and accessories specified in this Section.

Descriptive data and time-current curves for protective devices and let-through current curves for those devices with current- limiting characteristics. Include coordination charts and tables, and related data.

Wiring diagrams detailing power and control wiring and differentiating clearly between manufacturer-installed wiring and field-installed wiring.

Qualification data for firms and persons specified in the "Quality Assurance" Article to demonstrate their capabilities and experience. Include a list of completed projects with project names, addresses, names of Architects and Owners, and other information specified.

Field test reports indicating and interpreting test results.

Maintenance data for tripping devices to include in the "Operating and Maintenance Manual" specified in Division 1.

QUALITY ASSURANCE

Testing Agency Qualifications: In addition to the requirements specified in Division 1 Section "Quality Control Services," an independent testing agency shall meet OSHA criteria for accreditation of testing laboratories, Title 29, Part 1907, or shall be a full member company of the International Electrical Testing Association.

Testing Agency's Field Supervisor: Person currently certified by the International Electrical Testing Association or National Institute for Certification in Engineering Technologies, to supervise on-site testing specified in Part 3.

Comply with NFPA 70 "National Electrical Code" for components and installation.

Listing and Labeling: Provide products specified in this Section that are listed and labeled.

The Terms "Listed" and "Labeled": As defined in the "National Electrical Code," Article 100.

Listing and Labeling Agency Qualifications: A "Nationally Recognized Testing Laboratory" (NRTL) as defined in OSHA Regulation 1910.7.

Single-Source Responsibility: All enclosed switches and circuit breakers shall be the product of a single manufacturer.

PART 2 - PRODUCTS

MANUFACTURERS

Available Manufacturers: Subject to compliance with requirements, manufacturers offering enclosed switches and circuit breakers that may be incorporated in the Work include, but are not limited to, the following:

Manufacturers: Subject to compliance with requirements, provide enclosed switches and circuit breakers by one of the following:

Fusible Switches:
- Allen-Bradley Co.
- Challenger Electrical Equipment Corp.
- Crouse-Hinds Distribution Equipment.
- Distribution and Controls (formerly Westinghouse Electric Co.).
- Cutler-Hammer Products; Eaton Corp.
- Electrical Distribution and Control; General Electric Co.
- General Switch Corp.
- Siemens Energy & Automation, Inc.
- Square D Co.

Fused Power Circuit Devices:
- Boltswitch.
- Electrical Distribution and Control; General Electric Co.
- Pringle Electrical Mfg. Co.
- Square D Co.

Molded-Case Circuit Breakers:
- American Circuit Breaker Corp.
- Challenger Electrical Equipment Corp.
- Crouse-Hinds Distribution Equipment.
- Distribution and Control (formerly Westinghouse Electric Co.).
- Cutler-Hammer Products; Eaton Corp.
- Electrical Distribution and Control; General Electric Co.
- General Switch Corp.
- Klockner-Moeller.
- Siemens Energy & Automation, Inc.
- Square D Co.

ENCLOSED SWITCHES

Enclosed Nonfusible Switch: NEMA KS 1, Type HD, handle lockable with 2 padlocks.

Enclosed Fusible Switch, 800 Amperes and Smaller: NEMA KS 1, Type HD, clips to accommodate specified fuses, enclosure consistent with environment where located, handle lockable with 2 padlocks, and interlocked with cover in CLOSED position.

Enclosure: NEMA KS 1, Type 1, unless specified or required otherwise to meet environmental conditions of installed location.

Outdoor Locations: Type 3R.

Other Wet or Damp Indoor Locations: Type 4.

Hazardous Areas Indicated on Drawings: NEMA 7C.

ENCLOSED CIRCUIT BREAKERS

Enclosed Molded-Case Circuit Breaker: NEMA AB 1, handle lockable with 2 padlocks.

Characteristics: Frame size, trip rating, number of poles, and auxiliary devices as indicated; interrupting capacity rating to meet available fault current, 10,000 symmetrical RMS amperes minimum; with appropriate application listing when used for switching fluorescent lighting loads or heating, air conditioning, and refrigeration equipment.

Interchangeable Trips: Circuit breakers, 200 amperes and larger, with trip units interchangeable within frame size.

Field-Adjustable Trips: Circuit breakers, 400 amperes and larger, with adjustable short time and continuous current settings.

Current-Limiting Trips: Where indicated, let-through ratings less than NEMA FU 1, Class RK-5.

Current Limiters: Where indicated, integral fuse listed for circuit breaker.

Molded-Case Switch: Where indicated, molded-case circuit breaker without trip units.

Lugs: Mechanical lugs and power-distribution connectors for number, size, and material of conductors indicated.

Shunt Trip: Where indicated, 120 volts, 60 Hz.

Accessories: As indicated.

Enclosure: NEMA AB 1, Type 1, unless specified or required otherwise to meet environmental conditions of installed location.

Outdoor Locations: Type 3R.

Other Wet or Damp Indoor Locations: Type 4.

Hazardous Areas Indicated on Drawings: NEMA 7C.

PART 3 - EXECUTION

INSTALLATION

Install enclosed switches and circuit breakers in locations as indicated, according to manufacturer's written instructions.

Install enclosed switches and circuit breakers level and plumb.

Install wiring between enclosed switches and circuit breakers and control/indication devices.

Connect enclosed switches and circuit breakers and components to wiring system and to ground as indicated and instructed by manufacturer. Tighten connectors and terminals, including screws and bolts according to equipment manufacturer's published torque tightening values for equipment connectors. Where manufacturer's torquing requirements are not indicated, tighten connectors and terminals according to tightening torques specified in UL Standard 486A.

FIELD QUALITY CONTROL

Testing Agency: Owner will employ and pay an independent testing agency to perform specified field quality-control testing.

Testing Agency: Provide the services of a qualified independent testing agency to perform specified field quality-control testing.

Testing: After installing enclosed switches and circuit breakers and after electrical circuitry has been energized, demonstrate product capability and compliance with requirements.

Procedures: Perform each visual and mechanical inspection and electrical test stated in NETA Standard ATS, Section 7.5 for enclosed switches and Section 7.6 for molded-case circuit breakers. Certify compliance with test parameters.

Correct malfunctioning units at site, where possible, and retest to demonstrate compliance; otherwise, remove and replace with new units, and retest.

ADJUSTING

Set field-adjustable enclosed switches and circuit breaker trip ranges as indicated.

CLEANING

After completing system installation, including outlet fittings and devices, inspect exposed finish. Remove burrs, dirt, and construction debris and repair damaged finish including chips, scratches, and abrasions.

DEMONSTRATION

Train Owner's maintenance personnel on procedures and schedules for startup and shutdown, troubleshooting, servicing, and preventive maintenance.

Review data in the "Operating and Maintenance Manual." Refer to Division 1 Section "Project Closeout."

Schedule training with Owner through the Architect with at least 7 days' advance notice.

END OF SECTION 16476

SECTION 16721 – SUMMARY NETWORK FIRE ALARM CONTROL PANEL (NODE)

PART 1 – GENERAL

Network fire alarm control panels shall include all features as described in this specification for stand-alone FACPs and shall have network communication capabilities as described herein.

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.

Network communications shall be capable of supporting "point lists" that can be handled as though they were a single point.

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. The system shall include the capability to log into any node on the system via TCP/IP Ethernet network communications protocol compatible with IEEE Standard 802.3. Ethernet access to any fire alarm panel shall be capable of providing access only to authenticated users through a cryptographically authenticated and secure SLL tunnel. Provisions for a standard RJ-45 Ethernet connection to the owner's Ethernet network must be provided at each node as part of the contract. 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.

Work covered by this section includes the furnishing of labor, equipment, and materials for installation of the fire alarm system as indicated on the drawings and specifications.
The Fire Alarm System shall consist of all necessary hardware equipment and software programming to perform the following functions:

Fire alarm system detection and notification operations
Control and monitoring of elevators, smoke control equipment, door hold-open devices, fire suppression systems, emergency power systems, and other equipment as indicated in the drawings and specifications.
Two-way supervised firefighter's phone operations
One-way supervised automatic voice alarm operations

SCOPE OF WORK

Bidders shall provide unit pricing information on list of items on drawing 1 of the plans.

Provide a new complete voice evacuation multiplex addressable Fire Alarm System.

ACCEPTABLE EQUIPMENT AND SERVICE PROVIDERS

Manufacturers: The equipment and service described in this specification are those supplied and supported by Simplex Grinnell and represent the Basis of Design.

Subject to compliance with the requirements of this specification, provide products by one of the following manufacturers:

SimplexGrinnell
EST

Siemens

Being listed as an acceptable Manufacturer in no way relieves obligation to provide all equipment and features in accordance with these specifications.

Alternate products must be submitted to the Engineer a minimum of fourteen (14) days 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.

The equipment and service provider shall be a nationally recognized company specializing in fire alarm and detection systems. This provider shall employ factory trained and NICET Level IV certified technicians (Copy of NICET Level IV certification shall be submitted with bid documents), and shall maintain a service organization within 50 miles of this project location. The equipment and service provider shall have a minimum of 10 years experience in the fire protective signaling systems industry.

RELATED DOCUMENTS

Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 1 Specification Sections apply to this section.

The work covered by this section is to be coordinated with related work as specified elsewhere in the specifications. Requirements of the following sections apply:

Division 16: "Basic Electrical Materials and Methods."
Division 16: "Wiring Methods."

The system and all associated operations shall be in accordance with the following:

NFPA 72, National Fire Alarm Code, 2007Edition
NFPA 70, National Electrical Code, 2008 Edition
NFPA 101, Life Safety Code, 2009 Edition
NFPA 90A, Standard for the Installation of Air Conditioning and Ventilating Systems, 2009Edition
Local Jurisdictional Adopted Codes and Standards
ADA Accessibility Guidelines

SYSTEM DESCRIPTION

General: Provide a complete, voice evacuation multiplex 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.

Software: The fire alarm system shall allow for loading and editing instructions and operating sequences as necessary.

The system shall be capable of on-site programming to accommodate system expansion and facilitate changes in operation.

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.

Panels shall be capable of full system operation during new site specific configuration download, master exec downloads, and slave exec downloads.

Remote panel site-specific software and executive firmware downloads shall be capable of being performed over proprietary fire alarm network communications and via TCP/IP Ethernet network communications. Ethernet access to any fire alarm panel shall be capable of providing access only to authenticated users through a cryptographically authenticated and secure SSL tunnel.

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.

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.

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.

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.

Wiring/Signal Transmission: Transmission shall be hard-wired using separate individual circuits for each zone of alarm operation, as required or addressable signal transmission, dedicated to fire alarm service only.

System connections for initiating device circuits shall be Class B, Style D, signaling line circuits shall be Class B and notification appliance circuits shall be Class B, Style Y.

Circuit Supervision: Circuit faults shall be indicated by a trouble signal at the FACP. Provide a distinctive indicating audible tone and alphanumeric annunciation.

Constant Supervision Audio: When provided, audio notification appliance circuits shall be supervised during standby by monitoring for DC continuity to end-of-line resistors.

Supplemental Notification and Remote User Access (Fire Panel Internet Interface):

Fire Alarm Control Panel (FACP) shall provide the necessary hardware] to provide supplemental notification and remote user access to the FACP using Ethernet and TCP/IP communications protocol compatible with IEEE Standard 802.3.

A standard RJ-45 Ethernet connection shall connect to the owners Ethernet network. Provisions for that connection must be provided at each fire alarm control panel as part of the contract.

The means of providing supplemental email and SMS text messaging notification shall be agency listed for specific interfaces and for the purpose described in this section. The use of non-listed external third party products and interfaces is not acceptable.

The fire panel internet interface shall be capable of sending automated notification of discrete system events via email and SMS text messaging to up to 50 individual user accounts and via email to up to 5 distribution list.

Each user account and distribution list shall be capable of being configurable for the specific type of events to be received. Each account shall be configurable to receive notification upon any combination of the following types of events:

Fire Alarm
Priority 2
Supervisory
Trouble
Custom Action Messages
Fire Panel Internet Interface Security Violations

Each user account and distribution list shall be capable of being configurable for the specific content to be received. Each account shall be configurable to receive any combination of the following message content:

Summary
Event Information
Message
Emergency Contacts

Host Fire Alarm Control Panel Information: Each user account and distribution list shall be capable of being configurable for the type of Fire Alarm Control Panel Logs and Reports to be received. Each account shall be configurable to receive any combination of the following Logs and Reports via email:

Alarm Log
Trouble Log
Analog Sensor Status Report
Analog Sensor Service Report
Almost Dirty, Dirty and Excessively Dirty Sensor Report
CO Analog Sensor Service Report
Addressable Appliance Candela Report
Addressable Appliance Status Report

Each user account and distribution list shall be capable of receiving email distribution of Fire Alarm Control Panel Logs and Reports On-Demand or automatically on a Pre-Determined schedule. Receipt of Logs and Reports shall be capable of being scheduled as follows:

Weekly
Bi-weekly
Monthly

The Fire Alarm Control Panel Logs and Reports shall be sent in CSV file format which can be imported into common database applications for viewing, sorting, and customization.

Each user account shall be capable of being configured to receive system events via email and/or SMS text messaging.

Each distribution list shall be capable of supporting up to 20 email address recipients.

The means to provide email notification shall be compatible with SMTP mail servers, ISP email services, and Internet email services. Communication with the email server shall be verified at selectable intervals of 5 to 30 minutes.

Email operation shall be capable of being disabled for service by the system administrator.

An email log shall be accessible to authorized users. The email log shall display the 25 most recent email notifications sent.

The fire panel internet interface for supplemental notification and remote user access shall support:

Secure HTTPS/SSL encrypted connections
Up to 50 individual password protected user accounts
Dynamic and Static IP addressing
IP Address Blocking
Restricted number of log-in attempts before lock-out configurable from 1 to 20
Lock-out duration after unsuccessful log-in attempts configurable from 0 to 24 hours
Email notification to Administrators of unsuccessful log-in attempts
Automatic lock-out reset upon a new event
Automatic inactivity logout configurable from 10 minutes to 24 hours
Firmware updates over ethernet
Set-up and configuration via Local Service Port or via Remote Services over LAN/WAN connection

Authorized users shall be capable of accessing the fire alarm panel using a compatible web browser (Internet Explorer 6.0 or higher) and a secure HTTPS/SSL encrypted connection.

The fire panel internet interface shall support concurrent connections for up to 5 users plus 1 administrator.

Authorized users with remote access shall be capable of:

Viewing the fire panel internet interface web home page:

The fire panel internet interface home page shall display system status information and provide links to detailed status information and fire alarm panel reports and history logs.

The web browser on the user's computer shall automatically refresh system status information upon a new event.

Systems that require a manual refresh to acquire updated system status information shall not be accepted.

Viewing the fire alarm panel detailed card status information
Viewing the fire alarm panel detailed point status information
Viewing the fire alarm panel reports and history logs
Viewing the fire panel internet interface email log
Viewing system summary information
Accessing Custom Hypertext Links

The fire panel internet interface home page shall support customization to display the following information:

Customer Name and Address,
Fire Panel Location or Building Name,
Up to 10 Custom Hypertext Links with Text Descriptions

Remote Services Access: Fire Alarm Control Panel (FACP) shall have the capability to provide a remote service access feature using Ethernet and TCP/IP communications protocol compatible with IEEE Standard 802.3. The Remote Access feature shall provide automatic notification of system faults and remote diagnostics of system status for responding technicians prior to arrival on site.

A standard RJ-45 Ethernet connection shall connect to the owners Ethernet network. Provisions for that connection must be provided at each fire alarm control panel as part of the contract.

The Ethernet access feature shall be agency listed for specific interfaces and for the purpose described in this section. The use of non-listed external third party interfaces is not acceptable.

The internet remote access service function shall provide automated real time off-site reporting of discrete system events to a remote service support center with details of internal FACP fault conditions allowing a pre-site visit analysis of repair requirements.

The remote service network shall work on the customers Ethernet infrastructure and be Fire-Wall friendly for two-way communications for off-site reporting. The feature shall be compatible with existing proxy servers and firewalls shall not require any special changes or modifications.

The remote service system shall be able to connect to the remote service center without the need for a VPN account or similar tunnel.

The remote service system shall be a non Windows based application to protect against conventional virus attacks.

The remote service system shall support a secure connection with strong encryption, 128 bit or better, and an optional secondary encryption method if required.

The remote service system shall be compatible with virtual LANS (VLAN).

The remote service system shall work on an outbound communication premise (panel calls home) in order to eliminate the possibility of any inbound connection into the network (from trusted or non trusted sites).

The remote service system shall provide an audit trail of all events and service connections.

The Remote Service connection will provide access for panel software downloads and uploads for archiving job specific programs back at the enterprise server.

The supplier shall provide a service contract for the Remote Service program that provides the following requirements:

24/7 recording of FACP service activity
Off-site diagnostics by a technical specialist to provide repair and parts guidance to the service technician prior to a site visit.

Network communication: Network node communication shall be through a token ring, hub, or star topology configuration, or combination thereof.

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.

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.

Fiber optics communication shall be provided as an option 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.

The communication method shall be NFPA 72 style 7.

Network Synchronization of Notification Appliances

The fire alarm and emergency communications network shall be capable of providing UL Listed synchronization across all the notification appliance circuits for all panels on a network loop in accordance with the requirements of UL 1971.

Systems that require all notification appliances to be connected to a single panel for synchronization thus creating a potential single point of failure shall not be acceptable.

Up to 99 panels on a network loop shall be capable of UL Listed synchronization of all notification appliance circuits across the network loop in accordance with the requirements of UL 1971.

Should network communications be disrupted, re-synchronization shall occur across all nodes that continue to communicate together after network re-initialization is completed and restored to affected nodes.

INTEGRATED SYSTEMS

Security Integration: The FA System shall provide the means to be integrated directly to a Software House C-Cure 9000 or 800 Security Management System (SMS) via a software interface for the purpose of communicating fire alarm events directly to the security system.

Communication between the FA System and SMS shall be accomplished using Computer Port Protocol (CPP).

The FA and the C-Cure SMS shall be connected via a local or network serial port server based RS-232 serial port connection.

The CPP shall consist of a bi-directional serial protocol capable of accessing most of the Fire Alarm Control Panel (FACP) diagnostic features.

The interface shall provide the means to communicate the following information to the C-Cure SMS:

Device/Point status changes (e.g. Fire, Trouble, Disabled)
Panel event status (e.g. Number of Unacknowledged Fire Alarms, Card Failure Troubles, etc.
Panel health status (e.g., AC power, battery status)

Interface software shall include a data acquisition function that provides the following:

Establishes and maintains a supervised serial link
Extraction of the point database from the FACP
Merges the FACP database into the C-Cure SMS database

The software interface shall not allow system control functionality from the C-Cure SMS to the FA System.

The installation, programming and maintenance of the FA/C-Cure integration software interface shall be conducted by factory trained certified technicians.

Building Automation and Control Network (BACnet) Integration:

The fire alarm control unit shall be capable of providing a one-way communications interface between the fire alarm control unit and an industry-standard Building Automation and Control Network (BACnet) using ASHRAE BACnet IP (internet protocol) compliant with ANSI/ASHRAE Standard 135. Interface to the existing Johnson Controls System is required.

The BACnet communications module shall be agency listed to UL Standard 864 or ULC Standard S527.

The fire alarm control unit shall be capable of communicating up to 1000 status changes to the building automation system.

MS/TP Master and MS/TP Slave data link layer options communicating at baud rates up to 76,8000 bps shall be supported.

The interface shall be capable of supporting ANSI X3.4, ISO 10656 (ICS-4), ISO 10656 (UCS-2), ISO 8859-1, or IBM/Microsoft DBCS character sets.

A standard RJ-45 Ethernet connection to the Building Automatoin System Eternet network shall be provided at the fire alarm control unit as part of the contract (systems using relay interface shall not be accepted).

Required Functions: The following are required system functions and operating features:

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.

Non-interfering: 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.

Transmission to an approved Supervising Station: Automatically route alarm, supervisory, and trouble signals to an approved supervising station service provider, under another contract.

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.

Two-way handset communications shall be provided between FACP location and each annunciator panel location.

Selective Alarm: A system alarm shall include:

Indication of alarm condition at the FACP and the annunciator(s).

Identification of the device that is the source of the alarm at the FACP and the annunciator(s).

Operation of audible and visible notification appliances until silenced at FACP.

Selectively closing doors normally held open by magnetic door holders on the fire floor, floor above and floor below.

Unlocking doors for connection and interface with existing access control system.

Shutting down supply and return fans serving zone where alarm is initiated.

Closing smoke dampers on system serving zone where alarm is initiated.

Initiation of smoke control sequence.

Transmission of signal to the supervising station.

Initiation of elevator Phase I functions (recall, shunt trip, illumination of indicator in cab, etc.) in accordance with ASME/ANSI A17.1, when specified detectors or sensors are activated, as appropriate.

Supervisory Operations: Upon activation of a supervisory device such as a fire pump power failure and tamper switch, the system shall operate as follows:

Activate the system supervisory service audible signal and illuminate the LED at the control unit and the remote annunciator.

Pressing the Supervisory Acknowledge Key will silence the supervisory audible signal while maintaining the Supervisory LED "on" indicating off-normal condition.

Record the event in the FACP historical log.
Transmission of supervisory signal to the supervising station.

Restoring the condition shall cause the Supervisory LED to clear and restore the system to normal.

Alarm Silencing: If the "Alarm Silence" button is pressed, all audible alarm signals shall cease operation.

System Reset: 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-alarming the system. The display message shall indicate "ALARM PRESENT, SYSTEM RESET ABORTED."

Should an alarm condition continue the system will remain in an alarmed state.

A manual evacuation (drill) switch shall be provided to operate the notification appliances without causing other control circuits to be activated.

Walktest: The system shall have the capacity of eight (8) programmable pass code-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:

The city circuit connection and any suppression release circuits shall be bypassed for the testing group.

Control relay functions associated with one of the 8 testing groups shall be bypassed. The control unit shall indicate a trouble condition.

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.

The unit shall automatically reset itself after signaling is complete.

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.

Install Mode: The system shall provide the capability to group all non-commissioned points and devices into a single "Install Mode" trouble condition allowing an operator to clearly identify event activations from commissioned points and devices in occupied areas.

It shall be possible to individually remove points from Install Mode as required for phased system commissioning.

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.

Service Gateway: A Service Gateway software application shall be provided that allows an authorized service person to remotely query panel status during testing, commissioning, and service without the need to return to the panel using standard email or instant messaging tools. For systems without a service gateway application the service provider shall provide a minimum of two technicians for any system testing or commissioning.

ANALOG SMOKE SENSORS

Monitoring: FACP shall individually monitor sensors for calibration, sensitivity, and alarm

condition, and shall individually adjust for sensitivity. The control unit shall determine the condition of each sensor by comparing the sensor value to the stored values.

Environmental Compensation: The FACP shall maintain a moving average of the sensor's smoke chamber value to automatically compensate for dust, dirt, and other conditions that could affect detection operations.

Programmable Sensitivity: Photoelectric Smoke Sensors shall have 7 selectable sensitivity levels ranging from 0.2% to 3.7%, programmed and monitored from the FACP.

Sensitivity Testing Reports: The FACP shall provide sensor reports that meet NFPA 72 calibrated test method requirements. The reports shall be viewed on a CRT Display or printed for annual recording and logging of the calibration maintenance schedule.

The FACP shall automatically indicate when an individual sensor needs cleaning. The system shall provide a means to automatically indicate when a sensor requires cleaning. When a sensor's average value reaches a predetermined value, (3) progressive levels of reporting are provided. The first level shall indicate if a sensor is close to a trouble reporting condition and will be indicated on the FACP as "ALMOST DIRTY." This condition provides a means to alert maintenance staff of a sensor approaching dirty without creating a trouble in the system. If this indicator is ignored and the second level is reached, a "DIRTY SENSOR" condition shall be indicated at the FACP and subsequently a system trouble is reported to the Supervising Station. The sensor base LED shall glow steady giving a visible indication at the sensor location. The "DIRTY SENSOR" condition shall not affect the sensitivity level required to alarm the sensor. If a "DIRTY SENSOR" is left unattended, and its average value increases to a third predetermined value, an "EXCESSIVELY DIRTY SENSOR" trouble condition shall be indicated at the control unit.

The FACP shall continuously perform an automatic self-test on each sensor that will check sensor electronics and ensure the accuracy of the values being transmitted. Any sensor that fails this test shall indicate a "SELF TEST ABNORMAL" trouble condition.

Multi-Sensors shall combine photoelectric smoke sensing and heat sensing technologies. An alarm shall be determined by either smoke detection, with selectable sensitivity from 0.2 to 3.7 %/ft obscuration; or heat detection, selectable as fixed temperature or fixed with selectable rate-of-rise; or based on an analysis of the combination of smoke and heat activity.

Programmable Bases: It shall be possible to program relay and sounder bases to operate independently of their associated sensor.

Magnet test activation of smoke sensors shall be distinguished by its label and history log entry as being activated by a magnet.

Smoke Detectors: Provide to the owner, as an option, a maintenance and testing service providing the following:

Biannual sensitivity reading and logging for each smoke sensor.

Scheduled biannual threshold adjustments to maintain proper sensitivity for each smoke sensor.

Threshold adjustment to any smoke sensor that has alarmed the system without the presence of particles of combustion.

Scheduled biannual cleaning or replacement of each smoke detector or sensor within the system.

Semi-annual functional testing of each smoke detector or sensor using the manufacturer's calibrated test tool.
Written documentation of all testing, cleaning, replacing, threshold adjustment, and sensitivity reading for each smoke detector or sensor device within the system.

The initial service included in the bid price shall provide the above listed procedures for a period of five years after owner acceptance of the system.

Audible Alarm Notification: By voice evacuation and tone signals on loudspeakers in areas as indicated on drawings.

Automatic Voice Evacuation Sequence: The audio alarm signal shall consist of an alarm tone for a maximum of five seconds followed by an automatic digital voice message. At the end of the voice message, the alarm tone shall resume. This sequence shall sound continuously until the "Alarm Silence" switch is activated.

The system shall have the capability to broadcast a minimum of (10) prerecorded voice messages. In addition to the prerecorded fire alarm voice evacuation message, provide fire alarm voice evacuation message for approval at submittal stage.

All audio operations shall be activated by the system software so that any required future changes can be facilitated by authorized personnel without any component rewiring or hardware additions.

Zoning of speaker circuits shall be as follows: Each zone shall have a corresponding zone selector switch at the FACP and each Fire Alarm Annunciator Panel.

SOUTH ZONES:	NORTH ZONES:
LEVELS	LEVELS
P0	P3
P1	P4
P2	PL
P3	2
P4	3
PL	4
2	5
3	
4	

Speaker: Speaker notification appliances shall be listed to UL 1480. The speaker shall operate on a standard 25VRMS or 70.7VRMS NAC using twisted/shielded wire.

The following taps are available: 0.25W, 0.50W, 1.0W and 2.0W. At the 1.0W tap, the speaker has minimum UL rated sound pressure level of 84dBA at 10 feet.

The speaker shall have a frequency response of 400 to 4000 Hz for Fire Alarm and 125 to 12kHz for general signaling.

Manual Voice Paging: The system shall be configured to allow voice paging. Upon activation of any speaker manual control switch, the alarm tone shall be sounded over all speakers in that group. This function shall be provided at FACP and each annunciator panel location.

The control panel operator shall be able to make announcements via the push-to-talk paging microphone over the pre-selected speakers.

Total building paging shall be accomplished by the means of an "All Call" switch.

Constant Supervision of Non-Alarm Audio Functions: When required, the system shall be configured to allow Non-Alarm Audio (NAA) functions such as background music or general/public address paging.

During NAA operation, the speaker circuit shall be electrically supervised to provide continuous monitoring of the speaker circuit.

During an alarm condition, supervision shall be disabled and alarm signals delivered to speakers.

Firefighter's Phone: Provide a supervised, two-way communication system between the Command Center/main fire alarm control panel, annunciators, and emergency phones.

The firefighter's phone system shall be capable of handling single or simultaneous conversations with all phones connected into the system. As many as six phones shall be able to be connected into the active conversation.

The phone system circuits shall be designed to prevent static, hum or other interference for clear, intelligible two-way conversation between all phones of the system.

The phone system circuits shall be supervised, such that the FACP shall be able to differentiate between whether a handset has been plugged into the emergency phone jack and whether the circuit has a shorted wire.

A beeping busy signal shall indicate to the person attempting to use a remote phone that the signal is being received at the control unit and that the lines are intact.

The act of plugging a handset into an emergency phone jack or removal of any phone from its normal hook position shall cause an audible and visual indication at the control unit. Picking up of the master phone and acknowledgment of the phone circuit shall silence the tone and allow for direct two-way communications.

The act of unplugging handsets in use and replacement of remote phones to their cradle shall restore normal supervisory functions.

Provide emergency phone jacks for installation in each elevator car by the elevator contractor. Required wiring from elevator controls to each elevator car shall be furnished and installed by the elevator contractor.

Provide emergency phone jacks as shown on the plans. Each jack shall be mounted on a stainless steel single gang plate with the words "Fire Emergency Phone" screened on each. Provide a minimum of five (5) pluggable emergency phones within a storage cabinet.

FIRE SUPPRESSION MONITORING

Water flow: Activation of a water flow switch shall initiate general alarm operations.

Sprinkler valve tamper switch: The activation of any valve tamper switch shall activate system supervisory operations.

WSO: Water flow switch and sprinkler valve tamper switch shall be capable of existing on the same initiating zone. Activation of either device shall distinctly report which device is in alarm on the initiating zone.

Power Requirements: The control unit shall receive AC power via a dedicated fused disconnect circuit.

The system shall be provided with sufficient battery capacity to operate the entire system upon loss of normal AC power in a normal supervisory mode for a period of 24 hours with 15 minutes of alarm operation at the end of this period. The system shall automatically transfer to battery standby upon power failure. All battery charging and recharging operations shall be automatic.

All circuits requiring system-operating power shall be 24 VDC and shall be individually fused at the control unit.

The incoming power to the system shall be supervised so that any power failure will be indicated at the control unit. A green "power on" LED shall be displayed continuously at the user interface while incoming power is present.

The system batteries shall be supervised so that a low battery or a depleted battery condition, or disconnection of the battery shall be indicated at the control unit and displayed for the specific fault type.

The system shall support NAC Lockout feature to prevent subsequent activation of Notification Appliance Circuits after a Depleted Battery condition occurs in order to make use of battery reserve for front panel annunciation and control.

The system shall support 100% of addressable devices in alarm or operated at the same time, under both primary (AC) and secondary (battery) power conditions.

Loss of primary power shall sound a trouble signal at the FACP. FACP shall indicate when the system is operating on an alternate power supply.

SUBMITTALS

General: Submit the following according to Conditions of Contract and Division 1 Specification Sections.

Product data sheets for system components highlighted to indicate the specific products, features, or functions required to meet this specification. 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.

Wiring diagrams from manufacturer.

Shop drawings showing system details including location of FACP, all devices, circuiting and details of graphic annunciator; if this device is indicated on the drawings.

System power and battery charts with performance graphs and voltage drop calculations to assure that the system will operate in accordance with the prescribed backup time periods and under all voltage conditions per UL and NFPA standards.

System operation description including method of operation and supervision of each type of circuit and sequence of operations for all manually and automatically initiated system inputs and outputs. A list of all input and output points in the system shall be provided with a label indicating location or use of IDC, SLC, NAC, relay, sensor, and auxiliary control circuits.

Operating instructions for FACP.

Operation and maintenance data for inclusion in Operating and Maintenance Manual. Include data for each type product, including all features and operating sequences, both automatic and manual. Provide the names, addresses, and telephone numbers of service organizations.

Product certification signed by the manufacturer of the fire alarm system components certifying that their products comply with indicated requirements.

Record of field tests of system.

Submission to Authority Having Jurisdiction: In addition to routine submission of the above material, make an identical submission to the authority having jurisdiction. Include copies of shop drawings as required to depict component locations to facilitate review. Upon receipt of comments from the Authority, make resubmissions, if required, to make clarifications or revisions to obtain approval.

QUALITY ASSURANCE

System warranty shall be for a minimum of one (1) year after Substantial Completion.

Installer Qualifications: A factory authorized installer is to perform the work of this section.

Each and every item of the Fire Alarm System shall be listed under the appropriate category by Underwriters Laboratories, Inc. (UL), and shall bear the "UL" label.

MAINTENANCE SERVICE

Maintenance Service Contract: Provide to the owner, as an option, maintenance of fire alarm systems and equipment for a period of 24 months, using factory-authorized service representatives.

Basic Services: Systematic, routine maintenance visits on a quarterly basis at times scheduled with the Owner. In addition, respond to service calls within 24 hours of notification of system trouble. Adjust and replace defective parts and components with original manufacturer's replacement parts, components, and supplies.

Additional Services: Perform services within the above 24-month period not classified as routine maintenance or as warranty work when authorized in writing. Compensation for additional services must be agreed upon in writing prior to performing services.

Renewal of Maintenance Service Contract: No later than 60 days prior to the expiration of the maintenance services contract, deliver to the Owner a proposal to provide contract maintenance and repair services for an additional one-year term. Owner will be under no obligation to accept maintenance service contract renewal proposal.

EXTRA MATERIALS

General: Furnish extra materials, packaged with protective covering for storage in a lockable cabinet. This cabinet shall be keyed with the same lock that is used on the Fire Alarm Control Panel, Remote Power Supplies, Annunciators and Manual Pull Stations. The quantity of devices shall include:

Break Rods for Manual Stations: Furnish quantity equal to 15 percent of the number of manual stations installed; minimum of 6 rods.

Notification Appliances: Furnish quantity equal to 5 percent of each type and number of units installed, but not less than five (5) of each type.

Smoke Detectors or Sensors, Pull Stations, Fire Detectors, and Flame Detectors: Furnish quantity equal to 5 percent of each type and number of units installed but not less than one of each type.

Detector or Sensor Bases: Furnish quantity equal to 5% of each type and number of units installed but not less than one of each type.

PART 2 – PRODUCTS

FIRE ALARM CONTROL PANEL (FACP)

General: Comply with UL 864, "Control Units and Accessories for Fire Alarm Systems". The following FACP hardware shall be provided:

Power Limited base panel with platinum cabinet and door, 120 VAC input power. 2,000 point capacity where (1) point equals (1) monitor (input) or (1) control (output).

2,000 points of Network Annunciation at FACP Display and annunciator display when applied as a Network Node.

2000 points of annunciation where one (1) point of annunciation equals:

1 LED driver output on a graphic driver or 1 switch input on a graphic switch input module.

1 LED on panel or 1 switch on panel.

From all battery charging circuits in the system provide battery voltage and ammeter readouts on the FACP LCD Display.

Municipal City Circuit Connection with Disconnect switch, 24VDC Remote Station (reverse polarity), local energy, shunt master box, or a form "C" contact output.

One Auxiliary electronically resettable fused 2A @24VDC Output, with programmable disconnect operation for 4-wire detector reset.

One Auxiliary Relay, SPDT 2A @32VDC, programmable as a trouble relay, either as normally energized or de-energized, or as an auxiliary control.

Three (3) Class B or A (Style Y/Z) Notification Appliance Circuits (NAC; rated 3A@24VDC, resistive).

Where required, provide Intelligent Remote Battery Charger for charging up to 110Ah batteries.

Power Supplies with integral intelligent Notification Appliance Circuit [Class B] [Class A] for system expansion.

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.

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.

Remote Unit Interface: Supervised serial communication channel for control and monitoring of remotely located annunciators and I/O panels.

Modular Network Communications Card.

Programmable DACT for either Common Event Reporting or per Point Reporting.

Service Port Modem for dial in passcode access to all fire control panel information.

Voice Alarm: Provide an emergency communication system, integral with the FACP, including voice alarm system components, microphones, amplifiers, and tone generators. Features include:

Amplifiers comply with UL 1711, "Amplifiers for Fire Protective Signaling Systems." Amplifiers shall provide an onboard local mode temporal coded horn tone as a default backup tone. Test switches on the amplifier shall be provided to test and observe amplifier backup switchover. Each amplifier shall communicate to the host panel amplifier and NAC circuit voltage and current levels for display on the user interface. Each amplifier shall be capable of performing constant supervision for non-alarm audio functions such as background music and general paging.

Dual alarm channels, when required by specification, will permit simultaneous transmission of different announcements to different zones or floors automatically or by use of the central control microphone. All announcements are made over dedicated, supervised communication lines. All risers shall support Class B wiring for each audio channel.

Emergency voice communication audio controller module shall provide up to 32 minutes of message memory for digitally stored messages. Provide supervised connections for master microphone and up to 5 remote microphones.

Status annunciator indicating the status of the various voice alarm speaker zones and the status of fire fighter telephone two-way communication zones.

Each annunciator shall be a Redundant Voice Command Center capable of generating voice paging from more than one node in a network audio system.

Evacuation System – Non-Alarm Audio: The fire alarm control panel shall provide non-alarm audio from an owner supplied paging and/or music source over the fire alarm evacuation speakers. This feature shall be an integral part of the fire alarm system, and shall use some or all of the audio components from the fire alarm evacuation system.

The fire alarm system and the non-alarm audio operation shall comply with NFPA 72 requirements for non-emergency purposes at a fire command center that is not constantly attended by a trained operator.

All fire alarm system hardware and software shall be U.L. listed for non-alarm audio use. The fire alarm system shall supervise for system hardware and field wiring faults while playing non-alarm audio over the evacuation speakers. Any hardware failure or speaker circuit fault detected when the system is playing non-alarm audio shall report a trouble on the fire alarm control panel. All audio components used for both the non-alarm audio and the fire alarm evacuation system shall be manufactured by the same supplier.

The non-alarm audio shall have two dedicated audio inputs to the fire alarm control panel. Terminal strip connections and an industry standard RCA receptacle shall be provided at the fire alarm control panel for terminating the owners audio source. The fire alarm input shall be 600-Ohm impedance. The inputs on the fire alarm control panel shall be electrically isolated via an isolation transformer.

The fire alarm control panel shall accept industry standard "line level audio input" from the owner's non-alarm audio source. The fire alarm system hardware and software shall distribute the audio over the fire alarm evacuation speakers. The selection of which speaker zones to distribute the non-alarm audio to the building occupants shall be coordinated with the Owner's representative.

The fire alarm control panel shall be able to make audio input level adjustments from the Owner's non-alarm audio source. This adjustment will match the non-alarm audio source to the fire alarm input. After the audio levels are adjusted, the owner shall control the volume level from the non-alarm audio source.
The fire alarm system will provide "buttons" have the capability to provide operator "buttons" that will adjust the volume level of pre-assigned non-alarm audio zones. The volume level of non-alarm audio that is being broadcast to any audio zone will also be individually adjustable by time of day via a pre-specified schedule.

The non-alarm audio shall be the lowest priory audio on the fire alarm system. The non-alarm audio shall not interfere with any of the fire alarm emergency signals that may include live voice, pre-recorded emergency voice messages, or any alert tones. Switches shall be located on the fire alarm control panel to turn on or off the non-alarm audio system feature. The fire alarm control panel shall have LED lamps to indicate the ON vs. OFF status of the non-alarm audio feature. Speaker circuits that are actively broadcasting non-alarm audio will also be indicated by LEDs.

The non-alarm audio shall be synchronized throughout the fire alarm life safety system amplifiers and speaker circuits. Any remote amplifier panels located on the fire alarm system network shall also be synchronized. The system shall be capable of accepting a system-wide non-alarm audio input at the main fire alarm control or another local non-alarm audio input at a remote amplifier panel to serve only the areas served by that remote panel.

Multiple non-alarm audio sources must be accessible by the fire alarm non-alarm audio system. Each separate non-alarm audio source will have the ability to be broadcast into a distinct fire zone, depending on occupant preference. Any system restricted to a limited number of non-audio sources will not be accepted. The system must have the capability of broadcasting an unlimited number of non-alarm sources, except as determined by the number of individual fire zones served by the fire alarm system.

Non-alarm audio shall be automatically turned off in the event of primary power failure to the fire alarm control panel or any of the remote amplifier panels controlled by the main fire alarm control panel.

Fire fighters' telephone communication system: Arrange system to use dedicated, two-way, supervised voice communication links between the FACP and remote fire fighters' telephone stations throughout the building.

Distributed Module Operation: FACP shall be capable of allowing remote location of the following modules; interface of such modules shall be through a Style 4 (Class B)] supervised serial communications channel (SLC):

Amplifiers, voice and telephone control circuits
Addressable Signaling Line Circuits
Initiating Device Circuits
Notification Appliance Circuits
Auxiliary Control Circuits
Graphic Annunciator LED/Switch Control Modules

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.

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.

SMOKE CONTROL SYSTEM

Provide a smoke control system which is UL 864 (UUKL product category) listed for smoke control system service. The system shall provide automatic operation of smoke exhaust fans, makeup air fans, air handling units, and dampers in accordance with the smoke control sequence indicated on the drawings. The smoke control system shall be located in the fire command center.

Provide and install smoke control relays within 3' of each smoke exhaust fan controller, makeup air fan controller, air handling unit controller, and damper controlled by the smoke control system. The building automation/temperature control system contractor shall terminate the relays to the fan controllers, air handling unit controllers, and dampers.

Provide and install addressable modules to monitor status/operation of each smoke exhaust fan, makeup air fan, air handling unit, and damper controlled by the smoke control system. The fire alarm contractor shall terminate the modules to status indicators.

Enclosure: Finish to match the Fire Alarm Control Units. The locking cover/display assembly is hinged on the left. Key and lock shall be common to all secured fire alarm system enclosures.

SMOKE CONTROL SYSTEM GRAPHIC ANNUNCIATOR – LED TYPE

Annunciator Unit (zoned system): Provide an LED indicating light located on the graphic annunciator to indicate the status for all smoke control equipment. In addition, the systems with two or more smoke Control System Graphic Annunciators, each annunciator shall be programmable to allow multiple annunciators to have equal operation priority or to allow hierarchal priority control to be assigned to individual annunciators (locations).

Fans, dampers, and other operating equipment in normal status shall be indicated by a GREEN LED. Fans, dampers, and other operating equipment in off or closed status shall be indicated by a RED LED. Fans, dampers, and other operating equipment in fault status shall be indicated by a YELLOW LED. The annunciator shall graphically depict the building arrangement and smoke control system zones. Fans, major ducts, dampers, and airflow direction shall be indicated.

Provide HOA switches labeled ON-AUTO-OFF on the annunciator to permit the firefighters' manual control of each individual smoke control fan or air handling unit. HOA switches labeled OPEN-AUTO-CLOSE shall be provided on the annunciator for each individual smoke control damper.

Provide a toggle or push-button switch to test the LEDs mounted on the unit. The test switch does not require key operation.

Provide a HOA switch labeled OPEN-AUTO-LOCK on the annunciator for each stairway to permit firefighters' manual control of stairway door locks in accordance with local codes.

In the normal switch position, the fans, air handling units, or dampers operate automatically as controlled by the building automation/temperature control system. Automatic controls can be overridden with the HOA switches provided on the graphic annunciator. The operation of the HOA switches shall permit manual control and override of any conflicting signal from the building automation/temperature control system or any other system.

Enclosure: Finish to match Fire Alarm Control Units. The locking cover/display assembly is hinged on the left. Key and lock shall be common to all secured fire alarm system enclosures.

FIRE FIGHTERS' TELEPHONES

Telephone Hand Sets: High-impact plastic handset, heavy-duty coil cord, and hook switch; connected to the FACP by means of dedicated, supervised communication lines. Handsets have a dynamic receiver and a carbon transmitter, operating on 24VDC.

A black master telephone handset with a push to talk button and a flexible-coiled self-winding five (5) foot cord shall be provided and recessed within a protective unit-mounted enclosure at the command center.

Cabinet: Flush- or surface-mounted as indicated, 18-gage, minimum, painted steel with a latched hinged door with trim labeled "Fire Fighters' Phone." Size to accommodate handset and cord.

REMOTE LCD ANNUNCIATORS

Provide a remote LCD Annunciators, where indicated on the drawings, with the same "look and feel" as the FACP operator interface. The Remote LCD Annunciators shall use the same Primary Acknowledge, Silence, and Reset Keys; Status LEDs and LCD Display as the FACP.

Each annunciator shall have two-way communications with FACP location via handset.

Annunciator shall have super-twist LCD display with two lines of 40 characters each. Annunciator shall be provided with four (4) programmable control switches and associated LEDs.

Under normal conditions the LCD shall display a "SYSTEM IS NORMAL" message and the current time and date.

Should an abnormal condition be detected the appropriate LED (Alarm, Supervisory or Trouble) shall flash. The unit audible signal shall pulse for alarm conditions and sound steady for trouble and supervisory conditions.

The LCD shall display the following information relative to the abnormal condition of a point in the system:

40 character custom location label.
Type of device (e.g., smoke, pull station, waterflow).
Point status (e.g., alarm, trouble).

Operator keys shall be key switch enabled to prevent unauthorized use. The key shall only be removable in the disabled position. Acknowledge, Silence and Reset operation shall be the same as the FACP.

NETWORK ANNUNCIATORS

Network Display Unit Shall Contain the Following Features: 80 columns by 2 lines LCD display to indicate alarm, supervisory and component status messages, and shall include a keypad for use in entering and executing control commands.

Capacity to annunciate 12,000 network points and/or point lists.

Historical event logs shall maintain separate 600 Alarm and 600 Trouble events.

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.

TRUESITE GRAPHICAL WORKSTATION (TSW)

Graphical Workstation: Shall consist of UL 864 Listed for Annunciation and Control/Industrial Grade Core 2 Duo 2.16 GHZ Desktop or Core 2 Duo 2.16 GHZ Rack mount, (minimum) Personal Computer with detachable keyboard and mouse with required operating system

Two 500 GB Hard Drives (minimum) capacity with RAID 5, real-time, mirror imaging operation and survivability on Core 2 Duo PC. Should a failure occur on any one hard drive, the workstation operation shall immediately transfer to the alternate mirror drive without loss of operation and a trouble shall be reported on the Graphical Workstation until the failure mode has been cleared.

42" 1280 x 1024 high-resolution color LCD monitors with touch screen operation
CD/DVD Read/Write
8GB RAM (minimum)
Onboard Video for up to two displays
Core 2 Duo PC with 3 available USB Ports,1 Dedicated for Security Dongle
Two Ethernet Ports to support Remote Clients over Ethernet 24 hours minimum capacity
Integrated email Notification Service
USB Port for Event Printer
120 VAC UPS Primary and Secondary Standby Power Supply, UL1481 Listed for use with the Fire Alarm Graphical Workstation.
Pre-programmed functions

Field editor for graphics representations with ability to Import and Export AutoCAD graphic files
AutoCAD File Import shall support importing of DWG files up to AutoCAD Version 2011 and DXF files in AutoCAD Version R14 or 2000 formats
AutoCAD File Export shall support DWG/DXF file export in AutoCAD 2000 format for compatibility with any AutoCAD Version 2000 or higher programs

Capability to interface to Legacy 2120 Multiplex Systems on Core 2 Duo Workstations.

A fully functional Network Node communicating on the network. Capability to interface with up to seven (7) Network Loops on Core 2 Duo Workstations or two (2) Network Loops on i5 All-in-One Workstations.

The graphical workstation shall be capable of the following operations:

Dynamic pan-and-zoom operation, systems that require multiple graphic screens for each zoom-in/zoom-out view are not acceptable
Ability to create predefined zoom levels for rapid zoom into predefined areas within a graphic screen
Ability to automatically jump to a graphic screen or a predefined zoom level within a screen for each device upon an abnormal status change
Core 2 Duo Workstation support for Quad monitor operation with floatable/dockable windows allowing individual windows to be simultaneously displayed on up to four separate monitors. At minimum the graphical workstation shall be able to display the Main Banner with Active List, a Graphic Screen, a Historical Log or System Report, or an Active Web Page (such as a webcam video display) separately on individual monitors.

Information displayed for Point Status, Control, Alarm Lists, Historical Logs, and Reports shall be capable of being sorted by individual categories of information; e.g., Number, Time, Date, Event, Detail, Status, etc.
42" screen resolution up to 1920 x 1200 color
Ability to assign operator preferences on a per operator basis. The selectable operator preferences shall be:

Font Size: Small or Large
Toolbar Size: Small or Large
User Interface Theme: MS Office 2003 or System Theme
Menu Bar and Toolbar Options: Show/Hide Menu bar, Show/Hide Toolbar

Graphic files shall be capable of being modified in the graphical workstation editor or exported back to AutoCAD file formats where files can be edited in AutoCAD and re-imported for system changes and upgrades

It shall be possible to import a custom site-specific system banner bitmap used to display a corporate logo or other user preferred system banner background

It shall be possible to import a custom site-specific main screen bitmap used to display a corporate logo, facility photograph and layout, or other user preferred main screen background image

The graphical workstation shall have a configurable inactivity timer that automatically logs out inactive users based on a pre-defined inactivity time limit. When no user is logged in, the

graphical workstation shall provide view access to system activity. Login to the system shall be required for access to additional control operations.

It shall be possible to assign a different WAV file notification signal for each abnormal event category; Fire, Priority 2, Supervisory or Trouble, that shall be played at the Server and Remote Clients.

The graphical workstation shall be capable of displaying separate Active List for Alarm, Priority 2, Supervisory, and Trouble event categories. Each Active List event category shall be capable of displaying up to 2,900 events.

The Graphical Workstation shall operate by receiving system events and displaying specified graphic representations of the building(s), and system devices. Individual system events shall include a description of the building or area associated with each point in the workstation's views and reports.

The workstation monitor shall be touch sensitive and serve as the interactive interface between the operator and the network system. From the touch screen or mouse the operator shall be able to perform the following tasks:

Silence signals
Acknowledge all alarm supervisory and trouble events and return to normal conditions
Log operator notes associated with individual event activity
Select a command link from a graphic screen to call-up an associated web-page, web-camera, or web-link. The web page command link shall be capable of being manually operated or operated automatically when the graphic screen is loaded.
Reset system
Display list menus
Select the individual message screens
Perform manual operation of system(s) control points
Enable points into Test Mode to allow testing of selective devices without nuisance interruptions to the workstation operator

Test Mode events shall be recorded in the background to the workstation's historical logs. Test mode historical log events shall be flagged with a Test Mode Indicator for easy identification.

Request the "HELP" menu
Perform operator login / logout
Generate reports that can be printed or saved as an electronic textfile. Reports shall include Historical Log, Analog Device Status Report, Analog Device Service Report, AMZ Calibration Report, and Active List Report.
Connect (Set Host) to other nodes
Perform graphic editing functions
Set the system time and date

The unit shall be equipped with at least seven (7) levels of password-protected access. Remote Ethernet Client Support: The Graphical Workstation server shall be capable of supporting up to 20 Simultaneous Remote Client Connections over Ethernet. When the maximum simultaneous client connections have been reached a notice shall be communicated to any additional client connection attempts indicating the connection capacity limit has been reached.

Remote Clients shall be configurable for "Restricted Feature" view only or for "Protected Feature" full control operation.

Each Remote Client shall be configurable for Supervised or Unsupervised operation. Loss of communication with a supervised client shall be indicated at both the server and the remote supervised client. Loss of communication to an unsupervised client shall be indicated at the remote client only.

Remote Client operation shall be independent of the server whereas an operator at the remote client location shall be able to view graphics and text and control the system, independent of the server.

It shall be possible to vector information to Remote Supervised Clients by selecting which points and/or event categories (Alarm, Priority 2, Supervisory, Trouble) are to be displayed at each Remote Supervised Client.

A minimum 3 Mb/s connection speed shall be provided to Remote Clients

Logins/Logouts at Remote Clients shall be logged in the Historical Log. Supervised Clients shall be specified by client name.

The Graphical Workstation server shall be capable of supporting both Agency Listed Fire Alarm Ethernet LAN Applications and Supplemental Annunciation over the Customer's Ethernet LAN/WAN. Where a Fire Alarm Ethernet LAN is specified only Agency Listed Ethernet hardware shall be installed.

DACR Support: For fire alarm control panels that are not network compatible or may be to remote for a network connection, the Graphical Workstation shall be capable of, and agency listed for, communication with a Sur-Gard DACR model MLR2-DG, Sur-Gard DACR model System III, Bosch D6600, Bosch D6100i, AES Intellinet 7705i, Digital Alarm Communicating Receiver (DACR) via an RS-232 port. Remote fire alarm panels equipped with DACTs shall communicate their local event status (or individual point status if capable) to the DACR using [dial-up telephone connections TCP/IP protocol. The DACR shall forward the individual panel status to the Graphical Workstation for information processing and history logging.

Email Support: The graphical workstation shall have the ability to transmit email notifications when events occur on the graphical workstation.

Up to 50 user email accounts shall be supported.

Each email user account shall be configurable to receive one or more types of events (Fire, Priority 2, Supervisory, and/or Trouble).

The email content shall be selectable to include or exclude pre-defined message content allowing the size and content of the email message to be managed.

Graphical Workstation Operating Modes: When no alarms or troubles are present, the workstation monitor shall display a graphics screen menu used to access other graphic screens. Each screen shall also display current time and date, system status, and present operator name and access level.

Upon activation of any alarm and on request by the operator, the workstation monitor shall display the floor plan for the device in alarm of the floor in alarm with all devices shown. The device in alarm shall flash until acknowledged. The device in alarm shall then become steady until cleared.

If a second alarm is registered prior to the first being cleared, the second shall be identified by flashing, pending alarm indication. Touching the pending alarm area shall transfer the display to the second alarm point graphic screen. All subsequent alarms shall be displayed as indicated above. Alternately, the graphical workstation shall be configurable to automatically jump to the graphic screen for the device in alarm. If the auto jump operation is selected and the point in alarm is not associated with a graphic screen, the application shall jump to the active alarm list. The Graphical Workstation shall cause a "Trouble" condition on all other Network Nodes to indicate an off-line condition.

The Graphical Workstation shall have the capacity to annunciate 50,000 network point and/or point lists.

Historical event logs shall maintain up to 500,000 system events.

Built-in diagnostics shall provide graphical views of the network topology and status. Network communication breaks or inactive nodes shall be clearly indicated as a guide in returning the system to normal.

Individual point access shall display "real-time" analog sensor point information.

The Work Station shall include an oak three drawer desk (30"D x 72"W x 32"H) with professional roller chair.

The Graphical Workstation shall have the following editing functions:

Message Editor: System shall have the capability of on-site adding, changing, deleting or assigning of message screens.

List Editor: System shall have the capability of on-site editing of customer user lists.

Graphics Editor: System shall have the capability of on-site editing of graphics screens. Graphics editor shall have the capability of changing background graphics and adding or deleting point symbols. Capacity to create and edit up to 25,000 Graphic Screens.

Operating System Compatibility: The Graphical Workstation Server shall be compatible with the following operating systems:

Windows 7 Professional, 32 Bit, with Service Pack 1 or higher
Windows 7 Enterprise, 32 bit

Graphical Workstation Clients shall be compatible with the following operating systems:

Windows 7 Professional, 32 Bit, with Service Pack 1 or higher
Windows 7 Enterprise, 32 bit
Windows 7 Home Premium, 32 bit

EMERGENCY POWER SUPPLY

General: Components include battery, charger, and an automatic transfer switch.

Battery: Sealed lead-acid or nickel cadmium type. Provide sufficient capacity to operate the complete alarm system in normal or supervisory (non-alarm) mode for a period of 24hours. Following this period of operation on battery power, the battery shall have sufficient capacity to

operate all components of the system, including all alarm notification devices in alarm mode for a period of 5 minutes.

ADDRESSABLE MANUAL PULL STATIONS

Description: Addressable single- or double-action type, red LEXAN, with molded, raised-letter operating instructions of contrasting color. Station will mechanically latch upon operation and remain so until manually reset by opening with a key common with the control units.

Protective Shield: Where required as indicated on the drawings, provide a tamperproof, clear LEXAN shield and red frame that easily fits the manual pull stations. When shield is lifted to gain access to the station, a battery powered piercing warning horn shall be activated. The horn shall be silenced by lowering and realigning the shield. The horn shall provide 85dB at 10' and shall be powered by a 9 VDC battery.

SMOKE SENSORS

General: Comply with UL 268, "Smoke Detectors for Fire Protective Signaling Systems." Include the following features:

Factory Nameplate: Serial number and type identification.

Operating Voltage: 24 VDC, nominal.

Self-Restoring: Detectors do not require resetting or readjustment after actuation to restore normal operation.

Plug-In Arrangement: Sensor and associated electronic components are mounted in a module that connects to a fixed base with a twist-locking plug connection. Base shall provide break-off plastic tab that can be removed to engage the head/base locking mechanism. No special tools shall be required to remove head once it has been locked. Removal of the detector head shall interrupt the supervisory circuit of the fire alarm detection loop and cause a trouble signal at the control unit.

Quick Connect Arrangement: Photoelectric sensor and electronics in a single piece construction which shall twist-lock onto a mounting base that attaches to a standard electrical box.

Each sensor base shall contain an LED that will flash each time it is scanned by the Control Unit (once every 4 seconds). In alarm condition, the sensor base LED shall be on steady.

Each sensor base shall contain a magnetically actuated test switch to provide for easy alarm testing at the sensor location.

Each sensor shall be scanned by the Control Unit for its type identification to prevent inadvertent substitution of another sensor type. Upon detection of a "wrong device", the control unit shall operate with the installed device at the default alarm settings for that sensor; 2.5% obscuration for photoelectric sensor, 135-deg F and 15-deg F rate-of-rise for the heat sensor, but shall indicate a "Wrong Device" trouble condition.

The sensor's electronics shall be immune from nuisance alarms caused by EMI and RFI.

Sensors include a communication transmitter and receiver in the mounting base having a unique identification and capability for status reporting to the FACP. Sensor address shall be located in base to eliminate false addressing when replacing sensors.

Removal of the sensor head for cleaning shall not require the setting of addresses.

Type: Smoke sensors shall be of the photoelectric or combination photoelectric / heat type.

Bases: Relay output, sounder and isolator bases shall be supported alternatives to the standard base.

Duct Smoke Sensor: Photoelectric type, with sampling tube of design and dimensions as recommended by the manufacturer for the specific duct size and installation conditions were applied. Sensor includes relay as required for fan shutdown.

Environmental compensation, programmable sensitivity settings, status testing, and monitoring of sensor dirt accumulation for the duct smoke sensor shall be provided by the FACP.

The Duct Housing shall provide a supervised relay driver circuit for driving up to 15 relays with a single "Form C" contact rated at 7A@ 28VDC or 10A@ 120VAC. This auxiliary relay output shall be fully programmable. Relay shall be mounted within 3 feet of HVAC control circuit.

Duct Housing shall provide a relay control trouble indicator Yellow LED.

Duct Housing shall have a transparent cover to monitor for the presence of smoke. Cover shall secure to housing by means of four (4) captive fastening screws.

Duct Housing shall provide two (2) Test Ports for measuring airflow and for testing. These ports will allow aerosol injection in order to test the activation of the duct smoke sensor.

Duct Housing shall provide a magnetic test area and Red sensor status LED.

For maintenance purposes, it shall be possible to clean the duct housing sampling tubes by accessing them through the duct housing front cover.
Each duct smoke sensor shall have a Remote Test Station with an alarm LED and test switch.

Where indicated provide NEMA 4X weatherproof duct housing enclosure that shall provide for the circulation of conditioned air around the internally mounted addressable duct sensor housing to maintain the sensor housing at its rated temperature range. The housing shall be UL Listed to Standard 268A.

HEAT SENSORS

Thermal Sensor: Combination fixed-temperature and rate-of-rise unit with plug-in base and alarm indication lamp; 135-deg F fixed-temperature setting except as indicated.

Thermal sensor shall be of the epoxy encapsulated electronic design. It shall be thermistor-based, rate-compensated, self-restoring and shall not be affected by thermal lag.

Sensor fixed temperature sensing shall be independent of rate-of-rise sensing and] programmable to operate at 135-deg F or 155-deg F. Sensor rate-of-rise temperature detection shall be selectable at the FACP for either 15-deg F or 20-deg F per minute.

Sensor shall have the capability to be programmed as a utility monitoring device to monitor for temperature extremes in the range from 32-deg F to 155-deg F.

VERY EARLY SMOKE DETECTION SYSTEM

Provide an air sampling smoke detection system (Very Early Smoke Detection Apparatus – VESDA) for each area shown in the Contract Documents. Provide a [LaserFocus air sampling smoke detection system for areas up to 2500 sf] [LaserCOMPACT air sampling smoke detection system for areas up to 8000 sf] [Laser PLUS air sampling smoke detection system for areas up to 20,000 sf] in accordance with manufacturer's recommendations.

The air sampling smoke detection system shall consist of highly sensitive smoke detectors with aspirating fans, air sampling pipe network, filters, networked controllers, and a high level interface to the building Fire Alarm System, as required.

The air sampling detectors shall provide a nominal obscuration level range from .0015 to 6% /ft, adjustable through the system operator control interface.

Multiple VESDA systems serving protected areas shall be integrated via closed loop VESDAnet 2-wire communications and a high level RS-232 interface with the building Fire Alarm System. The system will provide access to all VESDA features and functions through the Fire larm Control Panel operator's interface.

The Fire Alarm System supplier shall coordinate the installation and testing of the VESDA system, in accordance with applicable codes and the Contract Documents. Provide complete VESDA system design, installation, interface, and programming to include the following?

Smoke Detector Assembly: The smoke detector, filter, and aspirating fan shall be hosued in a Detector Control Assembly Enclosure and arrange din such a way that air is drawn from the protected area through the filter and detector by the aspirating fan.

The Detector Control Assembly shall house the programmable intelligent controller, which will support air flow/detector supervision, automatic and manual sensitivity adjustment, time delay, and remote reset functions. LaserCOMPACT detector shall communicate with the FACP via IDNet channel.

The system shall provide three field selectable levels of alarm status: Alert Level 1 (.04% obscuration/ft), pre-Alarm Level 2 (.06% obscuration/ft), and Alarm Level 3 (2.6% obscuration/ft). Actual sensitivity levels will be determined in the field and programmed during system commissioning. Alarm Levels 1 and 2 will initiate a Supervisory Condition on the Fire Alarm System and Alarm Level 3 will initiate the building-wide evacuation sequence as described elsewhere in the Contract Documents.

Air Sampling Pipe Network: Shall consist of a ¾" nominal inside diameter pipe arranged to provide optimal efficiency and air transport times which shall not exceed 60 seconds from the furthest point on the network. Sampling points shall be separated at intervals specified in NFPA 72; not more than 30' and typically in the range of 13' to 26' intervals along the path of the piping network. Air sampling calculations shall be provided from a registered VESDA sampling pipe aspiration modeling program ASPIRE rev. 1.8 or later.

High Level Interface: Where VESDAnet is used, provide interface module integral to the Fire Alarm Control Panel with connection to the High Level Interface Module and installed in the VESDAnet equipment rack assembly.

ADDRESSABLE CIRCUIT INTERFACE MODULES

Addressable Circuit Interface Modules: Arrange to monitor or control one or more system components that are not otherwise equipped for addressable communication. Modules shall be used for monitoring of waterflow, valve tamper, non-addressable devices, and for control of AHU systems.

Addressable Circuit Interface Modules will be capable of mounting in a standard electric outlet box. Modules will include cover plates to allow surface or flush mounting. Modules will receive their operating power from the signaling line circuit or a separate two wire pair running from an appropriate power supply, as required.

There shall be the following types of modules:

Type 1 Monitor Circuit Interface Module: For conventional 2-wire smoke detector and/or contact device monitoring with Class B or Class A wiring supervision. The supervision of the zone wiring will be Class B. This module will communicate status (normal, alarm, trouble) to the FACP.

For conventional 4-wire smoke detector with Class B wiring supervision. The module will provide detector reset capability and over-current power protection for the 4-wire detector. This module will communicate status (normal, alarm, trouble) to the FACP.

Type 2 Line Powered Monitor Circuit Interface Module: This type of module is an individually addressable module that has both its power and its communications supplied by the two wire signaling line circuit. It provides location specific addressability to an initiating device by monitoring normally open dry contacts. This module shall have the capability of communicating four zone status conditions (normal, alarm, current limited, trouble) to the FACP.

This module shall provide location specific addressability for up to five initiating devices by monitoring normally closed or normally open dry contact security devices. The module shall communicate four zone status conditions (open, normal, abnormal, and short). The two-wire signaling line circuit shall supply power and communications to the module.

Type 3 Single Address Multi-Point Interface Modules: This multipoint module shall provide location specific addressability for four initiating circuits and control two output relays from a single address. Inputs shall provide supervised monitoring of normally open, dry contacts and be capable of communicating four zone status conditions (normal, open, current limited, and short). The input circuits and output relay operation shall be controlled independently and disabled separately.

This dual point module shall provide a supervised multi-state input and a relay output, using a single address. The input shall provide supervised monitoring of two normally open, dry contacts with a single point and be capable of communicating four zone status conditions (normal, open, current limited, and short). The two-wire signaling line circuit shall supply power and communications to the module.

This dual point module shall monitor an unsupervised normally open, dry contact with one point and control an output relay with the other point, using a single address. The two-wire signaling line circuit shall supply power and communications to the module.

Type 4 Line Powered Control Circuit Interface Module: This module shall provide control and status tracking of a Form "C" contact. The two-wire signaling line circuit shall supply power and communications to the module.

Type 5 4-20 mA Analog Monitor Circuit Interface Module: This module shall communicate the status of a compatible 4-20 mA sensor to the FACP. The FACP shall annunciate up to three threshold levels, each with custom action message; display and archive actual sensor analog levels; and permit sensor calibration date recording.

All Circuit Interface Modules shall be supervised and uniquely identified by the control unit. Module identification shall be transmitted to the control unit for processing according to the program instructions. Modules shall have an on-board LED to provide an indication that the module is powered and communicating with the FACP. The LEDs shall provide a troubleshooting aid since the LED blinks on poll whenever the peripheral is powered and communicating.

MAGNETIC DOOR HOLDERS

Description: Units shall be listed to UL 228. Units are equipped for wall or floor mounting as indicated and are complete with matching door plate. Unit shall operate from a 120VAC, a 24VAC or a 24VDC source, and develop a minimum of 25 lbs. holding force.

Material and Finish: Match door hardware.

ADDRESSABLE ALARM NOTIFICATION APPLIANCES

Addressable Notification Appliances: The Contractor shall furnish and install Addressable Notification Appliances and accessories to operate on compatible signaling line circuits (SLC).

Addressable Notification appliance operation shall provide power, supervision and separate control of horns and strobes over a single pair of wires. The controlling channel (SLC) digitally communicates with each appliance and receives a response to verify the appliance's presence on the channel. The channel provides a digital command to control appliance operation. SLC channel wiring shall be unshielded twisted pair (UTP), with a capacitance rating of less than 60pf/ft and a minimum 3 twists (turns) per foot.

Class B (Style 4) notification appliances shall be wired without requiring traditional in/out wiring methods; addressable "T" Tapping shall be permitted. Up to 63 appliances can be supported on a single channel.

Each Addressable notification appliance shall contain an electronic module and a selectable address setting to allow it to occupy a unique location on the channel. This on-board module shall also allow the channel to perform appliance diagnostics that assist with installation and subsequent test operations. A visible LED on each appliance shall provide verification of communications and shall flash with the appliances address setting when locally requested using a magnetic test tool.

Addressable Controller: Addressable Controller shall supervise Channel (SLC) wiring, communicate with and control addressable notification appliances. It shall be possible to program the High/Lo setting of the audible (horn) appliances by channel from the addressable controller.

Visible/Only: Addressable strobe shall be listed to UL 1971. The V/O shall consist of a xenon flash tube and associated lens/reflector system. The V/O enclosure shall mount directly to standard single gang, double gang or 4" square electrical box, without the use of special adapters or trim rings. Appliances shall be wired with UTP conductors, having a minimum of 3 twists per foot. V/O appliances shall be provided with different minimum flash intensities of 15cd, 75cd and 110cd. Provide a label inside the strobe lens to indicate the listed candela rating of the specific Visible/Only appliance.

Speaker/Visible: Combination Speaker/Visible (S/V) units combine the speaker and visible functions into a common housing. The S/V shall be listed to UL 1971 and UL 1480. Addressable functionality controls visible operation, while the speaker operates on a 25VRMS or 70.7VRMS NAC.

Twisted/shielded wire is required for speaker connections on a standard 25VRMS or 70.7VRMS NAC and UTP conductors, having a minimum of 3 twists per foot is required for addressable strobe connections.

The following taps are available: 0.25W, 0.50W, 1.0W and 2.0W. At the 1.0W tap, the speaker has minimum UL rated sound pressure level of 84dBA at 10 feet.

The S/V shall have a frequency response of 400 to 4000 Hz for Fire Alarm and 125 to 12kHz for general signaling.

The S/V installs directly to a 4" square, 1 ½" deep electrical box with 1 ½" extension.

Isolator Module: Isolator module provides short circuit isolation for addressable notification appliance SLC wiring. Isolator shall be listed to UL 864. The Isolator shall mount directly to a minimum 2 1/8" deep, standard 4" square electrical box, without the use of special adapter or trim rings. Power and communications shall be supplied by the Addressable Controller channel SLC; dual port design shall accept communications and power from either port and shall automatically isolate one port from the other when a short circuit occurs. The following functionality shall be included in the Isolator module:

Report faults to the host FACP.

On-board Yellow LED provides module status.

After the wiring fault is repaired, the Isolator modules shall test the lines and automatically restore the connection.

Addressable Textual Notification Appliance: Textual Notification Appliance, where indicated on the drawings, is to operate on a compatible Signaling Line Circuit (SLC) and is to provide a high visibility, multi-color LED text message display.

Textual Notification Appliance shall be Listed to UL 1638 Visual Signaling Appliances.

Appliance shall be capable of up to thirty two (32) pre-programmed message selections that can be activated in response to pre-defined emergency situations or linked to specific system point status conditions.

Textual Notification Appliance shall be capable of displaying dual or single line emergency instructions. Instructions can show as static, flashing, or scrolling with a variety of appearance/transition options. Instructions shall be capable of displaying using multi-colors to emphasize instructions content.

Textual Notification Appliance shall be capable of providing non-emergency information during non-emergency conditions. Emergency conditions will override non-emergency message/instructions and display emergency instructions.

Textual Notification Appliance shall be capable of scrolling instructions of at least 512 characters in length.

Textual Notification Appliance shall be viewable from a distance of 100 feet.

Textual Notification Appliance shall be powered by a listed fire alarm power supply providing 24VDC with battery back-up.

Textual Notification Appliance shall be capable of wall or ceiling mounting options.

Accessories: The contractor shall furnish the necessary accessories.

TRUEALERT ADDRESSABLE APPLIANCES NAC POWER EXTENDER

The TrueAlert Addressable Controller shall be a stand-alone panel capable of powering a minimum of 3 TrueAlert Signaling line circuits. Each channel shall be rated for 2.5 amps and support up to 63 TrueAlert addressable notification appliances. Power and communication for the notification appliances shall be provided on the same pair of wires.

Addressable SLC notification appliance circuits shall be Class B, Style 4.

The internal power supply & battery charger shall be capable of charging up 12.7 Ah batteries internally mounted or 18Ah batteries mounted in an external cabinet.

The NAC extender panel may be mounted close to the host control panel or can be remotely located.

PART 3 – EXECUTION

INSTALLATION – GENERAL

Install system components and all associated devices in accordance with applicable NFPA Standards and manufacturer's recommendations.

Installation personnel shall be supervised by persons who are qualified and experienced in the installation, inspection, and testing of fire alarm systems. Examples of qualified personnel shall include, but not be limited to, the following:

Factory trained and certified personnel.

National Institute of Certification in Engineering Technologies (NICET) fire alarm level II certified personnel.

Personnel licensed or certified by state or local authority.

EQUIPMENT INSTALLATION

Furnish and install a complete Fire Alarm System as described herein and as shown on the plans. Include sufficient control unit(s), annunciator(s), manual stations, automatic fire detectors, smoke detectors, audible and visible notification appliances, wiring, terminations, electrical boxes, ethernet drops, and all other necessary material for a complete operating system.

Equipment Removal: After acceptance of the new fire alarm system, disconnect and remove the existing fire alarm equipment and restore damaged surfaces. Package operational fire alarm and

detection equipment that has been removed and deliver to the Owner. Remove from the site and legally dispose of the remainder of the existing material.

Water-Flow and Valve Supervisory Switches: Connect for each sprinkler valve required to be supervised.

Device Location-Indicating Lights: Locate in the public space immediately adjacent to the device they monitor.

Install manual station with operating handle 48 inches (1.22 m) above floor. Install wall mounted audible and visual notification appliances not less than 80 inches (2.03 m) above floor to bottom of lens and not greater than 96 inches (2.44 m) above floor to bottom of lens.

Mount outlet box for electric door holder to withstand 80 pounds pulling force.

Automatic Detector Installation: Conform to NFPA 72.

Ethernet Drop: A standard RJ-45 Ethernet connection to the owner's Ethernet network shall be provided at each fire alarm control panel as part of the contract.

PREPARATION

Coordinate work of this Section with other affected work and the construction schedule.

WIRING INSTALLATION

System Wiring: Wire and cable shall be a type listed for its intended use by an approval agency acceptable to the Authority Having Jurisdiction and shall be installed in accordance with the appropriate articles from the current approved edition of NFPA 70: National Electric Code (NEC).

Contractor shall obtain from the Fire Alarm System Manufacturer written instruction regarding the appropriate wire/cable to be used for this installation. No deviation from the written instruction shall be made by the Contractor without the prior written approval of the Fire Alarm System Manufacturer.

Color Coding: Color-code fire alarm conductors differently from the normal building power wiring. Use one color code for alarm initiating device circuits wiring and a different color code for supervisory circuits. Color-code notification appliance circuits differently from alarm-initiating circuits. Paint fire alarm system junction boxes and covers red.

Mount end-of-line device in box with last device or separate box adjacent to last device for Class "B" supervision.

Ethernet circuits shall be provided to the Fire Alarm Control Panel and Graphical Workstation Remote Clients and PC Annunciator Remote Clients as shown on the plans. Where a Fire Alarm Ethernet LAN is specified only Agency Listed Ethernet hardware shall be installed.

FIELD QUALITY CONTROL

Manufacturer's Field Services: Provide services of a factory-authorized service representative to supervise the field assembly and connection of components and the pretesting, testing, and adjustment of the system.

Service personnel shall be qualified and experienced in the inspection, testing, and maintenance of fire alarm systems. Examples of qualified personnel shall be permitted to include, but shall not be limited to, individuals with the following qualifications:
Factory trained and certified.

National Institute for Certification in Engineering Technologies (NICET) fire alarm certified.

International Municipal Signal Association (IMSA) fire alarm certified.

Certified by a state or local authority.

Trained and qualified personnel employed by an organization listed by a national testing laboratory for the servicing of fire alarm systems.

Pretesting: Determine, through pretesting, the conformance of the system to the requirements of the Drawings and Specifications. Correct deficiencies observed in pretesting. Replace malfunctioning or damaged items with new and retest until satisfactory performance and conditions are achieved.

Inspection: Inspect equipment installation, interconnection with system devices, mounting locations, and mounting methods.

Verify that units and controls are properly installed, connected, and labeled and that interconnecting wires and terminals are identified.

Acceptance Operational Tests: Perform operational system tests to verify conformance with specifications:

Each alarm initiating device installed shall be operationally tested. Each device shall be tested for alarm and trouble conditions. Contractor shall submit a written certification that the Fire Alarm System installation is complete including all punch-list items. Test battery operated emergency power supply. Test emergency power supply to minimum durations specified. Test supervising station signal transmitter. Coordinate testing with Supervising Station monitoring firm/entity.

Test each Notification Appliance installed for proper operation. Submit written report indicating sound pressure levels at specified distances.

Test Fire Alarm Control Panel and Remote Annunciator.

Provide minimum 10 days notice of acceptance test performance schedule to Owner, and local Authority Having Jurisdiction.

Retesting: Correct deficiencies indicated by tests and completely retest work affected by such deficiencies. Verify by the system test that the total system meets the Specifications and complies with applicable standards.

Report of Tests and Inspections: Provide a written record of inspections, tests, and detailed test results in the form of a test log. Use NFPA 72 Forms for documentation.

Final Test, Record of Completion, and Certificate of Occupancy: Test the system as required by the Authority Having Jurisdiction in order to obtain a certificate of occupancy. Provide completed NFPA 72 Record of Completion form to Owner and AHJ.

CLEANING AND ADJUSTING

Cleaning: Remove paint splatters and other spots, dirt, and debris. Clean unit internally using methods and materials recommended by manufacturer.

Occupancy Adjustments: When requested within one year of date of Substantial Completion, provide on-site assistance in adjusting sound pressure levels and adjusting controls and sensitivities to suit actual occupied conditions. Provide up to three visits to the site for this purpose.

TRAINING

Provide the services of a factory-authorized service representative to demonstrate the system and train Owner's maintenance personnel as specified below.

Train Owner's maintenance personnel in the procedures and schedules involved in operating, troubleshooting, servicing, and preventive maintaining of the system. Provide a minimum of 8 hours' training.

Schedule training with the Owner at least seven days in advance.

END OF SECTION 16721