SECTION 26 05 53 - IDENTIFICATION FOR ELECTRICAL SYSTEMS

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:
1. Nameplates.
2. Labels.
3. Wire markers.
4. Conduit markers.
5. Stencils.
6. Underground Warning Tape.
7. Lockout Devices.

B. Related Sections:
1. Section 09 90 00 - Painting and Coating: Execution requirements for painting specified by this section.

1.2 SUBMITTALS

A. Section 01 33 00 - Submittal Procedures: Submittal procedures.

B. Product Data:
1. Submit manufacturer's catalog literature for each product required.
2. Submit electrical identification schedule including list of wording, symbols, letter size, color coding, tag number, location, and function.

C. Samples:
1. Submit two (2) tags, actual size.
2. Submit two (2) labels, actual size.
3. Submit two (2) samples of each type of identification products applicable to project.
4. Submit two (2) nameplates, 4 x 4 inch in size illustrating materials and engraving quality.

D. Manufacturer's Installation Instructions: Indicate installation instructions, special procedures, and installation.

1.3 CLOSEOUT SUBMITTALS

A. Project Record Documents: Record actual locations of tagged devices; include tag numbers.

1.4 QUALITY ASSURANCE

A. Perform Work in accordance with NYSBC.

1.5 QUALIFICATIONS

A. Manufacturer: Company specializing in manufacturing Products specified in this section with minimum three (3) years documented experience.

1.6 DELIVERY, STORAGE AND HANDLING

A. Accept identification products on site in original containers. Inspect for damage.

B. Accept materials on site in original factory packaging, labeled with manufacturer's identification, including product density and thickness.

C. Protect insulation from weather and construction traffic, dirt, water, chemical, and mechanical damage, by storing in original wrapping.

1.7 ENVIRONMENTAL REQUIREMENTS

A. Install labels and nameplates only when ambient temperature and humidity conditions for adhesive are within range recommended by manufacturer.

1.8 EXTRA MATERIALS

A. Furnish two (2) containers of spray-on adhesive.

PART 2 - PRODUCTS

2.1 NAMEPLATES

A. Laminate and engraved plastic nameplates shall consist of a base layer, an internal layer (letter color) and a top layer (background). Minimum nameplate thickness shall be 1/8” (3 mm). Nameplates shall be attached to equipment with machine screws or pop-rivets. The lettering height, letter color and background shall be as indicated below:

System	Background Color	Letter Color
Utility Power	Black	White
Emergency Power	Red	White
Fire Alarm	Red	White

B. Nameplate Legend Schedule shall be as follows:

Type		Information required
'A'	Line 1:	Equipment Designation (1" high letters)
	Line 2:	Voltage, phase, No. wires (1/4" high letters)
	Line 3:	Incoming feeder designation (1/4" high letters)

Type		Information required
'B'	Line 1:	Load description (1/4" high letters)
	Line 2:	Breaker trip or fuse rating (1/4" high letters)
'C'	Line 1:	Transformer KVA rating (1" high letters)
	Line 2:	Designation of panel served (1/2" high letters)
	Line 3:	Incoming feeder designation (1/4" high letters)
'D'	Line 1:	Feeder designations (1/4" high letters)
'E'	Line 1:	Cabinet Designation (1" high letters)
'F'	Line 1:	Description of operation and equipment controlled (1/2" high letters)

C. Laminated engraved nameplates shall be provided for all electrical equipment, including, but not limited to, the following:

ITEM	NAMEPLATE TYPE
Distribution panelboards	A
Main and branch devices in distribution panelboards	B
Lighting, Receptacle and Power panelboards	A
Dry type transformers	C
Safety switches	B
Pullboxes and cable tap boxes	D
Strip cabinets	E
Pushbuttons, pilot lights, etc. for motor controls	F
Single pole switches used for motor disconnect switch	B
Control panels	E
Switchgear	A
Main and feeder devices in switchgear	A
Switchboards	A
Main and feeder devices in switchboard	B
Motor Control Centers (MCC)	A
Motor starters in MCC’s and individual starters	B
Automatic Transfer Switch	D

2.2 LABELS

A. Manufacturers: Subject to the requirement of the specification, the following manufacturer’s products may be incorporated into the project:
   1. Brady.
   2. Seton Identification Products.
   3. Or Approved Equal.

B. Labels – Self-adhesive vinyl, appropriately sized for the require information. Labels shall comply with OSHA, NFPA and ANSI requirement and standards.

2.3 WIRE MARKERS

A. Manufacturers: Subject to the requirement of the specification, the following manufacturer's products may be incorporated into the project:
   1. Ideal Industries, Inc.
   2. DYMO.
   3. Brady.
   4. Or Approved Equal.

B. Description: Plastic impregnated cloth tape, pre-printed with letters or numbers. These markers shall be utilized for branch circuit conductors.

C. Description: Heat shrinkable wire markers, custom machine printed prior to installation. These markers shall be utilized for feeder and branch circuit conductors.

D. Legend:
   1. Power and Lighting Circuits: Branch circuit or feeder number. Black letters on white background for normal power, black letters on yellow background for emergency power, black letters on orange background for standby power.
   2. Control Circuits: Control wire number as indicated on shop drawings.

2.4 CONDUIT AND RACEWAY MARKERS

A. Manufacturers: Subject to the requirement of the specification, the following manufacturer's products may be incorporated into the project:
   1. Brady
   2. Seton Identification Products.
   3. Or Approved Equal.

B. Conduit Markers – Normal and Standby: Self-adhesive vinyl, appropriately sized for the conduit size. Letters shall be black on an orange background. Labels shall identify the circuit contained within the conduit and shall be installed on all feeder conduits, including normal and standby power. Where the conduits are exposed, the labels shall be applied at a maximum spacing of 20 feet.

C. Conduit Markers – Emergency: Self-adhesive vinyl, appropriately sized for the conduit size. Letters shall be black on a yellow background. Labels shall identify the circuit contained within the conduit and shall be installed on all emergency feeder conduits. Where the conduits are exposed, the labels shall be applied at a maximum spacing of 10 feet.

D. Legend:
   1. 208 Volt System: 208/120 VOLTS for 4-wire feeders. 208 Volts for 3-wire feeders.
   2. 480 Volt System: 480/277 VOLTS for 4-wire feeders. 480 Volts for 3-wire feeders.

PART 3 - EXECUTION

3.1 PREPARATION

A. Degrease and clean surfaces to receive adhesive for identification materials.

B. Pre-drill holes in equipment covers for installation of nameplates prior to energizing the equipment. Vacuum the interior of electrical enclosures to remove all metal chips.

3.2 EXISTING WORK

A. Install identification on existing equipment to remain in accordance with this section.

B. Install identification on unmarked existing equipment.

C. Replace lost or missing nameplates, warning labels, and circuit markers.

3.3 INSTALLATION

A. Install identifying devices after completion of painting.

B. Nameplate Installation:
1. Install nameplate parallel to equipment lines.
2. Install nameplate for each electrical distribution and control equipment enclosure with corrosive-resistant mechanical fasteners, or adhesive.
3. Install nameplates for each control panel and major control components located outside panel with corrosive-resistant mechanical fasteners, or adhesive.
4. Secure nameplate to equipment front using stainless steel machine screws, or pop-rivets.
5. Secure nameplate to inside surface of door on recessed panelboard in finished locations.
6. Install nameplates for the following:
    a. Switchgear and Switchboards.
    b. Service Disconnects.
    c. Panelboards.
    d. Transformers.
    e. Enclosed Switches (fused and non-fused).
    f. Combination Motor Starters.
    g. Enclosed Motor Starters.
    h. Enclosed Contactors.
    i. Control Panels.

C. Label Installation:
1. Install label parallel to equipment lines.
2. Install label for identification of individual control device stations.
3. Install Arc-Flash warning labels on all electrical equipment, including switchgear, switchboards, transformers, panelboards, enclosed switches, motor starters (enclosed and combination), enclosed contactors and control panels.
4. Install labels for permanent adhesion.

D. Wire Marker Installation:
   1. Install wire marker for each conductor at panelboard gutters, pull boxes, outlet and junction boxes and each load connection.

E. Conduit and Raceway Marker Installation:
   1. Install conduit and raceway marker for each conduit and raceway longer than 10-feet.
   2. Conduit and Raceway Marker Spacing: 20- feet on center.
   3. Raceway Painting: Identify conduit using field painting in accordance with Section 09 90 00.
      a. Paint each conduit exposed in mechanical and electrical rooms.
      b. Color:
         1) 208 and 208/120 Volt normal and standby power systems: Orange.
         2) 208 and 208/120 Volt emergency power system: Yellow.
         3) 480 and 480/277 Volt normal and standby power systems: Purple.
         4) 480 and 480/277 Volt emergency power system: Blue.

END OF SECTION 26 05 53

SECTION 26 05 73 - POWER SYSTEM STUDIES

PART 1 - GENERAL

1.1 SUMMARY

A. Section include:
   1. Short circuit and protective device coordination study encompassing portions of electrical distribution system from normal power source or sources up to and including main breaker in each panelboard.

B. Related Sections:
   1. Section 21 05 13 - Common Motor Requirements for Fire-Suppression Equipment.
   2. Section 22 05 13 - Common Motor Requirements for Plumbing Equipment.
   3. Section 23 05 13 - Common Motor Requirements for HVAC Equipment.
   4. Section 26 05 13 - Medium-Voltage Cables.
   5. Section 26 05 19 - Low-Voltage Electrical Power Conductors and Cables.
   6. Section 26 11 16 - Secondary Unit Substations.
   7. Section 26 12 00 - Medium-Voltage Transformers.
   8. Section 26 13 13 - Medium-Voltage Circuit Breaker Switchgear.
   9. Section 26 13 19 - Medium-Voltage Vacuum Interrupter Switchgear.
   10. Section 26 18 13 - Medium-Voltage Cutouts.
   11. Section 26 18 39 - Medium-Voltage Motor Controllers.
   12. Section 26 22 00 - Low-Voltage Transformers.
   13. Section 26 22 03 - Low-Voltage Transformers For Nonlinear Loads.
   14. Section 26 22 06 - Low-Voltage Transformer Load Centers.
   15. Section 26 24 13 - Switchboards.
   16. Section 26 24 16 - Panelboards.
   17. Section 26 24 19 - Motor-Control Centers.
   18. Section 26 25 00 - Enclosed Bus Assemblies.
   19. Section 26 26 00 - Power Distribution Units.
   20. Section 26 28 13 - Fuses.
   21. Section 26 28 19 - Enclosed Switches.
   22. Section 26 28 23 - Enclosed Circuit Breakers.
   23. Section 26 28 26 - Enclosed Transfer Switches.
   24. Section 26 29 13 - Enclosed Controllers.
   25. Section 26 29 16 - Enclosed Contactors.
   26. Section 26 29 23 - Variable-Frequency Motor Controllers.
   27. Section 26 32 13 - Engine Generators.
   28. Section 26 33 53 - Static Uninterruptible Power Supply.
   29. Section 26 35 13 - Capacitors.
   30. Section 26 35 33 - Power Factor Correction Equipment.

1.2 REFERENCES

A. Institute of Electrical and Electronics Engineers:

1. IEEE 242 - Recommended Practice for Protection and Coordination of Industrial and Commercial Power Systems (Buff Book).

B. National Fire Protection Association:
1. NFPA 70 - National Electrical Code.

1.3 DESIGN REQUIREMENTS

A. Complete Short Circuit and Protective Device Coordination Study to meet requirements of NFPA 70.

B. Report Preparation:
1. Prepare study prior to ordering distribution equipment to verify equipment ratings required.
2. Perform study with aid of computer software program.
3. Obtain actual settings for packaged chiller and motor characteristics and for equipment incorporated into Work.
4. Calculate short circuit interrupting and, when applicable, momentary duties for assumed 3-phase bolted fault short circuit current and phase to ground fault short circuit current at each of the following:
   a. Utility supply bus.
   b. Medium voltage air interrupter switchgear.
   c. Medium voltage circuit breaker switchgear.
   d. Secondary unit substations.
   e. Automatic transfer switch.
   f. Manual transfer switch.
   g. Engine generator.
   h. Medium voltage motor controllers.
   i. Low-voltage switchgear.
   j. Switchboards.
   k. Motor control centers.
   l. Distribution panelboards.
   m. Branch circuit panelboards.
   n. Busway.
   o. Each other significant equipment location throughout system.

C. Report Contents:
1. Include the following:
   a. Calculation methods and assumptions.
   b. Base per unit value selected.
   c. One-line diagram.
   d. Source impedance data including power company system available power and characteristics.
   e. Typical calculations.
      1) Fault impedance.
      2) X to R ratios.
      3) Asymmetry factors.
      4) Motor fault contribution.
      5) Short circuit kVA.

6) Symmetrical and asymmetrical phase-to-phase and phase-to-ground fault currents.
7) Tabulations of calculation quantities and results.

f. One-line diagram revised by adding actual instantaneous short circuits available.
g. State conclusions and recommendations.

2. Prepare time-current device coordination curves graphically indicating coordination proposed for system, centered on conventional, full-size, log-log forms.
3. Prepare with each time-curve sheet complete title and one-line diagram with legend identifying specific portion of system covered by that particular curve sheet.
4. Prepare detailed description of each protective device identifying its type, function, manufacturer, and time-current characteristics. Tabulate recommended device tap, time dial, pickup, instantaneous, and time delay settings.
5. Plot device characteristic curves at point reflecting maximum symmetrical fault current to which device is exposed. Include on curve sheets the following:
   a. Power company relay characteristics.
   b. Power company fuse characteristics.
   c. Medium voltage equipment protective relay characteristics.
   d. Medium voltage equipment protective fuse characteristics.
   e. Low voltage equipment circuit breaker trip device characteristics.
   f. Low voltage equipment fuse characteristics.
   g. Cable damage point characteristics.
   h. Pertinent transformer characteristics including:
      1) Transformer full load current.
      2) Transformer magnetizing inrush.
      3) ANSI transformer withstand parameters.
      4) Significant symmetrical fault current.
   i. Pertinent motor characteristics.
   j. Generator characteristics including:
      1) Phase and ground coordination of generator protective devices.
      2) Decrement curve and damage curve.
      3) Operating characteristic of protective devices.
      4) Actual impedance value.
      5) Time constants.
      6) Current boost data.
      7) Do not use typical values for generator.
   k. Transfer switch characteristics.
   l. Other system load protective device characteristics.

1.4 SUBMITTALS

A. Qualifications Data: Submit the following for review prior to starting study.
   1. Submit qualifications and background of firm.
   2. Submit qualifications of Professional Engineer performing study.

B. Software: Submit for review information on software proposed to be used in performing study.

C. Product Data: Submit the following:
   1. Report: Summarize results of study in report format including the following:
      a. Descriptions, purpose, basis, and scope of study.

b. Tabulations of circuit breaker, fuse and other protective device ratings versus calculated short-circuit duties, and commentary regarding same.
c. Protective device time versus current coordination curves, tabulations of relay and circuit breaker trip settings, fuse selection, and commentary regarding same.
d. Fault current calculations including definition of terms and guide for interpretation of computer printout.

D. Submit copies of final report signed by professional engineer. Make additions or changes required by review comments.

1.5 QUALITY ASSURANCE

A. Perform Work in accordance with NYSBC.

B. Maintain one (1) copy of each document on site.

C. Use commercially available software, designed specifically for short circuit and protective device coordination studies with minimum of ***5*** years documented availability approved by Engineer.

D. Perform study in accordance with IEEE 242.

1.6 QUALIFICATIONS

A. Study Preparer: Company specializing in performing work of this section with minimum three (3) years documented experience and having completed ***3*** projects of similar size and complexity within the past ***5*** years.

B. Perform study under direct supervision of Professional Engineer experienced in design of this Work and licensed at Project location with minimum of five years' experience in power system analysis.

C. Demonstrate company performing study has capability and experience to provide assistance during system start up.

1.7 PRE-INSTALLATION MEETINGS

A. Convene minimum one (1) week prior to commencing work of this section.

1.8 SEQUENCING

A. Complete study within ***4*** weeks after pre-installation meeting.

B. Allow two (2) weeks for review of completed study by Engineer.

C. Submit short circuit and protective device coordination study to Engineer prior to receiving final approval of distribution equipment shop drawings and prior to releasing equipment for manufacturing.

D. When formal completion of study will cause delay in equipment manufacturing, obtain approval from Engineer for preliminary submittal of study data sufficient in scope to ensure selection of device ratings and characteristics will be satisfactory.

1.9 SCHEDULING

A. Schedule work to expedite collection of data to ensure completion of study for final approval of distribution equipment shop drawings prior to release of equipment for manufacturing.

1.10 COORDINATION

A. Coordinate work with local power company.

PART 2 - PRODUCTS (NOT USED)

PART 3 - EXECUTION

3.1 FIELD QUALITY CONTROL

A. Provide assistance to electrical distribution system equipment manufacturer during start-up of electrical system and equipment.

B. Select each primary protective device for delta-wye connected transformer so device's characteristic or operating band is within transformer characteristics, including point equal to 58 percent of ANSI withstand point to provide secondary line-to-ground fault protection.

C. Separate transformer primary protective device characteristic curves from associated secondary device characteristics by 16 percent current margin to provide proper coordination and protection in event of secondary line-to-line faults.

D. Separate medium-voltage relay characteristic curves from curves for other devices by at least 0.4 second time margin.

3.2 ADJUSTING

A. Perform field adjustments of protective devices and modifications to equipment to place equipment in final operating condition. Adjust settings in accordance with approved short circuit and protective device coordination study.

END OF SECTION 26 05 73

SECTION 26 05 83 - WIRING CONNECTIONS

PART 1 - GENERAL

1.1 SUMMARY

A. Section includes electrical connections to equipment.

B. Related Sections:
   1. Section 26 05 19 - Low-Voltage Electrical Power Conductors and Cables.
   2. Section 26 05 33 - Raceway and Boxes for Electrical Systems.

1.2 REFERENCES

A. National Electrical Manufacturers Association:
   1. NEMA WD 1 - General Requirements for Wiring Devices.
   2. NEMA WD 6 - Wiring Devices-Dimensional Requirements.

1.3 SUBMITTALS

A. Product Data: Submit wiring device manufacturer's catalog information showing dimensions, configurations, and construction.

B. Manufacturer's installation instructions.

1.4 CLOSEOUT SUBMITTALS

A. Project Record Documents: Record actual locations, sizes, and configurations of equipment connections.

1.5 COORDINATION

A. Obtain and review shop drawings, product data, manufacturer's wiring diagrams, and manufacturer's instructions for equipment furnished under other sections.

B. Determine connection locations and requirements.

C. Sequence rough-in of electrical connections to coordinate with installation of equipment.

D. Sequence electrical connections to coordinate with start-up of equipment.

PART 2 - PRODUCTS

2.1 CORD AND PLUGS

A. Manufacturers: Subject to the requirement of the specification, the following manufacturer's products may be incorporated into the project:
1. Cooper Wiring Devices (abbreviated Cooper)
2. Hubbell
3. Pass & Seymour (abbreviated P & S)
4. Leviton
5. Curbell
6. Or Approved Equal.

B. Attachment Plug Construction: Conform to NEMA WD 1.

C. Configuration: NEMA WD 6; match receptacle configuration at outlet furnished for equipment.

D. Cord Construction: Type [SOOW] [SJOOW] multiconductor flexible cord with identified equipment grounding conductor, suitable for use in damp locations.

E. Size: Suitable for connected load of equipment, length of cord, and rating of branch circuit overcurrent protection.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Verify equipment is ready for electrical connection, for wiring, and to be energized.

3.2 EXISTING WORK

A. Remove exposed abandoned equipment wiring connections, including abandoned connections above accessible ceiling finishes.

B. Disconnect abandoned utilization equipment and remove wiring connections. Remove abandoned components when connected raceway is abandoned and removed. Install blank cover for abandoned boxes and enclosures not removed.

C. Extend existing equipment connections using materials and methods compatible with existing electrical installations.

3.3 INSTALLATION

A. Make electrical connections.

B. Make conduit connections to equipment using flexible conduit. Use liquidtight flexible conduit with watertight connectors in damp or wet locations.

C. Connect heat producing equipment using wire and cable with insulation suitable for temperatures encountered.

D. Install receptacle outlet to accommodate connection with attachment plug.

E. Install cord and cap for field-supplied attachment plug.

F. Install suitable strain-relief clamps and fittings for cord connections at outlet boxes and equipment connection boxes.

G. Install disconnect switches, controllers, control stations, and control devices to complete equipment wiring requirements.

H. Install terminal block jumpers to complete equipment wiring requirements.

I. Install interconnecting conduit and wiring between devices and equipment to complete equipment wiring requirements.

J. Coolers and Freezers: Cut and seal conduit openings in freezer and cooler walls, floor, and ceilings.

3.4 ADJUSTING

A. Cooperate with utilization equipment installers and field service personnel during checkout and starting of equipment to allow testing and balancing and other startup operations. Provide personnel to operate electrical system and checkout wiring connection components and configurations.

END OF SECTION 26 05 83

SECTION 26 09 23 - LIGHTING CONTROL DEVICES

PART 1 - GENERAL

1.1 SUMMARY

A. Section includes devices and associated accessories for automatic control of lighting and other loads:
   1. Mechanical wall switches.
   2. Wall dimmers and electronic switches.
   3. Wallbox occupancy sensors.

B. Related Sections:
   1. Section 26 05 19 - Low-Voltage Electrical Power Conductors and Cables.
   2. Section 26 05 33 - Raceway and Boxes for Electrical Systems: Product requirements for raceway and boxes for placement by this Section.
   3. Section 26 05 53 - Identification for Electrical Systems: Product requirements for electrical identification items for placement by this Section.
   4. Section 26 24 16 - Panelboards.
   5. Section 26 27 26 - Wiring Devices: Product requirements for wiring devices for placement by this Section.

1.2 REFERENCE STANDARDS

A. 47 CFR 15 - Radio Frequency Devices current edition.

B. ASTM D4674 - Standard Practice for Accelerated Testing for Color Stability of Plastics Exposed to Indoor Office Environments 2019.

C. ASTM E308 - Standard Practice for Computing the Colors of Objects by Using the CIE System 2018.

D. IEC 61000-4-2 - Electromagnetic Compatibility (EMC) - Part 4-2: Testing and Measurement Techniques - Electrostatic Discharge Immunity Test 2008.

E. ISO 9001 - Quality management systems -- Requirements 2015.

F. NECA 1 - Standard for Good Workmanship in Electrical Construction 2015.

G. NECA 130 - Standard for Installing and Maintaining Wiring Devices 2010.

H. NEMA WD 1 - General Color Requirements for Wiring Devices 1999 (Reaffirmed 2015).

I. NFPA 70 - National Electrical Code Most Recent Edition Adopted by Authority Having Jurisdiction, Including All Applicable Amendments and Supplements.

1.3 ADMINISTRATIVE REQUIREMENTS

A. Coordination:
1. Coordinate the placement of sensors and wall controls with millwork, furniture, equipment, etc. installed under other sections or by others.
2. Coordinate the work to provide luminaires and lamps compatible with the lighting controls to be installed.
3. Notify Architect of any conflicts or deviations from the contract documents to obtain direction prior to proceeding with work.

B. Sequencing:
1. Do not install sensors and wall controls until final surface finishes and painting are complete.

1.4 SUBMITTALS

A. Section 01 33 00 - Submittal Procedures: Requirements for submittals.

B. Shop Drawings: Indicate dimensioned drawings of lighting control system components and accessories.
1. One Line Diagram: Indicating system configuration indicating panels, number and type of switches or devices.
2. Include typical wiring diagrams for each component.

C. Product Data: Submit manufacturer's standard product data for each system component.

D. Manufacturer's Installation Instructions: Submit for each system component.

E. Manufacturer's Certificate: Certify products meet or exceed specified requirements.

1.5 CLOSEOUT SUBMITTALS

A. Project Record Documents: Record following information:
1. Actual locations of components and record circuiting and switching arrangements.
2. Wiring diagrams reflecting field installed conditions with identified and numbered system components and devices.

B. Operation and Maintenance Data:
1. Submit replacement parts numbers.
2. Submit manufacturer's published installation instructions and operating instructions.
3. Recommended renewal parts list.

1.6 QUALITY ASSURANCE

A. Perform Work according to NYSBC.

B. Conform to requirements of NFPA 70.

C. Maintain at the project site a copy of each referenced document that prescribes execution requirements.

1.7 MANUFACTURER QUALIFICATIONS

A. Company with not less than ten years of experience manufacturing lighting controls, including products using wireless communication between devices.

B. Registered to ISO 9001, including in-house engineering for product design activities.

C. Provides factory direct technical support hotline available 24 hours per day, 7 days per week.

D. Qualified to supply specified products and to honor claims against product presented in accordance with warranty.

1.8 DELIVERY, STORAGE AND HANDLING

A. Accept components on Site in manufacturer's packaging. Inspect for damage.

B. Store products in a clean, dry, indoor space in original manufacturer's packaging in accordance with manufacturer's written instructions until ready for installation.

1.9 WARRANTY

A. Furnish five-year manufacturer's warranty for components.

1.10 EXTRA MATERIALS

A. Furnish two of each switch type.

B. Furnish two of each occupancy/vacancy sensor type.

1.11 FIELD CONDITIONS

A. Maintain field conditions within manufacturer's required service conditions during and after installation.
   1. Basis of Design System Requirements - Lutron, Unless Otherwise Indicated:
      a. Ambient Temperature:
         1) Lighting Controls: Between 32 and 104 degrees F (0 and 40 degrees C).
      b. Relative Humidity: Less than 90 percent, non-condensing.
      c. Protect lighting controls from dust.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

A. Basis of Design Manufacturer: Lutron Electronics Company, Inc; www.lutron.com/#sle.

2.2 LIGHTING CONTROL DEVICES - GENERAL REQUIREMENTS

A. Provide products listed, classified, and labeled by Underwriters Laboratories Inc. (UL) as suitable for the purpose indicated.

B. Unless specifically indicated to be excluded, provide all required equipment, conduit, boxes, wiring, connectors, hardware, supports, accessories, programming, etc. as necessary for a complete operating system that provides the control intent indicated.

C. Design lighting control equipment for 10-year operational life while operating continually at any temperature in an ambient temperature range of 32 degrees F (0 degrees C) to 104 degrees F (40 degrees C) and 90 percent non-condensing relative humidity.

D. Electrostatic Discharge Tolerance: Design and test equipment to withstand electrostatic discharges without impairment when tested according to IEC 61000-4-2.

E. Power Failure Recovery: When power is interrupted for periods up to 10 years and subsequently restored, lights to automatically return to same levels (dimmed setting, full on, or full off) as prior to power interruption.

F. Wireless Devices:
   1. Capable of diagnosing system communications.
   2. Capable of having addresses automatically assigned to them.
   3. Receives signals from other wireless devices and provides feedback to user.
   4. Capable of determining which devices have been addressed.
   5. RF Frequency: 434 MHz; operate in FCC governed frequency spectrum for periodic operation; continuous transmission spectrum is not permitted.
   6. RF Range: 60 feet (18 m) line-of-sight or 30 feet (9 m) through typical construction materials between RF transmitting devices and compatible RF receiving devices.
   7. Electromagnetic Interference/Radio Frequency Interference (EMI/RFI) Limits: Comply with FCC requirements of 47 CFR 15, for Class B application.

G. Device Finishes:
   1. Standard Colors: Comply with NEMA WD 1 where applicable.
   2. Color Variation in Same Product Family: Maximum delta E of 1, CIE L*a*b color units per ASTM E308.
   3. Visible Parts: Exhibit ultraviolet color stability when tested with multiple actinic light sources as defined in ASTM D4674. Provide proof of testing upon request.

2.3 MECHANICAL WALL SWITCHES

A. Comply with NEMA WD 6, where applicable, and list as complying with UL 20.

B. Paddle Type Mechanical Wall Switches; Lutron Claro Series (Designer Style):
   1. Switch Control: Paddle type rocker switch for on/off operation.
   2. Product(s) - Paddle Type Mechanical Switches:
      a. Single-pole switch, 15 A, 120/277 V; Lutron Claro Series.
         1) Lutron Model CA-1PS (gloss finish).

2.4 WALL DIMMERS AND ELECTRONIC SWITCHES

A. General Requirements:
   1. Utilize air gap off, activated when user selects "off" to disconnect the load from line supply.
   2. Provide air gap service switch accessible without removing faceplate.
   3. Operates at the rated capacity across the full ambient temperature range including modified capacities for ganged configurations which require removal of fins.
   4. Provide radio frequency interference suppression.
   5. Surge Tolerance: Designed and tested to withstand surges of 6,000 V, 200 amps according to IEEE C62.41.2 without impairment to performance.
   6. Dimmers: Provide full range, continuously variable control of light intensity.
   7. Dimmers for Electronic Low Voltage (ELV) Transformers:
      a. Provide circuitry designed to control the input of electronic (solid-state) low-voltage (ELV) transformers. Do not use dimmers that utilize standard phase control.
      b. Provide resettable overload protection that provides automatic shut-off when dimmer capacity is exceeded. Do not use protection methods that are non-resettable or require device to be removed from outlet box.
      c. Designed to withstand a short, per UL 1472, between load hot and either neutral or ground without damage to dimmer.
   8. Fluorescent Dimmers:
      a. Provides direct control of fluorescent dimming ballasts up to the ballast manufacturer's specified rating.
   9. Electronic Switches:
      a. Listed as complying with UL 20, UL 508, and UL 1472.

B. Preset Wall Dimmers; Lutron Diva Series (Designer Style):
   1. Dimmer Control: Paddle switch for on/off operation with small, discrete, captive linear slide for dimmer adjustment.
   2. 3-Way Dimmers: Compatible with standard 3-way and 4-way mechanical switches.
   3. Dimmer High End:
      a. Dimmers for Electronic Low Voltage (ELV) Transformers: Minimum of 90 percent of line voltage.
   4. Product(s) - Preset Dimmers:
      a. Preset Dimmer; Lutron Diva Series: Reverse phase electronic low voltage, dimmable LED/CFL (250 W, 120 V), incandescent/halogen (500 W, 120 V), ELV with halogen (500 W, 120 V); neutral required; minimum load requirement; does not have locator light.

1) Lutron Model DVRP-253P (gloss finish); single-pole/3-way; 120 V.

b. Preset Dimmer; Lutron Diva Series: 0-10V control for 0-10V fluorescent ballasts/LED drivers (50 mA max control current); no power pack required to switch line voltage load (8 A, 120-277 V); adjustable high-end and low-end trim; does not have locator light.

1) Lutron Model DVSTV (gloss finish); single-pole/3-way, 120-277 V.

2.5 WALLBOX OCCUPANCY SENSORS

A. General Requirements:

1. Passive Infrared Sensing:
   a. Utilize multiple segmented lens, with internal grooves to eliminate dust and residue build-up.
   b. Passive infrared coupled with technology for sensing fine motions; Lutron XCT Technology. Signal processing technology detects fine-motion passive infrared (PIR) signals without the need to change the sensor's sensitivity threshold.
2. Ultrasonic Sensing: Utilize an operating frequency of 32 kHz or 40 kHz, crystal-controlled to operate within plus/minus 0.005 percent tolerance.
3. Dual Technology Sensing: Passive infrared and ultrasonic sensing coupled with technology for sensing very fine motions; Lutron XCT Technology. Signal processing technology detects fine-motion passive infrared (PIR) and ultrasonic signals without the need to change the sensor's sensitivity threshold.

B. Wall Switch Occupancy/Vacancy Sensors; Lutron Maestro Series:

1. General Requirements:
   a. Turns off lighting after reasonable and adjustable time delay once the last person to occupy the space vacates a room or area. Provide adjustable timeout settings of 1, 5, 15, and 30 minutes.
   b. Switches at point of minimum energy to maximize relay life, actively adapting to variations in relay timing.
   c. Suitable for incandescent, halogen, electronic low-voltage, magnetic low-voltage, compact fluorescent, LED, magnetic fluorescent, electronic fluorescent, and fan loads.
2. Passive Infrared Wall Switch Combination Occupancy/Vacancy Sensors:
   a. Programmable to operate as an occupancy sensor (automatic-on and automatic-off) or a vacancy sensor (manual-on and automatic-off).
   b. Adjustable sensitivity (high, low presets).
   c. Selectable option to enable low light feature (automatic-on when ambient light is below threshold). Ambient light threshold to be adaptive utilizing occupant feedback; Lutron Smart Ambient Light Detection.
   d. Selectable option to inhibit automatic turn-on of lights after manual-off operation while room is occupied for applications such as presentation viewing in conference rooms and classrooms; when room is vacated, returns to normal automatic-on operation after time delay period.
   e. Product(s):
      1) Type _____ - Passive Infrared Wall Switch Occupancy/Vacancy Sensor; Lutron Maestro Series, Model MS-OPS6M2-DV: 6 A lighting (120-277 V), 3 A fan (120 V); coverage of 900 square feet (81 sq m) with mounting height of 4 feet (1.2 m); 180-degree field of view; compatible with standard

3-way mechanical switches; multi-location capability using companion switches (up to nine companion switches may be connected).

3. Passive Infrared Wall Switch Vacancy-Only Sensors:
   a. Operates only as a vacancy sensor (manual-on and automatic-off) in accordance with California Title 24 requirements.
   b. Adjustable sensitivity (high, low presets).
   c. Product(s):
      1) Type ___ - Passive Infrared Wall Switch Vacancy-Only Sensor; Lutron Maestro Series, Model MS-VPS6M2-DV: 6 A lighting (120-277 V), 3 A fan (120 V); coverage of 900 square feet (81 sq m) with mounting height of 4 feet (1.2 m); 180 degree field of view; compatible with standard 3-way mechanical switches; multi-location capability using companion switches (up to nine companion switches may be connected).

2.6 SOURCE QUALITY CONTROL

A. See Section 01 40 00 - Quality Requirements, for additional requirements.

B. Factory Testing; Lutron Standard Factory Testing:
   1. Perform full-function factory testing on all completed assemblies. Statistical sampling is not acceptable.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Verify that field measurements are as shown on the drawings.

B. Verify that ratings and configurations of devices are consistent with the indicated requirements.

C. Verify that mounting surfaces are ready to receive devices.

D. Verify that conditions are satisfactory for installation prior to starting work.

3.2 PREPARATION

A. Clean dirt, debris, plaster, and other foreign materials from outlet boxes.

3.3 INSTALLATION

A. Perform work in a neat and workmanlike manner in accordance with NECA 1 and, where applicable, NECA 130, except for mounting heights specified in those standards.

B. Coordinate locations of outlet boxes provided under Section 26 05 33.16 as required for installation of devices provided under this section.

C. Where multiple devices are installed at the same location and at the same mounting height, gang devices together under a common wall plate.

D. Install products in accordance with manufacturer's instructions.

E. Install permanent barrier between ganged devices when voltage between adjacent devices exceeds 300 V.

F. Lamp Burn-In: Operate lamps at full output for prescribed period per manufacturer's recommendations prior to use with any dimming controls. Replace lamps that fail prematurely due to improper lamp burn-in.

3.4 CLEANING

A. Clean exposed surfaces to remove dirt, paint, or other foreign material and restore to match original factory finish.

3.5 PROTECTION

A. Protect installed products from subsequent construction operations.

3.6 ADJUSTING

A. Test each system component after installation to verify proper operation.

B. Confirm correct loads are recorded on directory card in each panel.

3.7 DEMONSTRATION

A. Demonstrate operation of following system components:
   1. Each type of occupancy/vacancy sensor.

B. Furnish eight hours to instruct Owner's personnel in operation and maintenance of system. Schedule training with Owner, provide at least seven days' notice to Owner of training date.

END OF SECTION 26 09 23

SECTION 26 09 43 - NETWORK LIGHTING CONTROLS

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:
   1. Digital-network lighting control system and associated components:
      a. Lighting control modules; Lutron Energi Savr Node.
      b. Lighting management hubs.
      c. Lighting management system software.
      d. Control stations.
      e. Low-voltage control interfaces.
      f. Wired sensors.

1.2 REFERENCE STANDARDS

A. ASTM D4674 - Standard Practice for Accelerated Testing for Color Stability of Plastics Exposed to Indoor Office Environments 2019.

B. IEC 60929 - AC and/or DC-Supplied Electronic Control Gear for Tubular Fluorescent Lamps - Performance Requirements 2015.

C. IEC 61000-4-2 - Electromagnetic Compatibility (EMC) - Part 4-2: Testing and Measurement Techniques - Electrostatic Discharge Immunity Test 2008.

D. IEEE C62.41.2 - IEEE Recommended Practice on Characterization of Surges in Low-Voltage (1000 V and less) AC Power Circuits 2002 (Corrigendum 2012).

E. ISO 9001 - Quality management systems -- Requirements 2015.

F. NECA 1 - Standard for Good Workmanship in Electrical Construction 2015.

G. NECA 130 - Standard for Installing and Maintaining Wiring Devices 2010.

H. NEMA SSL 7A - Phase Cut Dimming for Solid State Lighting: Basic Compatibility 2015.

I. NEMA WD 1 - General Color Requirements for Wiring Devices 1999 (Reaffirmed 2015).

J. NFPA 70 - National Electrical Code Most Recent Edition Adopted by Authority Having Jurisdiction, Including All Applicable Amendments and Supplements.

K. UL 94 - Tests for Flammability of Plastic Materials for Parts in Devices and Appliances Current Edition, Including All Revisions.

L. UL 508 - Industrial Control Equipment Current Edition, Including All Revisions.

M. UL 924 - Emergency Lighting and Power Equipment Current Edition, Including All Revisions.

N. UL 1472 - Solid-State Dimming Controls Current Edition, Including All Revisions.

1.3 ADMINISTRATIVE REQUIREMENTS

A. Coordination:
1. Coordinate placement of sensors and wall controls with millwork, furniture, equipment, etc. installed under other sections or by others.
2. Coordinate placement of wall controls with actual installed door swings.
3. Coordinate work to provide luminaires and lamps compatible with lighting controls to be installed.
4. Notify Architect of conflicts or deviations from contract documents; obtain direction prior to proceeding with work.

B. Pre-Wire Meeting: Conduct on-site meeting with lighting control system manufacturer prior to commencing work as part of manufacturer's standard startup services. Manufacturer to review with installer:
1. Low-voltage wiring requirements.
2. Separation of power and low-voltage/data wiring.
3. Wire labeling.
4. Lighting management hub locations and installation.
5. Control locations.
6. Computer jack locations.
7. Load circuit wiring.
8. Network wiring requirements.
9. Connections to other equipment and other Lutron equipment.
10. Installer responsibilities.

C. Sequencing:
1. Do not install sensors and wall controls until final surface finishes and painting are complete.

1.4 SUBMITTALS

A. Shop Drawings: Indicate dimensioned drawings of lighting control system components and accessories.
1. One Line Diagram: Indicating system configuration indicating panels, number and type of switches or devices.
2. Include typical wiring diagrams for each component.

B. Product Data: Submit manufacturer's standard product data for each system component.

C. Manufacturer's Installation Instructions: Submit for each system component.

D. Manufacturer's Certificate: Certify products meet or exceed specified requirements.

1.5 QUALITY ASSURANCE

A. Perform Work according to NYSBC.

B. Conform to requirements of NFPA 70.

C. Maintain at project site one copy of each referenced document that prescribes execution requirements.

D. Manufacturer Qualifications:
1. Company with not less than ten years of experience manufacturing lighting control systems of similar complexity to specified system.
2. Registered to ISO 9001, including in-house engineering for product design activities.
3. Qualified to supply specified products and to honor claims against product presented in accordance with warranty.

1.6 DELIVERY, STORAGE, AND HANDLING

A. Store products in clean, dry space in original manufacturer's packaging in accordance with manufacturer's written instructions until ready for installation.

1.7 FIELD CONDITIONS

A. Maintain field conditions within manufacturer's required service conditions during and after installation.
1. Lutron System Requirements, Unless Otherwise Indicated:
a. Ambient Temperature:
1) Lighting Control System Components, Except Those Listed Below: Between 32 and 104 degrees F (0 and 40 degrees C).
2) Fluorescent Electronic Dimming Ballasts: Between 50 and 140 degrees F (10 and 60 degrees C).
b. Relative Humidity: Less than 90 percent, noncondensing.

1.8 WARRANTY

A. Manufacturer's Standard Warranty, With Manufacturer Start-Up; Lutron Standard 2-Year Warranty; Lutron LSC-B2:
1. Manufacturer Lighting Control System Components, Except Wireless Sensors, Ballasts/Drivers, and Ballast Modules:
a. First Two Years:
1) 100 percent replacement parts coverage, 100 percent manufacturer labor coverage to troubleshoot and diagnose lighting issue.
2) First-available on-site or remote response time.
3) Remote diagnostics for applicable systems.
b. Telephone Technical Support: Available 24 hours per day, 7 days per week, excluding manufacturer holidays.

2. Wireless Sensors: Five years 100 percent parts coverage, no manufacturer labor coverage.
3. Ballasts/Drivers and Ballast Modules: Five years 100 percent parts coverage, no manufacturer labor coverage.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

A. Basis of Design Manufacturer: Lutron Electronics Company, Inc; Athena; www.lutron.com/#sle.

2.2 DIGITAL-NETWORK LIGHTING CONTROL SYSTEM - GENERAL REQUIREMENTS

A. Sensor Layout and Tuning: No Lighting Control Manufacturer Sensor Layout and Tuning service to be provided; Lutron LSC-NO-SENS-LT.
   1. Contractor to utilize Lighting Control Manufacturer Installation Instructions to place/install sensors.
   2. At Pre-wire and Startup, Lighting Control Manufacturer to provide rough sensor calibration only. Sensor fine-tuning to be responsibility of Contractor.

B. Provide products listed, classified, and labeled by Underwriter's Laboratories Inc. as suitable for purpose indicated.

C. Unless specifically indicated to be excluded, provide required equipment, conduit, boxes, wiring, connectors, hardware, supports, accessories, software, system programming, etc. as necessary for complete operating system that provides control intent indicated.

D. Design lighting control equipment for 10-year operational life while operating continually at any temperature in ambient temperature range of 32 degrees F (0 degrees C) to 104 degrees F (40 degrees C) and 90 percent non-condensing relative humidity.

E. Electrostatic Discharge Tolerance: Design and test equipment to withstand electrostatic discharges without impairment when tested according to IEC 61000-4-2.

F. Dimming and Switching/Relay Equipment:
   1. Designed so that electrolytic capacitors operate at least 36 degrees F (20 degrees C) below capacitor's maximum temperature rating when device is under fully loaded conditions at maximum rated temperature.
   2. Inrush Tolerance:
      a. Utilize load-handling thyristors (SCRs and triacs), field effect transistors (FETs) and isolated gate bipolar transistors (IGBTs) with maximum current rating at least two times rated operating current of dimmer/relay.
      b. Capable of withstanding repetitive inrush current of 50 times operating current without impacting lifetime of dimmer/relay.
   3. Surge Tolerance: Designed and tested to withstand surges of 6,000 V, 200 amps according to IEEE C62.41.2 without impairment to performance.

4. Power Failure Recovery: When power is interrupted and subsequently restored, within 3 seconds lights to automatically return to same levels, e.g., dimmed setting, full on, or full off, as prior to power interruption.
5. Dimming Requirements:
   a. Line Noise Tolerance: Provide real-time cycle-by-cycle compensation for incoming line voltage variations including changes in RMS voltage (plus or minus 2 percent change in RMS voltage per cycle), frequency shifts (plus or minus 2 Hz change in frequency per second), dynamic harmonics, and line noise.
      1) Systems not providing integral cycle-by-cycle compensation to include external power conditioning equipment as part of dimming system.
   b. Incorporate electronic "soft-start" default at initial turn-on that smoothly ramps lights up to appropriate levels within 0.5 seconds.
   c. Utilize air gap off to disconnect load from line supply.
   d. Control light sources in smooth and continuous manner. Dimmers with visible steps are not acceptable.
   e. Load Types:
      1) Assign load type to each dimmer that will provide proper dimming curve for specific light source to be controlled.
      2) Provide capability of being field-configured to have load types assigned per circuit.
   f. Minimum and Maximum Light Levels: User adjustable on circuit-by-circuit basis.
   g. Line Voltage Dimmers:
      1) Dimmers for Magnetic Low Voltage (MLV) Transformers:
         a) Provide circuitry designed to control and provide symmetrical AC waveform to input of magnetic low voltage transformers per UL 1472.
         b) Dimmers using unipolar load current devices, e.g., FETs or SCRs, to include DC current protection in event of single device failure.
      2) Dimmers for Electronic Low Voltage (ELV) Transformers: Operate transformers via reverse phase control. Alternately, forward phase control dimming may be used if dimming equipment manufacturer has recommended specific ELV transformers being provided.
      3) Dimmers for Neon and Cold Cathode Transformers:
         a) Magnetic Transformers: Listed for use with normal (low) power factor magnetic transformers.
         b) Electronic Transformers: Must be supported by ballast equipment manufacturer for control of specific ballasts being provided.
6. Switching Requirements:
   a. Rated Life of Relays: Typical of 1,000,000 cycles at fully rated 16 A for all lighting loads.
   b. Switch load in manner that prevents arcing at mechanical contacts when power is applied to and removed from load circuits.
   c. Provide output fully rated for continuous duty for inductive, capacitive, and resistive loads.

G. Device Finishes:
   1. Standard Colors: Comply with NEMA WD 1 where applicable.
   2. Color Variation in Same Product Family: Maximum delta E of 1, CIE L*a*b color units.

3. Visible Parts: Exhibit ultraviolet color stability when tested with multiple actinic light sources as defined in ASTM D4674. Provide proof of testing upon request.

2.3 LIGHTING CONTROL MODULES; LUTRON ENERGI SAVR NODE

A. Provide lighting control modules as indicated or as required to control loads as indicated.

B. General Requirements:
1. Listed to UL 508 as industrial control equipment.
2. Delivered and installed as listed factory-assembled panel.
3. Passively cooled via free-convection, unaided by fans or other means.
4. Mounting: Surface.
5. Connection without interface to wired:
   a. Occupancy sensors.
   b. Daylight sensors.
6. Connects to lighting management hub via RS485.
7. LED status indicators confirm communication with occupancy sensors and daylight sensors.
8. Contact Closure Input (select models):
   a. Directly accept contact closure input from dry contact closure or solid-state output without interface to:
      1) Activate scenes.
         a) Scene activation from momentary or maintained closure.
      2) Enable or disable after hours.
         a) Automatic sweep to user-specified level after user-specified time has elapsed.
         b) System provides occupants visual warning prior to sweeping lights to user-specified level.
         c) Occupant can reset timeout by interacting with lighting system.
      3) Activate or deactivate demand response (load shed).
         a) Load shed event reduces lighting load by user-specified amount.

9. Emergency Contact Closure Input:
   a. Turn all zones to full output during emergency state via direct contact closure input from UL 924 listed emergency lighting interface, security system or fire alarm system.
   b. Allow configurable zone response during emergency state.
   c. Disable control operation until emergency signal is cleared.
10. Supplies power for control link for keypads and control interfaces (select models).
11. Distributes sensor data among multiple lighting control modules.
12. Capable of being controlled via wireless sensors and controls.

C. 0-10V Lighting Control Modules:
1. Products:
   a. Lutron 0-10V Energi Savr Node; Model QSN-4T16-S: 16 A continuous-use per channel.
2. Coordination Between Low Voltage Dimming Module and Line Voltage Relay: Capable of being electronically linked to single zone.
3. Single low voltage dimming module; capable of controlling the following light sources:

a. 0-10V analog voltage signal.
   1) Provide Class 2 isolated 0-10V output signal conforming to IEC 60929.
   2) Sink current per IEC 60929.
b. 10V-0V analog voltage signal.
   1) Provide Class 2 isolated 0-10V output signal conforming to IEC 60929.
   2) Sink current per IEC 60929.

4. Switching:
   a. Rated Life of Relay: Typical of 1,000,000 cycles at fully rated 16 A for all lighting loads.
   b. Load switched in manner that prevents arcing at mechanical contacts when power is applied to and removed from load circuits.
   c. Fully rated output continuous duty for inductive, capacitive, and resistive loads.
   d. Module to integrate up to four individually controlled zones.
   e. Utilize air gap off, activated when user selects "off" at any control to disconnect load from line supply.

2.4 LIGHTING MANAGEMENT HUBS

A. Products:
   1. Lutron Athena Light Management Hub (QP5).
      a. Type _____ - 2-link hub; Lutron Model QP5-2L-POE; one Athena Edge processor and two QS links.
   2. Accessories:
      a. Wire Landing Boards; Lutron Model QS-WLB: Provide as indicated or as required for terminating wiring.

B. Supports connection to QS wired devices via QS links; supports connection to Athena Edge processors and Athena Clear Connect Gateway - Type X wireless gateways via system Ethernet link.

C. Supports communication with Clear Connect - Type X wireless devices, including Ketra intelligent light sources, via Athena Clear Connect Gateway - Type X wireless gateways.

D. Provided in pre-assembled NEMA listed enclosure with terminal blocks listed for field wiring.

E. Connects to controls via RS485.

F. Integrates control station devices, shades, and external inputs into single customizable lighting control system with:
   1. Multiple Failsafe Mechanisms:
      a. Power failure detection via emergency lighting interface.
      b. Protection: Lights go to full on if ballast wires are shorted.
      c. Distributed architecture provides fault containment. Single hub failure or loss of power does not compromise lights and shades connected to other lighting management hubs.
   2. Manual overrides.
   3. Automatic control.

G. Furnished with astronomical time clock.

H. Maintains backup of programming in non-volatile memory capable of lasting more than ten years without power.

2.5 LIGHTING MANAGEMENT SYSTEM SOFTWARE

A. Provide system software and hardware that is designed, tested, manufactured, and warranted by single manufacturer.

B. Configuration Setup Software:
   1. Product: Lutron Athena Designer.
   2. Suitable to make system programming and configuration changes.
   3. Windows-based, capable of running on either central server or remote client over TCP/IP connection.
   4. Back-Up Project Database: Allows user to back up project database that holds configuration information for system, including keypad programming, area scenes, daylighting, occupancy programming, emergency levels, night lights, and time clock.
   5. Publish Project Database: Allows user to send new project database to processors and devices. Project database holds configuration information for system, including keypad programming, area scenes, daylighting, occupancy programming, emergency levels, night lights, and time clock.
   6. Allows manufacturer (either remotely or with on-site service call) or end-user (with training) to:
      a. Capture system design:
         1) Geographical layout.
         2) Load schedule zoning.
         3) Equipment schedule.
         4) Equipment assignment to lighting management hubs.
         5) Daylighting design.
      b. Define configuration for the following in each area:
         1) Lighting scenes.
         2) Control station devices.
         3) Interface and integration equipment.
         4) Occupancy/after hours.
         5) Partitioning.
         6) Daylighting.
         7) Emergency lighting.
         8) Night lights.
      c. Startup:
         1) Addressing.
         2) Daylighting.
         3) Provide customized conditional programming.

C. API Integration:
   1. Support communication, without requiring interface, between lighting control system and third-party system via RESTful API.
   2. API Integration Capabilities:
      a. Discovery:
         1) Areas: Area and scene names.
         2) Zones: Zone names, minimum and maximum light levels.

b. Monitoring:
   1) Area Information:
      a) Occupancy status.
      b) Occupancy enabled.
      c) Lighting zone status.
      d) Active scene.
      e) Instantaneous and maximum lighting power.
   2) Zone Information:
      a) Light intensity.
      b) Switch level.
      c) Contact closure output status.
      d) Correlated color temperature, where controllable.
c. Control:
   1) Lighting Control:
      a) Activate scene.
      b) Set lighting zone level and correlated color temperature, where controllable.

D. Mobile Application:
   1. Product: Lutron App.
   2. Enables system tuning and control from iOS mobile device.
   3. Capabilities:
      a. Control lighting zones and scenes.
      b. Edit lighting scenes.
      c. Control shade groups and presets.
      d. Edit shade presets.
      e. View and edit timeclock events.

2.6 CONTROL STATIONS

A. Provide control stations with configuration as indicated or as required to control loads as indicated.

B. Wired Control Stations:
   1. General Requirements:
      a. Power: Class 2 (low voltage).
      b. UL listed.
      c. Provide faceplates with concealed mounting hardware.
      d. Borders, logos, and graduations to use laser engraving or silk-screened graphic process that chemically bonds graphics to faceplate, resistant to removal by scratching and cleaning.
      e. Finish: As specified for wall controls in "Device Finishes" under DIGITAL NETWORK LIGHTING CONTROL SYSTEM - GENERAL REQUIREMENTS article above.
   2. Multi-Scene Wired Control:
      a. General Requirements:
         1) Allows control of any devices part of lighting control system.
         2) Allows for easy reprogramming without replacing unit.

3) Communications: Utilize RS485 wiring for low-voltage communications link.
4) Engrave keypads with button, zone, and scene descriptions as indicated on drawings.
5) Software Configuration:
   a) Customizable control station device button functionality:
      (1) Buttons can be programmed to perform single defined action.
      (2) Buttons can be programmed to perform defined action on press and defined action on release.
      (3) Buttons can be programmed using conditional logic off of state variable such as time of day or partition status.
      (4) Buttons can be programmed to perform automatic sequence of defined actions.
      (5) Capable of deactivating select keypads to prevent accidental changes to light levels.
      (6) Buttons can be programmed for raise/lower of defined loads.
      (7) Buttons can be programmed to toggle defined set of loads on/off.
6) Status LEDs:
   a) Upon button press, LEDs to immediately illuminate.
   b) LEDs to reflect true system status. LEDs to remain illuminated if button press was properly processed or LEDs to turn off if button press was not processed.
   c) Support logic that defines when LED is illuminated:
      (1) Scene logic (logic is true when all zones are at defined levels).
      (2) Room logic (logic is true when at least one zone is on).
      (3) Pathway logic (logic is true when at least one zone is on).
      (4) Last scene (logic is true when spaces are in defined scenes).

b. Wired Keypads; Lutron seeTouch QS Wallstations:
   1) Style: Architectural Non-Insert Style.
   2) Mounting: Wallbox or low-voltage mounting bracket; provide wall plates with concealed mounting hardware.
   3) Button/Engraving Backlighting:
      a) Utilize backlighting for buttons and associated engraving to provide readability under all light conditions.
      b) Backlight intensity adjustable via programming software.
   4) Design keypads to allow field-customization of button color, configuration, and engraving using field-changeable replacement kits.
   5) Contact Closure Interface: Provide two contact closure inputs on back of unit which provide independent functions from front buttons; accepts both momentary and maintained contact closures.
   6) Terminal block inputs to be over-voltage and miswire-protected against reversals and shorts.

2.7 LOW-VOLTAGE CONTROL INTERFACES

A. Provide low-voltage control interfaces as indicated or as required to control loads as indicated.

B. UL listed.

C. Contact Closure Interface:
1. Product: Lutron Model QSE-IO.
2. Connects to lighting management hub via RS485.
3. The contact closure input device to accept both momentary and maintained contact closures.
4. The contact closure output device can be configured for maintained or pulsed outputs.
5. Contact closure can be programmed using conditional logic off of state variable such as time of day or partition status.

D. RS232 and Ethernet Interface:
1. Product: Lutron Model QSE-CI-NWK-E.
2. Connects to lighting management hub via RS485.
3. Provide ability to communicate via Ethernet or RS232 to audiovisual equipment, touchscreens, etc.
4. Provide control of:
   a. Light scene selections.
   b. Fine-tuning of light scene levels with raise/lower.
   c. Simulate system wall station button presses and releases.
5. Provide status monitoring of:
   a. Light scene status.
   b. Wall station button presses and releases.
   c. Wall station LEDs.
6. Provide ability to send custom output strings.

E. Sensor Modules:
1. Products:
   a. Sensor module with wired inputs only; Lutron Model QSMX-4W-C.
2. Connects to lighting management hub via RS485.
3. Wired Modules:
   a. Provide wired inputs for:
      1) Occupancy sensors.
      2) Daylight sensors.
      3) Wired wall stations.
4. Communicate sensor information to wired low-voltage digital link for use by compatible devices.

2.8 WIRED SENSORS

A. Wired Occupancy Sensors:
1. General Requirements:
   a. Connects directly to compatible ballasts and modules without need of power pack or other interface.
   b. Turns off or reduces lighting automatically after reasonable time delay when room or area is vacated by last person to occupy space.
   c. Accommodates conditions of space utilization and irregular work hours and habits.
   d. Comply with UL 94.

e. Self-Adaptive Sensors: Continually adjusts sensitivity and timing to ensure optimal lighting control for any use of space; furnished with field-adjustable controls for time delay and sensitivity to override adaptive features.
f. Provide capability to:
   1) Add additional timeout system-wide without need to make local adjustment on sensor.
   2) Group multiple sensors.
g. Power Failure Memory: Settings and learned parameters to be saved in nonvolatile memory and not lost should power be interrupted and subsequently restored.
h. Furnished with necessary mounting hardware and instructions.
i. Class 2 devices.
j. Ceiling-Mounted Sensors: Indicate viewing directions on mounting bracket.
k. Color: White.

2. Wired Passive Infrared Sensors:
   a. Utilize multiple segmented lens, with internal grooves to eliminate dust and residue build-up.
   b. Products:
      1) Type ___ - High Bay Passive Infrared Sensor, Surface-Mounted, 180 Degree; Lutron Model LUT-WSPSM24V-180-CPN6111: Coverage radius of 42 feet (13 m) at mounting height of 30 feet (9 m) and 50 feet (15 m) at mounting height of 45 feet (14 m); 180 degree field of view; field-adjustable timeout.

3. Wired Dual Technology Sensors:
   a. Passive Infrared: Utilize multiple segmented lens, with internal grooves to eliminate dust and residue build-up.
   b. Ultrasonic: Utilize operating frequency of 32 kHz or 40 kHz, crystal-controlled to operate within plus/minus 0.005 percent tolerance.
   c. Ceiling-Mounted Sensors: Provide customizable mask to block off unwanted viewing areas.
   d. Isolated Relay: Provide internal additional isolated relay with Normally Open, Normally Closed, and Common outputs for use with HVAC control, Data Logging and other control options where indicated.
   e. Integral Photocell: Provide integral photocell with adjustable sensitivity to prevent lights from turning on when there is sufficient natural light where indicated.
   f. Products, Without Isolated Relay and Integral Photocell:
      1) Type _____ - Ceiling-Mounted Dual Technology Sensor, 2000 square feet (186 sq m); Lutron Model LOS-CDT-2000-WH: Coverage of 2000 square feet (186 sq m) with ceiling height of 8 to 12 feet (2.4 to 3.7 m); 360 degree field of view; self-adaptive.
   g. Products, With Isolated Relay and Integral Photocell:
      1) Type _____ - Ceiling-Mounted Dual Technology Sensor, 2000 square feet (186 sq m); Lutron Model LOS-CDT-2000R-WH: Coverage of 2000 square feet (186 sq m) with ceiling height of 8 to 12 feet (2.4 to 3.7 m); 360 degree field of view; with isolated relay and integral photocell; self-adaptive.

B. Power Packs for Wired Sensors:
   1. Products:

a. Type ____ - 120-277 VAC power input/24 VDC, 150 mA power output; 16 A lighting (120-277 V), 1 HP motor (120-277 V) relay contact rating; Lutron Model PP-DV Power Pack.
b. Type _____ - 120-277 VAC power input (manual-on)/24 VDC, 150 mA power output; 16 A lighting (120-277 V), 1 HP motor (120-277 V) relay contact rating; Lutron Model PP-DV-M Power Pack.

2. Provide sensor power packs where required for power connection to sensors.
3. For ease of mounting, installation and future service, power pack(s) to be able to mount through 1/2-inch (16 mm) trade size knockout in standard electrical enclosure and be integrated, self-contained unit consisting internally of isolated load switching control relay and transformer to provide low-voltage power. Transformer to provide power to minimum of three sensors.
4. Plenum-rated.
5. Control Wiring Between Sensors and Control Units: Class 2, 18-24 AWG, stranded UL Classified, PVC insulated or TEFLON jacketed cable suitable for use in plenums, where applicable.

2.9 ACCESSORIES

A. Emergency Lighting Interface:
1. Product: Lutron Model LUT-ELI.
2. Provides total system listing to UL 924 when used with lighting control system.
3. Senses all three phases of building power.
4. Provides output to power panels or digital ballast interfaces if power on any phase fails and sends all lights controlled by these devices to emergency light level setting. Lights to return to their previous intensities when normal power is restored.
5. Accepts contact closure input from fire alarm control panel.

B. Provide power supplies as indicated or as required to power system devices and accessories.

2.10 SOURCE QUALITY CONTROL

A. See Section 01 40 00 - Quality Requirements for additional requirements.

B. Factory Testing; Lutron Standard Factory Testing:
1. Perform full-function factory testing on completed assemblies. Statistical sampling is not acceptable.
2. Perform factory audit burn-in of dimming assemblies and panels at 104 degrees F (40 degrees C) at full load for two hours.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Verify that field measurements are as shown on drawings.

B. Verify that ratings and configurations of system components are consistent with indicated requirements.

C. Verify that mounting surfaces are ready to receive system components.

D. Verify that conditions are satisfactory for installation prior to starting work.

3.2 INSTALLATION

A. Perform work in accordance with NECA 1 and, where applicable, NECA 130, except for mounting heights specified in those standards.

B. Install products in accordance with manufacturer's instructions.

C. Define each dimmer/relay load type, assign each load to zone, and set control functions.

D. Sensor Locations:
   1. Where Lighting Control Manufacturer Sensor Layout and Tuning service is specified in Part 2 under "DIGITAL-NETWORK LIGHTING CONTROL SYSTEM - GENERAL REQUIREMENTS", locate sensors in accordance with layout provided by Lighting Control Manufacturer. Lighting Control Manufacturer may direct Contractor regarding sensor relocation should conditions require deviation from locations indicated. Where Lighting Control Manufacturer Sensor Layout and Tuning service is not specified, locate sensors in accordance with drawings.

E. Lamp Burn-In: Operate lamps at full output for prescribed period per manufacturer's recommendations prior to use with dimming controls. Replace lamps that fail prematurely due to improper lamp burn-in.

F. Identify system components.

3.3 FIELD QUALITY CONTROL

A. See Section 01 40 00 - Quality Requirements for additional requirements.

B. Manufacturer's Startup Services; Lutron Standard Startup Services:
   1. Manufacturer's authorized Service Representative to conduct minimum of two site visits to ensure proper system installation and operation.
   2. Conduct Pre-Installation visit to review requirements with installer as specified in Part 1 under "Administrative Requirements".
   3. Conduct second site visit upon completion of lighting control system to perform system startup and verify proper operation:
      a. Verify connection of power wiring and load circuits.
      b. Verify connection and location of controls.
      c. Energize lighting management hubs and download system data program.
      d. Address devices.
      e. Verify proper connection of panel links (low-voltage/data) and address panel.
      f. Verify system operation control by control.

g. Verify proper operation of manufacturer's interfacing equipment.
h. Configure initial groupings of ballasts/drivers for wall controls, daylight sensors and occupancy sensors.
i. Provide initial rough calibration of sensors; fine-tuning of sensors is responsibility of Contractor unless provided by Lighting Control Manufacturer as part of Sensor Layout and Tuning service where specified in Part 2 under "DIGITAL-NETWORK LIGHTING CONTROL SYSTEM - GENERAL REQUIREMENTS".
j. Train Owner's representative on system capabilities, operation, and maintenance, as specified in Part 3 under "Closeout Activities".
k. Obtain sign-off on system functions.

4. Correct defective work, adjust for proper operation, and retest until entire system complies with contract documents.

3.4 CLEANING

A. Clean exposed surfaces to remove dirt, paint, or other foreign material and restore to match original factory finish.

3.5 COMMISSIONING

A. See Section 01 91 13 - General Commissioning Requirements for commissioning requirements.

3.6 CLOSEOUT ACTIVITIES

A. See Section 01 78 00 - Closeout Submittals for closeout submittals.

3.7 PROTECTION

A. Protect installed products from subsequent construction operations.

3.8 MAINTENANCE

A. See Section 01 70 00 - Execution and Closeout Requirements for additional requirements relating to maintenance service.

3.9 ADJUSTING

A. Test each system component after installation to verify proper operation.

B. Confirm correct loads are recorded on directory card in each panel.

3.10 DEMONSTRATION

A. Demonstrate operation of following system components:

1. Each type of occupancy/vacancy sensor.

B. Furnish eight hours to instruct Owner's personnel in operation and maintenance of system. Schedule training with Owner, provide at least seven days' notice to Owner of training date.

END OF SECTION 26 09 43

SECTION 26 22 00 - LOW-VOLTAGE TRANSFORMERS

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:
   1. Two-winding transformers.

1.2 Related Requirements:

1. Section 26 05 26 - Grounding and Bonding for Electrical Systems.
2. Section 26 05 29 - Hangers and Supports for Electrical Systems.
3. Section 26 05 33 - Raceway and Boxes for Electrical Systems.
4. Section 26 05 53 - Identification for Electrical Systems.

1.3 REFERENCE STANDARDS

A. National Electrical Manufacturers Association:
   1. NEMA ST 1 - Specialty Transformers (Except General Purpose Type).
   2. NEMA ST 20 - Dry Type Transformers for General Applications.

B. International Electrical Testing Association:
   1. NETA ATS - Acceptance Testing Specifications for Electrical Power Distribution Equipment and Systems.

1.4 SUBMITTALS

A. Product Data: Submit outline and support point dimensions of enclosures and accessories, unit weight, voltage, kVA, and impedance ratings and characteristics, tap configurations, insulation system type, and rated temperature rise.

B. Test and Evaluation Reports: Indicate loss data, efficiency at 25, 50, 75 and 100 percent rated load, and sound level.

C. Source Quality Control Submittals: Indicate results of factory tests and inspections.

D. Field Quality Control Submittals: Indicate results of Contractor furnished tests and inspections.

1.5 CLOSEOUT SUBMITTALS

A. Record Documentation: Record actual locations of transformers.

1.6 QUALIFICATIONS

A. Manufacturer: Company specializing in manufacturing products specified in this section with minimum three years documented experience.

1.7 DELIVERY, STORAGE, AND HANDLING

A. Store in clean, dry space. Maintain factory wrapping or provide additional canvas or plastic cover to protect units from dirt, water, construction debris, and traffic.

B. Handle in accordance with manufacturer's written instructions. Lift only with lugs provided. Handle carefully to avoid damage to transformer internal components, enclosure, and finish.

PART 2 - PRODUCTS

2.1 CONSTRUCTION – HARMONIC MITIGATING TRANSFORMERS TWO-WINDING TRANSFORMERS

A. Manufacturers: Subject to the requirement of the specification, the following manufacturer's products may be incorporated into the project:
1. Eaton
2. Schneider Electric/Square D.
3. Siemens.
4. General Electric/ABB.

B. Furnish materials in accordance with NYSBC.

C. Description: NEMA ST 20, factory-assembled, air-cooled, dry type transformers, ratings as indicated on Drawings. Transformers shall meet the requirements of 10 CFR 431 – Energy Conservation Standards for low-voltage, 3-phase transformers manufactured after January 1, 2016.

D. Operation:
1. Primary Voltage: 480 volts, 3 phase.
2. Secondary Voltage: 208Y/120 volts, 3 phase.
3. Insulation system and average winding temperature rise for rated kVA as follows:
4. 16-500 kVA: Class 220 with 115 degrees C rise.
5. Case temperature: Do not exceed 35 degrees C rise above ambient at warmest point at full load.
6. Winding Taps:
   a. Transformers 15 kVA and Larger: NEMA ST 20.
7. Sound Levels: NEMA ST 20. Quiet-type transformers shall have sound levels 3 dB less than those listed in NEMA ST 20.
8. Basic Impulse Level: 10 kV.
9. Mounting:
   a. 15-75 kVA: Suitable for wall, floor, or trapeze mounting.
   b. Larger than 75 kVA: Suitable for floor mounting.

E. Materials:
1. Ground core and coil assembly to enclosure by means of visible flexible copper grounding strap.
2. Coil Conductors: Continuous copper windings with terminations brazed or welded.
3. Enclosure: NEMA ST 20, Type 1 ventilated. Furnish lifting eyes or brackets.

F. Electrostatic Shielding:
1. Harmonic mitigating transformers shall be provided with an independent, [single][double], full-width electrostatic shield consisting of a single turn of copper placed between each primary and secondary winding and grounded.
   a. Electrostatic shield shall provide primary to secondary winding capacitance between 24 and 18 picofarads over the range of 100 Hz to 20 kHz.
   b. Electrostatic shielding shall provide the following minimum attenuation when tested per MIL-Std-220A, Method of Insertion Loss Measurement, with matched impedance no load technique:
   c. Common mode noise attenuation: Minus 80 dBA minimum at 0.1 kHz to 1.5 kHz; minus 55 dBA minimum at 1.51 kHz to 100 kHz.Normal mode (Transverse mode) noise attenuation: Minus 35dBA minimum at 1.5 kHz to 10 kHz.

G. Harmonic Treatment
1. Harmonic Mitigating Transformers (HMTs) shall have a low Positive/Negative sequence impedance (between 4.6% and 7.2%) and low Zero-Sequence impedance/reactance (less than 0.55% and 0.47% respectively)
2. Triplen harmonics shall be treated in the secondary windings through flux cancellation and not coupled in to the primary delta winding.
3. 5^{th} and 7^{th} harmonic currents shall be treated through the pairing of phase-shifted transformers such that these harmonic currents subtract at the common bus feeding the transformers with harmonics produced by other similar sources.
4. Each of the transformers used to treat 5^{th} and 7^{th} harmonic currents shall also treat triplen harmonics in the secondary windings of each transformer.
5. Fundamental current imbalance shall be reduced on the primary when compared to the secondary load measurements.
6. Harmonic treatment shall be through electromagnetic means; filters, capacitors, power electronic circuitry or other such devices shall not be used to treat harmonics.

H. Fabrication:
1. Isolate core and coil from enclosure using vibration-absorbing mounts.
2. Nameplate: Include transformer connection data and overload capacity based on rated allowable temperature rise.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Verify mounting supports are properly sized and located including seismic bracing to walls.

3.2 PREPARATION

A. Section 01 31 00 – Project Management and Coordination: Requirements for installation preparation.

B. Provide concrete pads under provisions of Section 03 30 00.

3.3 DEMOLITION

A. Disconnect and remove abandoned transformers.

B. Maintain access and adequate ventilation to existing transformers and other installations remaining active and requiring access and ventilation. Modify installation or provide access panel or ventilation grilles.

3.4 INSTALLATION

A. Provide 4" high concrete housekeeping pad for all floor-mounted transformers. Paint with epoxy paint to match floor. Set transformer plumb and level.

B. Use flexible conduit, in accordance with Section 26 05 33, 2 feet minimum length, 3 feet maximum length, for connections to transformer case. Make conduit connections to side panel of enclosure.

C. Support transformers in accordance with Section 26 05 29.
   1. Mount wall-mounted transformers using integral flanges or accessory brackets furnished by manufacturer.
   2. Mount floor-mounted transformers on vibration isolating pads suitable for isolating transformer noise from building structure.
   3. Mount trapeze-mounted transformers as indicated on Drawings.

D. Provide seismic restraints.

E. Install grounding and bonding in accordance with Section 26 05 26.

3.5 REPAIR & RESTORATION

A. Repair existing transformers to remain or to be reinstalled.

3.6 FIELD QUALITY CONTROL

A. Inspect and test in accordance with NETA ATS, except Section 4.

B. Perform inspections and tests listed in NETA ATS, Section 7.2.1.

3.7 ADJUSTING

A. Measure primary and secondary voltages and make appropriate tap adjustments.

3.8 CLEANING

A. Clean existing to remain or to be re-installed transformers interiors prior to energizing transformer. Where dust producing work is not completed prior to energizing the transformer, Contractor shall schedule a shutdown prior to turn over to clean the transformer.

END OF SECTION 26 22 00

SECTION 26 24 16 - PANELBOARDS

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:
   1. Distribution and branch circuit panelboards.
   2. Electronic grade branch circuit panelboards.

B. Related Requirements:
   1. Section 26 05 26 - Grounding and Bonding for Electrical Systems.
   2. Section 26 05 53 - Identification for Electrical Systems.
   3. Section 26 28 13 - Fuses.

1.2 REFERENCE STANDARDS

A. Institute of Electrical and Electronics Engineers:
   1. IEEE C62.41 - Recommended Practice on Surge Voltages in Low-Voltage AC Power Circuits.

B. National Electrical Manufacturers Association:
   1. NEMA FU 1 - Low Voltage Cartridge Fuses.
   2. NEMA ICS 2 - Industrial Control and Systems: Controllers, Contactors, and Overload Relays, Rated Not More Than 2000 Volts AC or 750 Volts DC.
   3. NEMA ICS 5 - Industrial Control and Systems: Control Circuit and Pilot Devices.
   4. NEMA KS 1 - Enclosed and Miscellaneous Distribution Equipment Switches (600 Volts Maximum).
   5. NEMA PB 1 - Panelboards.
   6. NEMA PB 1.1 - General Instructions for Proper Installation, Operation, and Maintenance of Panelboards Rated 600 Volts or Less.

C. International Electrical Testing Association:
   1. NETA ATS - Acceptance Testing Specifications for Electrical Power Distribution Equipment and Systems.

D. National Fire Protection Association:
   1. NFPA 70 - National Electrical Code.

E. C.Underwriter's Laboratories (UL):
   1. UL 50 - Cabinets and Boxes
   2. UL 67 - Safety for Panelboards.
   3. UL 489 - Molded-Case Circuit Breakers, Molded-Case Switches, and Circuit-Breaker Enclosures.
   4. UL 1283 - Electromagnetic Interference Filters.
   5. UL 1449 - Transient Voltage Surge Suppressors.

6. UL 1699 - Arc-Fault Circuit Interrupters.

1.3 SUBMITTALS

A. Section 01 33 00 - Submittal Procedures: Requirements for submittals.

B. Product Data: Submit catalog data showing specified features of standard products.

C. Shop Drawings: Indicate outline and support point dimensions, voltage, main bus ampacity, integrated short circuit ampere rating, circuit breaker, and fusible switch arrangement and sizes.

D. Source Quality control submittals: Indicate results of factory tests and inspections.

E. Field Quality Control Submittals: Indicate results of Contractor furnished tests and inspections.

1.4 CLOSEOUT SUBMITTALS

A. Section 01 70 00 - Execution and Closeout Requirements: Requirements for submittals.

B. Project Record Documents: Record actual locations of panelboards and record actual circuiting arrangements.

C. Operation and Maintenance Data: Submit spare parts listing, source and current prices of replacement parts and supplies, and recommended maintenance procedures and intervals.

1.5 MAINTENANCE MATERIAL SUBMITTALS

A. Section 01 70 00 - Execution and Closeout Requirements: Requirements for maintenance products.

B. Extra Stock Materials:
1. Furnish two (2) of each panelboard key. Panelboards keyed alike to Owner's current keying system.

1.6 QUALITY ASSURANCE

A. Qualifications
1. Manufacturer: Company specializing in manufacturing products specified in this Section with minimum three years' documented experience.

PART 2 - PRODUCTS

2.1 DISTRIBUTION PANELBOARDS

A. Manufacturers: Subject to the requirement of the specification, the following manufacturer's products may be incorporated into the project:
   1. Eaton.

B. Description: NEMA PB 1, circuit breaker type panelboard.

C. Panelboard Busses:
   1. Tin/silver-plated copper, ratings as indicated. Buses shall be arranged for sequence phasing of branch circuits. Spaces for future devices shall be bussed for the maximum device that can be installed into the panel with suitable insulation and bracing to maintain proper short circuit rating. All provisions shall be made for ready insertion of a future protective device.
   2. Multiple cable lugs for incoming feeder cables shall be furnished where required. Lugs shall be secured to bus by stud bolts.
   3. Provide an isolated copper neutral bus in each panel with lugs for each feeder neutral conductor and each outgoing branch circuit.
   4. Provide copper ground bus in each panelboard. Ground bus shall be bare, un-insulated and suitably bolted to the cabinet. Provide suitable lugs for each feeder ground conductor and each outgoing feeder circuit.
   5. All interiors shall be completely factory assembled with switching and protective devices, connectors, etc. They shall be so designed that switching and protective devices can be replaced without disturbing adjacent units, without removing the main bus connectors, and shall be so designed that circuits may be changed without machining, drilling or tapping.

D. Minimum short circuit rating: 65,000 amperes RMS Symmetrical.

E. Molded Case Circuit Breakers:
   1. NEMA AB 1. Provide circuit breakers with integral thermal and instantaneous magnetic trip in each pole. Provide circuit breakers UL listed as Type HACR for air conditioning equipment branch circuits.
   2. Circuit breakers shall be bolted in type, consisting of the number of poles and ampere ratings as noted on the drawings. Two and three pole breakers shall be of the common trip type.

F. Provide circuit breaker accessory trip units and auxiliary switches as indicated.

G. All circuit breakers shall be factory tested and labeled as required.

H. All distribution panelboard circuit breakers shall be equipped with lock-out/tag-out devices.

I. Enclosure: NEMA PB 1, Type 1.

J. Cabinet box: 10-inches (250 mm) deep; 44-inches (1118 mm) wide (maximum). Box shall be fabricated from code gauge galvanized sheet steel without pre-punched knockouts.

K. Cabinet Front: Door-in-door trim, bolted to the cabinet. Doors shall have three-point latching mechanisms. Finish in manufacturer's standard gray enamel. Locks shall be keyed alike.

L. Distribution Panelboards shall be Schneider Electric/Square D I-Line or approved equal.

2.2 BRANCH CIRCUIT PANELBOARDS

A. Manufacturers: Subject to the requirement of the specification, the following manufacturer's products may be incorporated into the project:
1. Eaton.

B. Description: NEMA PB 1, circuit breaker type, lighting and appliance branch circuit panelboard.

C. Minimum Short Circuit Rating: 22,000A RMS symmetrical for 240V panelboards; 65,000A RMS symmetrical for 480 V panelboards.

D. Panelboard Busses:
1. Tin/silver-plated copper, ratings as indicated. Buses shall be arranged for sequence phasing of branch circuits. Spaces for future devices shall be bussed for the maximum device that can be installed into the panel with suitable insulation and bracing to maintain proper short circuit rating. All provisions shall be made for ready insertion of a future protective device.
2. Multiple cable lugs for incoming feeder cables shall be furnished where required. Lugs shall be secured to bus by stud bolts. Multiple section panels shall have sub-feed lugs with full capacity taps to adjacent panel section.
3. Provide an isolated copper neutral bus in each panel with lugs for each feeder neutral conductor and each outgoing branch circuit.
4. Provide a tin-plated copper ground bus in each panelboard. Ground bus shall be bare, un-insulated and suitably bolted to the cabinet. Provide suitable lugs for each feeder ground conductor and each outgoing branch or feeder circuit.
5. All interiors shall be completely factory assembled with switching and protective devices, connectors, etc. They shall be so designed that switching and protective devices can be replaced without disturbing adjacent units, without removing the main bus connectors, and shall be so designed that circuits may be changed without machining, drilling or tapping.

E. Molded Case Circuit Breakers: NEMA AB 1, bolt-on type thermal magnetic trip circuit breakers, with common trip handle for all poles. Provide circuit breakers UL listed as Type SWD for lighting circuits, type HACR for air conditioning equipment circuits. Provide UL Class A ground fault interrupter circuit breakers where scheduled. Do not use tandem circuit breakers. Where multi-pole circuit breakers are required, circuit breakers shall have a common trip. Handle ties for multi-pole circuits will not be accepted. All circuit breakers shall be factory tested and labeled as required.

F. Enclosure: NEMA PB 1, Type 1.

G. Cabinet box: 6 inches (153 mm) deep; 20 inches (500 mm) wide for branch circuit (240 volt and less) and lighting (480/277 volt) panelboards. Box shall be fabricated from code gauge galvanized sheet steel without pre-punched knockouts.

H. Cabinet Front: Door-in-door trim, bolted to the cabinet. Finish in manufacturer's standard gray enamel. Doors shall be provided with locks and shall be keyed alike.

I. Branch Circuit panelboards shall be Square D Type NQOD or approved equal for 208/120 volts. Circuit breakers shall be Square D Type QOB-VH or approved equal.

2.3 ELECTRONIC GRADE PANELBOARD

A. Description:
1. Integral Surge Suppresser: Component recognized according to UL 1449 and UL 1283.
2. Panelboard: UL 67 listed and TVSS device UL 1449 Component Recognized. TVSS device meets UL 1449. Furnish panelboard markings with clamp voltage at TVSS terminals and clamp voltage at panelboard line terminals.

B. Performance:
1. Integral Surge Suppressers:
   a. Maximum single impulse current rating not less than 200 kA for each phase.
   b. Pulse Lift Test: Capable of protecting against and surviving 5000 IEEE C62.41 Category C transients without failure or degradation.
   c. Clamping Voltage:
      1) 208Y/120 Configuration:
         a) L-N: 500 V.
         b) N-G: 500 V.
         c) L-G: 500 V.
      2) 480Y/277 Configuration:
         a) L-N: 1,000 V.
         b) N-G: 1,000 V.
         c) L-G: 1,000 V.

C. Fabrication:
1. Integral Surge Suppresser:
   a. Furnish copper bus bars for surge current path.
   b. Construct using surge current modules (MOV based). Each module fused with user replaceable 200,000 AIR rated fuses. Status of each module monitored on front cover of panelboard enclosure and on module.
   c. Furnish with audible alarm activated when one of surge current modules has failed. Furnish alarm on/off to silence alarm and alarm push-to-test switch to test alarm. Locate switches and alarm on front cover of panelboard enclosure.
   d. Furnish response time no greater than five nanoseconds for individual protection modes.
   e. Designed to withstand maximum continuous operating voltage (MCOV) of not less than 115 percent of nominal RMS voltage.
   f. Furnish visible indication of proper suppresser connection and operation. Lights indicate operable phase and module.
   g. Furnish minimum EFI/RFI filtering of 34 dB at 100 kHz with insertion loss ratio of 50:1 using Mil Std. 220A methodology.
2. Panelboards:
   a. Top or bottom feed as indicated on Drawings. Furnish circuit directory inside door.
   b. Construct box of galvanized steel. Box size as indicated on Drawings.

c. Main bus constructed of copper and rated for load current.
d. Furnish interior with branch circuit breakers. Furnish one 60 A circuit breaker, with appropriate number of poles, as dedicated disconnect for TVSS.
e. Furnish standard rated neutral assembly with copper neutral bus.
f. Furnish with insulated ground bus and safety ground bus.
g. Furnish wiring gutters according to NEC.
h. Field connections to panelboard: main breaker type.
i. Construct with surface mounted trim and NEMA Type 1 enclosure.
j. Furnish with branch breaker positions and nominal current rating as indicated on Drawings.

2.4 SOURCE QUALITY CONTROL

A. Independently test integral surge suppressers with category C3 high exposure waveform (20 kV-1.2/50us, 10kA-8/20 us) per IEEE C62.41.

PART 3 - EXECUTION

3.1 DEMOLITION

A. Disconnect abandoned panelboards and load centers. Remove abandoned panelboards and load centers.

B. Maintain access to existing panelboards and load centers remaining active and requiring access. Modify installation or provide access panel.

3.2 INSTALLATION

A. Install panelboards according to NEMA PB 1.1.

B. Install panelboards plumb.

C. Install recessed panelboards flush with wall finishes.

D. Height: 6 feet to top of panelboard; install panelboards taller than 6 feet with bottom no more than 4 inches above floor.

E. Install filler plates for unused spaces in panelboards.

F. Provide typed circuit directory for each branch circuit panelboard. Revise directory to reflect circuiting changes to balance phase loads. Identify each circuit as to its clear, evident and specific purpose of use.

G. Install engraved plastic nameplates according to Section 26 05 53.

H. Ground and bond panelboard enclosure according to Section 26 05 26. Connect equipment ground bars of panels according to NFPA 70.

3.3 REPAIR & RESTORATION

A. Repair existing panelboards and load centers to remain or to be reinstalled.

3.4 FIELD QUALITY CONTROL

A. Contractor shall test the panelboard in accordance with NETA acceptance testing specifications.

3.5 ADJUSTING

A. Measure steady state load currents at each panelboard feeder; rearrange circuits in panelboard to balance phase loads to within 10 percent of each other. Maintain proper phasing for multi-wire branch circuits.

3.6 CLEANING

A. Clean the interior of all panelboards to remove dirt and debris using a vacuum cleaner with a collection bag and cartridge filter.

END OF SECTION 26 24 16

SECTION 26 27 26 - WIRING DEVICES

PART 1 - GENERAL

1.1 SUMMARY

A. Section includes:
   1. Wall switches
   2. Wall dimmers
   3. Receptacles
   4. Device plates and decorative box covers

B. Related Sections:
   1. Section 26 05 33 - Raceway and Boxes for Electrical Systems: Outlet boxes for wiring devices.

1.2 REFERENCES

A. NEMA WD 1 - General Requirements for Wiring Devices.

B. NEMA WD 6 - Wiring Devices-Dimensional Requirements.

1.3 SUBMITTALS

A. Product Data: Submit manufacturer's catalog information showing dimensions, colors, and configurations.

B. Samples: Submit two samples of each wiring device and wall plate illustrating materials, construction, color, and finish.

1.4 QUALIFICATIONS

A. Manufacturer: Company specializing in manufacturing products specified in this section with minimum three years documented experience.

1.5 EXTRA MATERIALS

A. Furnish two (2) of each style, size, and finish wall plate.

PART 2 - PRODUCTS

2.1 UNIFORMITY OF MANUFACTURER

A. Products provided under this Section shall be from one manufacturer for identical catalog items (i.e., receptacles); wherever possible, provide uniformity of manufacturer for similar types of items.

B. Plugs shall be of same manufacturer and grade as receptacles.

C. Manufacturers: Subject to compliance with requirement, provide products by one of the following:
1. Cooper Wiring Devices (abbreviated Cooper)
2. Hubbell
3. Pass & Seymour (abbreviated P & S)
4. Leviton
5. Curbell
6. Or Approved Equal.

2.2 WALL SWITCHES

A. General Requirements:
1. Heavy-duty, AC only general-use snap switch, quiet operation type.
2. Voltage: 120/277 volts, AC.
3. Current: 20 amperes.
4. Horsepower rating: 1 HP@120V; 2 HP@277V.
5. Body and Handle: Decora Decorator style thermoplastic with a nylon toggle handle. Handle color shall be selected by the Architect from the manufacturer's standard colors.
6. Switch shall be mounted on a plated steel yoke with a grounding terminal screw.
7. Provide LED illuminated switch.

B. Switch Types: Switch types and manufacturer's catalog numbers as follows:

	Manufacturer's Catalog Numbers			
Description	Cooper	Leviton	Hubbell	P&S
Single Pole	7621	5621-2	2121 SNAP2121IL RNA SNAP2121IL WNA	2621
Double Pole	7622	5622-2	2122 N/A	2622
Three-Way	7623	5623-2	2123 SNAP2123IL RNA SNAP2123IL WNA	2623

	Manufacturer's Catalog Numbers			
Description	Cooper	Leviton	Hubbell	P&S
Four-Way	7624	5624-2	2124	2624

C. Patient room Low Voltage Lighting Control.
   1. Low Voltage Controller Wall Switch: Curbell WPA-1000-001
   2. Low Voltage Controller: Curbell LVC-2000-004

2.3 WALL DIMMERS

A. Refer to Specification 260923 Lighting Control Devices for Wall Dimmer devices.

B. Manufacturers: Subject to the requirement of the specification, the following manufacturer products may be incorporated into the project:
   1. Hubbell
   2. Lutron
   3. Legrand

C. Comply with UL 1472.

D. Provide dimmer and wall plate colors that match other wiring devices in the respective room. Multiple wall-box dimmers may be used sporadically throughout the project on common circuits; provide compatible dimmers accordingly.

E. Provide dedicated neutrals for circuits serving loads controlled by dimmers.

F. Install dimmers within terms of their listing. Verify that dimmers used for fan speed control are listed for that application. Install unshared neutral conductors online and load side of dimmers according to manufacturers' device listing conditions in the written instructions. Provide low-voltage control wiring, where applicable, as required to render all dimming functionality fully operational.

G. LED Dimmer Switches: Specification grade; modular; thin profile; compatible with dimming drivers; dimmer-driver combination capable of consistent full-range dimming. Provide low-voltage control wiring, in addition to branch circuit wiring, as required to render dimming fully operational.

2.4 RECEPTACLES

A. General Requirements:
   1. Wide double blade contacts designed to maintain positive pressure against both sides of plug or cap having flat fingers. Contacts shall be solid brass.
   2. Polarized grounding type with grounding contacts bonded to receptacle mounting strap or housing, except isolated ground receptacles. Mounting strap shall be plated steel.
   3. Contacts separated by impact resisting molded plastic insulating material.
   4. Receptacles shall be SNAPConnect LED, Extra Heavy Duty Hospital Grade, and a nylon face.
   5. Locking devices, where specified, to "lock" cap in place with simple twisting motion.

6. Receptacles shall be Style Line Decorator style. Normal power receptacles shall be white unless otherwise selected by the Architect from the manufacturer's standard colors. Receptacles connected to emergency panelboards shall be red.
7. Provide SNAPConnect right angle connectors as required.

B. Hospital Grade Receptacle Types: Rating in amperes, number of poles and wires, voltage, NEMA configuration, description and manufacturer's catalog numbers as follows:

			Manufacturer's Catalog Numbers			
Rating	NEMA	Description	Leviton	Cooper	Hubbell	P&S
20A, 2P, 3W, 125V	5-20R	Duplex	8300	AH8300	SNAP2182RLTRA SNAP2182WLTRA	8300
20A, 2P, 3W, 125V	5-20R	Duplex Ground Fault Circuit Interrupter	GFNT2-HG	SGFH20	GFTWRST20SNAPR GFTWRST20SNAPW	2097HG
20A, 2P, 3W, 125VAC / 5VDC, 3.1A – 5A	5-20R	Dual USB Type A Charger with Tamper-Resistant Duplex Receptacle	M58AA-HG	TR8355	SNAP8300USBR SNAP8300USBW	TR8300HUSB
125VAC, 5VDC, 4.2A – 5A		Four USB Charging Station – Type A	USB4P	7750	USB4	TM8USB4NICC6

2.5 WALL PLATES

A. Manufacturers: Subject to the requirement of the specification, the following manufacturer's products may be incorporated into the project:
1. Leviton
2. Cooper Wiring Devices, Inc.
3. Hubbell, Inc.
4. Pass & Seymour, Inc.
5. Or Approved Equal.

B. Cover plate: Beveled metal, stainless steel 302/304 with metal mounting screws to matching the wiring devices selected. Color shall be as selected by the Architect from the manufacturer's standard colors. Number of gangs and configuration as required to fit the devices used.

C. Weatherproof Cover Plate: Gasketed thermoplastic with hinged gasketed device cover. Gaskets shall be provided between the box and the cover mounting surface and between the mounting surface and the hinged cover. Cover shall be capable of being closed with a plug inserted in the receptacle and shall be UL listed as "Suitable for Wet Locations While in Use." Covers shall be TayMac or Approved Equal.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Verify outlet boxes are installed at proper height.

B. Verify wall openings are neatly cut and completely covered by wall plates.

C. Verify branch circuit wiring installation is completed, tested, and ready for connection to wiring devices.

3.2 PREPARATION

A. Clean debris from outlet boxes.

3.3 EXISTING WORK

A. Disconnect and remove abandoned wiring devices.

B. Modify installation to maintain access to existing wiring devices to remain active.

C. Clean and repair existing wiring devices to remain or to be reinstalled.

3.4 INSTALLATION

A. Install devices plumb and level.

B. Install switches with OFF position down.

C. Install wall dimmers to achieve full rating specified and indicated after derating for ganging as instructed by manufacturer.

D. Do not share neutral conductor on load side of dimmers.

E. Install receptacles with grounding pole on top.

F. Connect wiring device grounding terminal to outlet box with bonding jumper and branch circuit equipment grounding conductor.

G. Install wall plates on flush mounted switches, receptacles, and blank outlets.

H. Install decorative plates on switch, receptacle, and blank outlets in finished areas.

I. Connect wiring devices by wrapping solid conductor around screw terminal. Install stranded conductor for branch circuits 10 AWG and smaller. When stranded conductors are used in lieu of solid, use crimp on fork terminals for device terminations. Do not place bare stranded conductors directly under device screws.

J. Use jumbo size plates for outlets installed in masonry walls.

K. Install galvanized steel plates on outlet boxes and junction boxes in unfinished areas, above accessible ceilings, and on surface mounted outlets.

3.5 INTERFACE WITH OTHER PRODUCTS

A. Coordinate locations of outlet boxes provided under Section 26 05 33 to obtain mounting heights as indicated on drawings.

B. Install wall switch 48 inches above finished floor.

C. Install convenience receptacle 18 inches above finished floor.

D. Install convenience receptacle 6 inches above back splash of counter.

E. Install dimmer 48 inches above finished floor.

F. Coordinate installation of wiring devices with underfloor raceway service fittings provided under Section 26 05 39.

G. Coordinate installation of wiring devices with floor box service fittings provided under Section 26 05 34.

3.6 FIELD QUALITY CONTROL

A. Inspect each wiring device for defects. Confirm the physical integrity of each receptacle by visual inspection.

B. Operate each wall switch with circuit energized and verify proper operation.

C. Verify the continuity of the grounding circuit in each receptacle.

D. Verify each receptacle device is energized.

E. Test each receptacle device for proper polarity of the hot and neutral connections.

F. Test each GFCI receptacle device for proper operation.

G. Confirm that the retention force of the grounding blade of each hospital-grade receptacle (except locking-type receptacles) shall be not less than 115 g (4 oz).

3.7 ADJUSTING

A. Adjust devices and wall plates to be flush and level.

3.8 CLEANING

A. Clean exposed surfaces to remove splatters and restore finish.

END OF SECTION 26 27 26

SECTION 26 28 13 - FUSES

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:
   1. Fuses.
   2. Spare fuse cabinet.

B. Related Sections:
   1. Section 26 24 16 - Panelboards.
   2. Section 26 28 19 - Enclosed Switches.
   3. Section 26 29 13 - Enclosed Controllers.
   4. Section 26 29 23 - Variable-Frequency Motor Controllers.
   5. Section 26 51 00 - Interior Lighting.

1.2 REFERENCE STANDARDS

A. National Electrical Manufacturers Association:
   1. NEMA FU 1 - Low Voltage Cartridge Fuses.

1.3 SUBMITTALS

A. Product Data: Submit data sheets showing electrical characteristics, including time-current curves.

1.4 CLOSEOUT SUBMITTALS

A. Project Record Documents: Record actual sizes, ratings, and locations of fuses.

1.5 MAINTENANCE MATERIALS

A. Spare Parts:
   1. Furnish two (2) fuse pullers.

B. Extra Materials:
   1. Furnish 10% but not less than six spare fuses of each Class, size, and rating installed.

1.6 QUALITY ASSURANCE

A. Qualifications:

1. Manufacturer: Company specializing in manufacturing products specified in this section with minimum ten years documented experience.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

A. Manufacturers: Subject to the requirement of the specification, the following manufacturer's products may be incorporated into the project:
   1. Cooper Industries - Bussmann.
   2. Mersen.
   3. Littelfuse.
   4. Or Approved Equal.

2.2 DESIGN REQUIREMENTS

A. Select fuses to provide appropriate levels of short circuit and overcurrent protection for the following components: wire, cable, bus structures, and other equipment. Design system to maintain component damage within acceptable levels during faults.

B. Select fuses to coordinate with time current characteristics of other overcurrent protective elements, including other fuses, circuit breakers, and protective relays. Design system to maintain operation of device closest to fault operates.

2.3 FUSE PERFORMANCE REQUIREMENTS

A. Main Service Switches Larger than 600 amperes: UL Class L (time-delay).

B. Main Service Switches less than 600 amperes: UL Class RK1 (time-delay).

C. Feeder Switches Larger than 601 amperes: UL Class L (time-delay).

D. Feeder Switches less than 600 amperes: UL Class RK1 (time-delay).

E. Motor Load Feeder Switches: UL Class RK1 (time-delay).

F. General Purpose Branch Circuits: UL Class RK1 (time-delay).

G. Motor Branch Circuits: Class RK1 (time delay).

H. Lighting Branch Circuits: UL Class CC (time delay).

I. Motor Control Transformers: UL Class CC (time-delay).

2.4 FUSES

A. Dimensions and Performance: NEMA FU 1, Class as specified or as indicated on Drawings.

B. All fuses shall have an interrupting rating of 200,000 amperes RMS Symmetrical.

C. All fuses shall be UL Listed.

D. All fuses utilized on the project shall be products of one manufacturer.

E. Voltage: Rating suitable for circuit phase-to-phase voltage.

F. Substitution Limitations:
1. Section 01 25 00 – Substitution Procedures: Requirements for substitutions for other manufacturers and products.

2.5 CLASS RK1 (TIME DELAY) FUSES

A. Manufacturers: Subject to the requirement of the specification, the following manufacturer's products may be incorporated into the project:
1. Bussmann Type LPN-RK (250V) or Type LPS-RK (600V).
2. Ferraz-Shawmut A2D (250V) or A6D (600V).
3. Littelfuse Type LLN-RK (250V) or Type LLS-RK (600V).

B. Description: Dual-Element, time-delay, current limiting, rejection type.

2.6 CLASS J (TIME DELAY) FUSES

A. Manufacturers: Subject to the requirement of the specification, the following manufacturer's products may be incorporated into the project:
1. Bussmann Type LPJ (600V).
2. Littelfuse Type JTD (600V).

B. Description: Dual element, time-delay fuse; current limiting.

2.7 CLASS L (TIME DELAY) FUSES

A. Manufacturers: Subject to the requirement of the specification, the following manufacturer's products may be incorporated into the project:
1. Bussmann Type KRP-C (600V).
2. Littelfuse Type KLP-C (600V).
3. Mersen A4BQ (600V).

B. Description: Time-delay (minimum 4 sec at 500% of rating), current limiting, machined end bells with o-ring inlays, silver plated terminals.

2.8 CLASS CC (TIME DELAY) FUSES

A. Manufacturers: Subject to the requirement of the specification, the following manufacturer's products may be incorporated into the project:
   1. Bussmann Type LP-CC (600V).
   2. Mersen ATDR (600V).
   3. Littelfuse Type KLDR (600V).

B. Description: Time-delay fuse; rejection type.

2.9 SPARE FUSE CABINET

A. Manufacturers: Subject to the requirement of the specification, the following manufacturer's products may be incorporated into the project:
   1. Bussmann.
   2. Mersen.
   3. Littelfuse.
   4. Or Approved Equal.

B. Description: Wall-mounted sheet metal cabinet with shelves, suitably sized to store spare fuses and fuse pullers specified.
   1. Doors: Hinged, with hasp for Owner's padlock.

C. Finish:
   1. Manufacturer's standard baked enamel finish.

PART 3 - EXECUTION

3.1 DEMOLITION

A. Remove fuses from abandoned circuits.

B. Maintain access to existing fuses and other installations remaining active and requiring access. Modify installation or provide access panel.

3.2 INSTALLATION

A. Install fuse with label oriented so manufacturer, type, and size are easily read.

B. Promptly replace all fuses cleared during construction for whatever cause.

C. Install spare fuse cabinet.

3.3 FUSE TYPE

A. The type of fuses required for each application are given in the Specification Sections where equipment requiring fuses are specified.

B. If the fuse type is not identified, provide UL Class RK-1 fuses.

END OF SECTION 26 28 13

SECTION 26 28 16.13 - ENCLOSED CIRCUIT BREAKERS

PART 1 - GENERAL

1.1 SUMMARY

A. Section includes:
   1. Molded-case and insulated-case circuit breakers in individual enclosures.

B. Related Sections:
   1. Section 26 05 26 - Grounding and Bonding for Electrical Systems.
   2. Section 26 05 29 - Hangers and Supports for Electrical Systems.
   3. Section 26 05 53 - Identification for Electrical Systems.

1.2 REFERENCES

A. International Electrical Testing Association:
   1. NETA ATS - Acceptance Testing Specifications for Electrical Power Distribution Equipment and Systems.

1.3 Underwriters Laboratories Inc.:

A. UL 489 - Molded-Case Circuit Breakers, Molded-Case Switches, and Circuit-Breaker Enclosures.

1.4 SUBMITTALS

A. Product Data: Submit catalog sheets showing ratings, trip units, time current curves, dimensions, and enclosure details.

1.5 CLOSEOUT SUBMITTALS

A. Project Record Documents: Record actual locations and continuous current ratings of enclosed circuit breakers.

1.6 QUALIFICATIONS

A. Manufacturer: Company specializing in manufacturing products specified in this section with minimum three years documented experience.

1.7 EXTRA MATERIALS

A. Furnish three (3) of each size and type of current limiter.

PART 2 - PRODUCTS

2.1 MOLDED CASE CIRCUIT BREAKER

A. Manufacturers: Subject to the requirement of the specification, the following manufacturer's products may be incorporated into the project:
   1. Eaton.

B. Product Description: Enclosed, molded-case circuit breaker conforming to UL 489.

C. Service Conditions:
   1. Temperature: 100 degrees F (37.8 degrees C).
   2. Altitude: 200 feet (61 M) above sea level.

D. Field-Adjustable Trip Circuit Breaker: Circuit breakers with frame sizes 200 amperes and larger have mechanism for adjusting [long time] [short time] [continuous current] [[short time] [long time] pickup current] setting for automatic operation. Range of Adjustment: _____ [seconds.] [amperes.] [percent.]

E. Field-Changeable Ampere Rating Circuit Breaker: Circuit breakers with frame sizes 200 amperes and larger have changeable trip units.

F. Current Limiting Circuit Breaker: Circuit breaker indicated as current-limiting have automatically-resetting current limiting elements in each pole. Let-through Current and Energy: Less than permitted for same size Class RK-5 fuse.

G. Solid-State Circuit Breaker: Electronic sensing, timing, and tripping circuits for adjustable current settings; [ground fault trip with [integral ground fault sensing] [zero sequence type ground fault sensor]]; instantaneous trip; and adjustable short time trip.

H. Current Limiter: Designed for application with molded case circuit breaker.
   1. Coordinate limiter size with trip rating of circuit breaker to prevent nuisance tripping and to achieve interrupting current rating specified for circuit breaker.
   2. Interlocks trip circuit breaker and prevent closing circuit breaker when limiter compartment cover is removed or when one or more limiter is not in place or has operated.

I. Accessories: [As indicated on Drawings.] Conform to UL 489.
   1. Shunt Trip Device: [120] _____ volts, [AC] [DC].
   2. Undervoltage Trip Device: [120] _____ volts, [AC] [DC].
   3. Auxiliary Switch: [120] _____ volts, [AC] [DC].
   4. Alarm Switch: [120] _____ volts, [AC] [DC].
   5. Electrical Operator: [120] _____ volts, [AC] [DC].
   6. Handle Lock: Provisions for [sealing.] padlocking.

7. [Insulated] Grounding Lug: In each enclosure.

J. Enclosure: UL 489, to meet conditions. Fabricate enclosure from steel finished with manufacturer's standard gray enamel.
1. Interior Dry Locations: Type 1.
2. Exterior Locations: Type 4X.
3. Damp or Wet Locations: Type 4X.

K. Service Entrance: Switches identified for use as service equipment are to be labeled for this application. Furnish solid neutral assembly and equipment ground bar.

2.2 INSULATED CASE CIRCUIT BREAKER

A. Manufacturers: Subject to the requirement of the specification, the following manufacturer's products may be incorporated into the project:
1. Eaton.

B. Product Description: Enclosed, insulated-case circuit breaker conforming to UL 489.

C. Service Conditions:
1. Temperature: 100 degrees F (37.8 degrees C).
2. Altitude: 200 feet (61 M) above sea level.

D. Trip Unit: Electronic sensing, timing, and tripping circuits for adjustable current settings; [ground fault trip with [integral ground fault sensing] [zero sequence type ground fault sensor]]; instantaneous trip; and adjustable short time trip.

E. Accessories: [As indicated on Drawings.] Conform to UL 489.
1. Shunt Trip Device: [120] _____ volts, [AC] [DC].
2. Undervoltage Trip Device: [120] _____ volts, [AC] [DC].
3. Auxiliary Switch: [120] _____ volts, [AC] [DC].
4. Alarm Switch: [120] _____ volts, [AC] [DC].
5. Electrical Operator: [120] _____ volts, [AC] [DC].
6. Handle Lock: Provisions for [sealing.] padlocking.
7. [Insulated] Grounding Lug: In each enclosure.

F. Enclosure: UL 489, to meet conditions. Fabricate enclosure from steel finished with manufacturer's standard gray enamel.
1. Interior Dry Locations: Type 1.
2. Exterior Locations: Type 4X.
3. Damp or Wet Locations: Type 4X.

G. Service Entrance: Switches identified for use as service equipment are to be labeled for this application. Furnish solid neutral assembly and equipment ground bar.

PART 3 - EXECUTION

3.1 EXISTING WORK

A. Disconnect and remove abandoned enclosed circuit breakers.

B. Maintain access to existing enclosed circuit breakers and other installations remaining active and requiring access. Modify installation or provide access panel.

C. Clean and repair existing enclosed circuit breakers to remain or to be reinstalled.

3.2 INSTALLATION

A. Install enclosed circuit breakers plumb. Provide supports in accordance with Section 26 05 29.

B. Height: 5 feet to operating handle.

C. Install grounding and bonding in accordance with requirements of Section 26 05 26.

D. Locate and install engraved plastic nameplates in accordance with Section 26 05 53.

3.3 FIELD QUALITY CONTROL

A. Inspect and test in accordance with NETA ATS, except Section 4.

B. Perform inspections and tests listed in NETA ATS, Section 7.6.1.1.

3.4 ADJUSTING

A. Adjust trip settings to coordinate circuit breakers with other overcurrent protective devices in circuit.

B. Adjust trip settings to provide adequate protection from overcurrent and fault currents.

END OF SECTION 26 28 16.13

SECTION 26 28 16.16 - ENCLOSED SWITCHES

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:
   1. Fusible.
   2. Nonfusible switches.

B. Related Requirements:
   1. Section 26 05 29 - Hangers and Supports for Electrical Systems.
   2. Section 26 05 53 - Identification for Electrical Systems.
   3. Section 26 28 13 - Fuses.

1.2 REFERENCE STANDARDS

A. National Electrical Manufacturers Association:
   1. NEMA FU 1 - Low Voltage Cartridge Fuses.
   2. NEMA KS 1 - Enclosed and Miscellaneous Distribution Equipment Switches (600 Volts Maximum).

B. International Electrical Testing Association:
   1. NETA ATS - Acceptance Testing Specifications for Electrical Power Distribution Equipment and Systems.

1.3 SUBMITTALS

A. Product Data: Submit switch ratings and enclosure dimensions.

1.4 CLOSEOUT SUBMITTALS

A. Project Record Documents: Record actual locations of enclosed switches and ratings of installed fuses.

1.5 QUALIFICATIONS

A. Manufacturer: Company specializing in manufacturing products specified in this section with minimum three years documented experience.

PART 2 - PRODUCTS

2.1 FUSIBLE SWITCH ASSEMBLIES

A. Manufacturers: Subject to the requirement of the specification, the following manufacturer's products may be incorporated into the project:
   1. Eaton.

B. Description: NEMA KS 1, Type HD with externally operable handle interlocked to prevent opening front cover with switch in ON position, enclosed load interrupter knife switch. Handle lockable in OFF position.

C. Operation:
   1. Switch Ratings
      a. Switch Rating: Horsepower rated for AC or DC as indicated on Drawings.
      b. Short Circuit Current Rating:
         1) UL Class RK-1 fuses – 200,000 RMS symmetrical amperes.
         2) UL Class J fuses – 200,000 RMS symmetrical amperes.
         3) UL Class L fuses – 200,000 RMS symmetrical amperes.

D. Materials:
   1. Fuse clips: Designed to accommodate NEMA FU 1, Class R fuses.
   2. Enclosure: NEMA KS 1, to meet conditions. Fabricate enclosure from steel finished with manufacturer's standard gray enamel.
      a. Interior Dry Locations: Type 1.
      b. Exterior Locations: Type 4X.
      c. Damp or Wet Locations: Type 4X.
   3. Service Entrance: Switches identified for use as service equipment are to be labeled for this application. Furnish solid neutral assembly and equipment ground bar.
   4. Furnish switches with entirely copper current carrying parts.
   5. Provide auxiliary contact in each switch for connection to variable speed drive control circuit.
   6. Switches shall be furnished with copper isolated neutral bus and copper ground bus in each switch.

2.2 NONFUSIBLE SWITCH ASSEMBLIES

A. Manufacturers: Subject to the requirement of the specification, the following manufacturer's products may be incorporated into the project:
   1. Eaton.

B. Description: NEMA KS 1, Type HD with externally operable handle interlocked to prevent opening front cover with switch in ON position, enclosed load interrupter knife switch. Handle lockable in OFF position.

C. Operation:
   1. Switch Ratings
      a. Switch Rating: Horsepower rated for AC or DC as indicated on Drawings.

b. Short Circuit Current Rating:
   1) UL Class RK-1 fuses – 200,000 RMS symmetrical amperes.
   2) UL Class J fuses – 200,000 RMS symmetrical amperes.
   3) UL Class L fuses – 200,000 RMS symmetrical amperes.

D. Materials:
1. Enclosure: NEMA KS 1, to meet conditions. Fabricate enclosure from steel finished with manufacturer's standard gray enamel.
   a. Interior Dry Locations: Type 1.
   b. Exterior Locations: Type 4X.
   c. Damp or Wet Locations: Type 4X.
2. Service Entrance: Switches identified for use as service equipment are to be labeled for this application. Furnish solid neutral assembly and equipment ground bar.
3. Furnish switches with entirely copper current carrying parts.
4. Provide auxiliary contact in each switch for connection to variable speed drive control circuit.
5. Switches shall be furnished with copper isolated neutral bus and copper ground bus in each switch.

PART 3 - EXECUTION

3.1 DEMOLITION

A. Disconnect and remove abandoned enclosed switches.

B. Maintain access to existing enclosed switches and other installations remaining active and requiring access. Modify installation or provide access panel [specified in Section 08 31 13].

3.2 INSTALLATION

A. Install enclosed switches where indicated.

B. Install enclosed switches plumb. Provide supports in accordance with Section 26 05 29.

C. Height: 5 feet to operating handle.

D. Install fuses for fusible disconnect switches. Refer to Section 26 28 13 for product requirements.

E. Install engraved plastic nameplates in accordance with Section 26 05 53. Engrave nameplates with the equipment served and the panel and circuit number supplying the switch.

F. Apply adhesive tag on inside door of each fused switch indicating NEMA fuse class and size installed.

3.3 REPAIR & RESTORATION

A. Repair existing enclosed switches to remain or to be reinstalled.

3.4 FIELD QUALITY CONTROL

A. Inspect and test in accordance with NETA ATS, except Section 4.

B. Perform inspections and tests listed in NETA ATS, Section 7.5.

3.5 CLEANING

A. Clean existing enclosed switches to remain or to be reinstalled.

END OF SECTION 26 28 16.16

SECTION 26 29 13 - ENCLOSED CONTROLLERS

PART 1 - GENERAL

1.1 SUMMARY

A. Section includes manual and magnetic motor controllers in individual enclosures.

B. Related Sections:
1. Section 26 28 13 - Fuses.

1.2 REFERENCES

A. National Electrical Manufacturers Association:
1. NEMA FU 1 - Low Voltage Cartridge Fuses.
2. NEMA ICS 2 - Industrial Control and Systems: Controllers, Contactors, and Overload Relays, Rated Not More Than 2000 Volts AC or 750 Volts DC.
3. NEMA ICS 5 - Industrial Control and Systems: Control Circuit and Pilot Devices.
4. NEMA ICS 6 - Industrial Control and Systems: Enclosures.
5. NEMA KS 1 - Enclosed and Miscellaneous Distribution Equipment Switches (600 Volts Maximum).

B. International Electrical Testing Association:
1. NETA ATS - Acceptance Testing Specifications for Electrical Power Distribution Equipment and Systems.

C. Underwriters Laboratories Inc.:
1. UL 489 - Molded-Case Circuit Breakers, Molded-Case Switches, and Circuit-Breaker Enclosures.

1.3 SUBMITTALS

A. Section 01 33 00 - Submittal Procedures: Submittal procedures.

B. Product Data: Submit catalog sheets showing voltage, controller size, ratings and size of switching and overcurrent protective devices, short circuit ratings, dimensions, and enclosure details.

C. Test Reports: Indicate field test and inspection procedures and test results.

1.4 CLOSEOUT SUBMITTALS

A. Section 01 70 00 - Execution and Closeout Requirements: Closeout procedures.

B. Project Record Documents: Record actual locations and ratings of enclosed controllers.

C. Operation and Maintenance Data: Submit Replacement parts list for controllers.

1.5 QUALIFICATIONS

A. Manufacturer: Company specializing in manufacturing products specified in this section with minimum three years documented experience.

PART 2 - PRODUCTS

2.1 MANUAL MOTOR CONTROLLER

A. Manufacturers: Subject to the requirement of the specification, the following manufacturer's products may be incorporated into the project:
1. Schneider Electric / Square D.

B. Product Description: NEMA ICS 2, AC general-purpose, Class A, manually operated, full-voltage controller with overload element, [red pilot light,] [[NO] [NC] auxiliary contact,] and [push button] [toggle] operator.

C. Enclosure: NEMA ICS 6, Type [1] [1B] [4] [to meet conditions of installation].

2.2 FRACTIONAL-HORSEPOWER MANUAL CONTROLLER

A. Manufacturers: Subject to the requirement of the specification, the following manufacturer's products may be incorporated into the project:
1. Schneider Electric / Square D.

B. Product Description: NEMA ICS 2, AC general-purpose, Class A, manually operated, full-voltage controller for fractional horsepower induction motors, with thermal overload unit, [[red] [green] pilot light,] and [key] [toggle] operator.

C. Enclosure: NEMA ICS 6, Type [1] [1B] [4] [to meet conditions of installation].

2.3 MOTOR STARTING SWITCH

A. Manufacturers: Subject to the requirement of the specification, the following manufacturer's products may be incorporated into the project:
1. Schneider Electric / Square D.

B. Product Description: NEMA ICS 2, AC general-purpose Class A manually operated, full-voltage controller for fractional horsepower induction motors, without thermal overload unit, with [[red] [green] pilot light and] [key] [toggle] operator.

C. Enclosure: NEMA ICS 6, Type [1] [1B] [4] [to meet conditions of installation].

2.4 FULL-VOLTAGE NON-REVERSING CONTROLLERS

A. Manufacturers: Subject to the requirement of the specification, the following manufacturer's products may be incorporated into the project:
   1. Schneider Electric / Square D.

B. Product Description: NEMA ICS 2, AC general-purpose Class A [magnetic] [solid-state] controller for induction motors rated in horsepower.

C. Control Voltage: [120] [480] <_____> volts, 60 Hertz.

D. Overload Relay: NEMA ICS 2; [bimetal] [melting alloy].

E. Product Features:
   1. Auxiliary Contacts: NEMA ICS 2, [2] <_____> each [normally [open] [closed]] [field convertible] contacts in addition to seal-in contact.
   2. Cover Mounted Pilot Devices: NEMA ICS 5, [standard] [heavy] duty [oiltight] type.
   3. Pilot Device Contacts: NEMA ICS 5, Form Z, rated [A150] <_____>.
   4. Pushbuttons: [Unguarded] [Recessed] [Shrouded] [Shielded] [Covered] [Lockable] type.
   5. Indicating Lights: [Transformer] [Resistor], [incandescent] [LED] [neon] type.
   6. Selector Switches: Rotary type.
   7. Relays: NEMA ICS 2, <_____>.
   8. Control Power Transformers: [120] <_____> volt secondary, [<_____> VA minimum, in each motor starter.] [as indicated on Drawings.] Furnish fused [primary and] secondary, and bond unfused leg of secondary to enclosure.

F. Combination Controllers: Combine motor controllers with disconnect in common enclosure, using thermal magnetic circuit breaker conforming to UL 489, with integral thermal and instantaneous magnetic trip in each pole.

****** [OR] ******

G. Combination Controllers: Combine motor controllers with disconnect in common enclosure, using motor circuit protector conforming to UL 489, with integral instantaneous magnetic trip in each pole. Obtain IEC Class 2 coordinated component protection.

****** [OR] ******

H. Combination Controllers: Combine motor controllers with disconnect in common enclosure, using non-fusible switch conforming to NEMA KS 1, enclosed knife switch with externally operable handle.

****** [OR] ******

I. Combination Controllers: Combine motor controllers with disconnect in common enclosure, using fusible switch conforming to NEMA KS 1, enclosed knife switch with externally operable

handle. Fuse clips: Designed to accommodate NEMA FU 1, Class [R] [J] fuses. Obtain IEC Class 2 coordinated component protection.

J. Enclosure: NEMA ICS 6, to meet conditions. Fabricate enclosure from steel finished with manufacturer's standard gray enamel.
   1. Interior Dry Locations: Type 1.
   2. Interior Wet Locations: Type 4X.
   3. Exterior Locations: Type 4X.

2.5 TWO-SPEED CONTROLLERS

A. Manufacturers: Subject to the requirement of the specification, the following manufacturer's products may be incorporated into the project:
   1. Schneider Electric / Square D.

B. Product Description: NEMA ICS 2, AC general-purpose Class A [magnetic] [solid-state] controller for induction motors rated in horsepower. Include integral time delay transition between FAST and SLOW speeds.

C. Control Voltage: [120] [480] <_____> volts, 60 Hertz.

D. Overload Relay: NEMA ICS 2; [bimetal] [melting alloy].

E. Product Features:
   1. Auxiliary Contacts: NEMA ICS 2, [2] <_____> each [normally [open] [closed]] [field convertible] contacts in addition to seal-in contact.
   2. Cover Mounted Pilot Devices: NEMA ICS 5, [standard] [heavy] duty [oiltight] type.
   3. Pilot Device Contacts: NEMA ICS 5, Form Z, rated [A150] <_____>.
   4. Pushbuttons: [Unguarded] [Recessed] [Shrouded] [Shielded] [Covered] [Lockable] type.
   5. Indicating Lights: [Transformer] [Resistor], [incandescent] [LED] [neon] type.
   6. Selector Switches: Rotary type.
   7. Relays: NEMA ICS 2, <_____>.
   8. Control Power Transformers: [120] <_____> volt secondary, [<_____> VA minimum, in each motor starter.] [as indicated on Drawings.] Furnish fused [primary and] secondary, and bond unfused leg of secondary to enclosure.

F. Combination Controllers: Combine motor controllers with disconnect in common enclosure, using thermal magnetic circuit breaker conforming to UL 489, with integral thermal and instantaneous magnetic trip in each pole.

****** [OR] ******

G. Combination Controllers: Combine motor controllers with disconnect in common enclosure, using motor circuit protector conforming to UL 489, with integral instantaneous magnetic trip in each pole. Obtain IEC Class 2 coordinated component protection.

****** [OR] ******

H. Combination Controllers: Combine motor controllers with disconnect in common enclosure, using non-fusible switch conforming to NEMA KS 1, enclosed knife switch with externally operable handle.

****** [OR] ******

I. Combination Controllers: Combine motor controllers with disconnect in common enclosure, using fusible switch conforming to NEMA KS 1, enclosed knife switch with externally operable handle. Fuse clips: Designed to accommodate NEMA FU 1, Class [R] [J] fuses. Obtain IEC Class 2 coordinated component protection.

J. Enclosure: NEMA ICS 6, to meet conditions. Fabricate enclosure from [steel finished with manufacturer's standard gray enamel.
   1. Interior Dry Locations: Type 1.
   2. Interior Wet Locations: Type 4X.
   3. Exterior Locations: Type 4X.

2.6 FULL-VOLTAGE REVERSING CONTROLLERS

A. Manufacturers: Subject to the requirement of the specification, the following manufacturer's products may be incorporated into the project:
   1. Schneider Electric / Square D.

B. Product Description: NEMA ICS 2, AC general-purpose Class A [magnetic] [solid-state] controller for induction motors rated in horsepower. Include electrical interlock [and integral time delay transition] between FORWARD and REVERSE rotation.

C. Control Voltage: [120] [480] <_____> volts, 60 Hertz.

D. Overload Relay: NEMA ICS 2; [bimetal] [melting alloy].

E. Product Features:
   1. Auxiliary Contacts: NEMA ICS 2, [2] <_____> each [normally [open] [closed]] [field convertible] contacts in addition to seal-in contact.
   2. Cover Mounted Pilot Devices: NEMA ICS 5, [standard] [heavy] duty [oiltight] type.
   3. Pilot Device Contacts: NEMA ICS 5, Form Z, rated [A150] <_____>.
   4. Pushbuttons: [Unguarded] [Recessed] [Shrouded] [Shielded] [Covered] [Lockable] type.
   5. Indicating Lights: [Transformer] [Resistor], [incandescent] [LED] [neon] type.
   6. Selector Switches: Rotary type.
   7. Relays: NEMA ICS 2, <_____>.
   8. Control Power Transformers: [120] <_____> volt secondary, [<_____> VA minimum, in each motor starter.] [as indicated on Drawings.] Furnish fused [primary and] secondary, and bond unfused leg of secondary to enclosure.

F. Combination Controllers: Combine motor controllers with disconnect in common enclosure, using thermal magnetic circuit breaker conforming to UL 489, with integral thermal and instantaneous magnetic trip in each pole.

****** [OR] ******

G. Combination Controllers: Combine motor controllers with disconnect in common enclosure, using motor circuit protector conforming to UL 489, with integral instantaneous magnetic trip in each pole. Obtain IEC Class 2 coordinated component protection.

****** [OR] ******

H. Combination Controllers: Combine motor controllers with disconnect in common enclosure, using non-fusible switch conforming to NEMA KS 1, enclosed knife switch with externally operable handle.

****** [OR] ******

I. Combination Controllers: Combine motor controllers with disconnect in common enclosure, using fusible switch conforming to NEMA KS 1, enclosed knife switch with externally operable handle. Fuse clips: Designed to accommodate NEMA FU 1, Class [R] [J] fuses. Obtain IEC Class 2 coordinated component protection.

J. Enclosure: NEMA ICS 6, to meet conditions. Fabricate enclosure from [steel finished with manufacturer's standard gray enamel.
   1. Interior Dry Locations: Type 1.
   2. Interior Wet Locations: Type 4X.
   3. Exterior Locations: Type 4X.

PART 3 - EXECUTION

3.1 EXISTING WORK

A. Disconnect and remove abandoned enclosed motor controllers.

B. Maintain access to existing enclosed motor controllers and other installations to remain active and to require access. Modify installation or provide access panel.

C. Clean and repair existing enclosed motor controllers to remain or to be reinstalled.

3.2 INSTALLATION

A. Install enclosed controllers plumb. Provide supports in accordance with Section 26 05 29.

B. Height: 5 feet (1500 mm) to operating handle.

C. Install fuses for fusible switches. Refer to Section 26 28 13 for product requirements.

D. Select and install overload heater elements in motor controllers to match installed motor characteristics.

E. Install engraved plastic nameplates. Refer to Section 26 05 53 for product requirements and location.

F. Neatly type label and place inside each motor controller door identifying motor served, nameplate horsepower, full load amperes, code letter, service factor, and voltage/phase rating. Place label in clear plastic holder.

3.3 FIELD QUALITY CONTROL

A. Section 014000 - Quality Requirements: Field inspecting, testing, adjusting, and balancing.

B. Inspect and test in accordance with NETA ATS, except Section 4.

C. Perform inspections and tests listed in NETA ATS, Section 7.16.1.

END OF SECTION 26 29 13

SECTION 26 51 00 - INTERIOR LIGHTING

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

B. In cases where conflicts exist between the Architectural drawings and the Electrical/Lighting drawings, the Architectural drawings shall govern. The Contractor is to notify the Architect of the conflict before proceeding with the Work and receive approval to proceed from the Architect.

1.2 SCOPE

A. Included in the work of this Section are labor, materials and appurtenances required to complete the work of this Section, as specified herein, as required by job conditions, or as indicated on drawings. General requirements for lighting fixtures including coordination, definitions, quality assurances, submittals, mockups, samples and general responsibility for a complete job.

B. Furnish and install a luminaire of the type indicated by letter/number at each location shown on the drawings.

C. Furnish and install lamps for all luminaires furnished as part of this electrical Work.

D. All materials, accessories, components and any other equipment necessary for the complete and proper installation and operation of all luminaires, even those not usually indicated on the drawings nor specified but that are necessary for the proper installation and operation of the luminaires shall be furnished by the Contractor.

E. Luminaires shall be manufactured in strict accordance with the Contract Documents. The Contractor shall be held responsible for the omission or absence of any detail, construction feature, etc. which may be required in the manufacture of the luminaires. The responsibility of accurately fabricating the luminaires to the fulfillment of this specification rests with the Contractor.

F. Specifications and scale drawings are intended to convey the main features, function and character of the luminaires only, and do not undertake to illustrate or set forth every item or detail necessary for the Work.

G. The Work shall include all labor, tools, equipment, transportation, insurance, temporary protection, and miscellaneous items essential to the proper installation of the luminaires.

H. Contractor shall provide itemized costs for all luminaires. Cost shall include rough-in housing, trim, lamp, accessories and/or other components as described on the Lighting Fixture Schedule.

I. Study drawings for complete understanding of the intent and scope of the Work. Check and verify dimensions and details on Drawings before proceeding with the Work. Report any discrepancies at once to the Architect. Should it appear the Work intended to be described, or any of the matters relative thereto, are not sufficiently detailed or explained on the Drawings or in the Specifications, notify the Architect for further drawings or explanations as may be necessary. Conform to these explanations in the Work. If any question arises about the true meaning of the Drawings or Specifications, refer the matter to the Architect whose decision is final and conclusive. In no case submit a bid, or proceed on any Work with uncertainty. The intention of the Specification and the accompanying or applicable Drawings is to provide a job complete in every respect. The Contractor is responsible for this result.

1.3 DEFINITIONS

A. In this specification, the term "Architect" includes the Architect, Owner's representative and/or the lighting consultant, together or individually as they shall decide. The term "fixtures" refers to lighting fixtures and luminaires.

1.4 GENERAL REQUIREMENTS

A. Provide labor, materials, and equipment for the installation of indoor and outdoor lighting fixtures, lighting equipment, and lamps as shown on the drawings and specified here.

B. Refer to drawings for dimensions and details. Check and verify dimensions and details on drawings before proceeding with the work. Report any discrepancies at once to the Architect. Should it appear that the work intended is not sufficiently detailed or explained on the drawings or in the specifications, apply to the Architect for further drawings or explanations, as may be necessary. Conform to these explanations in the work. If any question arises about the true meaning of the drawings or specifications, refer the matter to the Architect whose decision is final and conclusive. In no case submit a bid, or proceed on any work with uncertainty. The intention of this specification and the accompanying or applicable drawings is to provide a job complete in every respect. Contractor is responsible for this result.

1.5 COORDINATION

A. Fixture locations as indicated on the electrical drawings are generalized and approximate. Carefully verify locations with Architect's plans, reflected ceiling plans and other reference data prior to installation. Check for adequacy of headroom and non-interference with other equipment, such as ducts, pipes, openings or insulation. Bring conflicts to the Architect's attention before proceeding with the work.

B. Although the location of equipment included in the work of this Section may be shown on the Contract Drawings in a certain place, actual construction may disclose that the location for the work does not make its position easily and quickly accessible. In such cases, call the Architect's attention to this situation before installing this work, and comply with the Architect's installation instructions.

C. Clearly indicate the work to be performed by other trades contractors, and the materials that are adjacent to or abutting the work of this Section. Coordinate as required.

D. Give ample notice of special openings required for placing equipment in the building, in order to avoid cutting of completed work.

E. Coordinate and schedule the work of this Section with the work of other Sections, Utility Companies and the Telephone Company so that there shall be no delay in the proper installation and completion of any part of each respective work. Construction work shall proceed in its natural sequence without unnecessary delay caused by the work of this Section.

F. Contractor shall coordinate with other contractors engaged in the construction of the project whose work might in any way affect his installation, and shall arrange his installation in proper relation to other work and with architectural finish so that it shall harmonize in service and appearance and so that there shall be no interference with the work of others, including interference in location or level.

G. Schedule the work to prevent work of this Section being damaged by other construction operations. Remove and replace work so damaged at no cost to Owner.

H. Furnish the materials and labor for work included under this Section in ample time, and in sufficient quantities so that all of the work may be installed in proper sequence to avoid unnecessary cutting of the floors and walls.

I. Where work of this Section is to be flush or concealed, install it to assure that it does not project beyond the finished lines of floors, ceilings or walls, or beyond sightlines noted in drawings.

J. Verify ceiling conditions and furnish appropriate mounting details for each fixture. Such mounting details shall be approved by the Architect.

K. Contractor for work of the Section shall take responsibility to become familiarized with all equipment listed in the Lighting Fixture Schedule and shall be responsible for the successful completion of the entire lighting installation.

L. Contractor of Work of this section shall verify compatibility of supply voltage indicated on electrical drawings with voltage specified for each luminaire prior to release. Bring discrepancies to Architect's (Construction Manager's) attention.

1.6 QUALITY ASSURANCES

A. Manufacturers: Acceptable manufacturers are listed on the Lighting Fixture Schedule. Acceptable manufacturers shall provide proof of satisfactory production of equal or similar fixtures for a period of at least five years prior to bidding.

B. Statement of Application:
   1. By commencing the work of this Section, the Contractor assumes overall responsibility, as a part of his warranty of the work, to assure that assemblies, components and parts shown or required within the work of this Section, comply with the Contract Documents.

2. Warranty: In addition to any warranties required by the General Requirements, the Contractor of the work in this section shall:
    a. For a period of one year after Owner's initial acceptance and establishment of the beginning date of the warranty period, and at no additional cost, Contractor shall promptly provide and install replacements for fixtures or components there of which in the opinion of Owner are defective in materials or workmanship under normal operating conditions, except for lamps; or Contractor shall repair installed equipment at the job site to Owner's satisfaction. For any time during the warranty period that fixtures are not fully functional due to defects in materials or workmanship, Contractor shall provide or pay for and install and remove suitable and adequate temporary lighting fixtures. Contractor also warrants replacement fixtures or components to be free of defects in workmanship or materials for a period of one year following replacement, and shall replace any defective replacements.
    b. Contractor shall not be held responsible for acts of vandalism or for abnormal or accidental abuse of the fixtures or their components occurring after the beginning of the guarantee period, nor shall Contractor be held responsible for deleterious effects caused by maintenance procedures performed without the concurrence of Contractor.

C. Substitutions:
1. Fixtures included under this Section are specified by approved manufacturer and type. Furnish equipment, as specified, unless substitutions are mutually agreed upon, as follows:
    a. During the construction period, no substitutions shall be considered unless compelling reasons are given such as inability to meet delivery schedule. This reason shall not be acceptable if delay is caused by Contractor's failure to order fixture in accordance with the schedule presented under "SUBMITTALS" below. In such cases, it is Contractor's responsibility to provide fixtures as specified without delay to the project and without additional cost to the Owner.
    b. Substitutions shall be named, samples, catalogue cuts and complete photometric reports submitted, and cost savings documented.
    c. Submit a written request for proposed fixtures to be substituted to Architect at least two weeks before the end of the bid period. Make the request an alternate, separate proposal, accompanied by complete descriptive and technical data and fully functional working sample with cord/plug, and all specified accessories. Indicate addition or deduction from the base bid. Substitutions proposed less than two weeks before the end of the bid period, or not including proper documentation shall not be considered. Architect shall accept or reject proposed substitutions.
    d. Where proposed substitutions alter the functional or visual design, or change the space requirements or mounting details indicated here or on the drawings, detail such changes in the proposal and include costs for revised design and construction for trades involved.
    e. Reimburse Architect and their consultants for costs of evaluating proposed substitutions, whether or not such substitutions are accepted.

D. Equipment Compatibility:
1. Provide similar fixtures and components fabricated by one manufacturer, to simplify maintenance and replacement of equipment.

E. Regulatory Agencies:
1. Materials and installation shall be in accordance with the latest revision of the National Electric Code and any applicable Federal, State, and local codes and regulations.
2. Provide luminaires and ballasts shall conform to or exceed Underwriters Laboratories (UL) standards, and which conform to provisions of applicable codes which exceed those standards.
3. For any category of luminaire tested by any of the following agencies, provide luminaires that are listed and labeled by one of the following Nationally Recognized Testing Laboratories (NRTL) or approved by the local Authority Having Jurisdiction (AHJ). Labels shall be affixed to each luminaire in a position concealing it from normal view.
   a. Underwriters Laboratories (UL).
   b. Intertek (ETL).
   c. MET Electrical Testing Company (MET).
   d. Canadian Standards Association (CSA/US).
4. Provide luminaires which conform to additional regulations necessary to obtain approval for use of specified luminaires in locations shown. Use only electrical components listed by the agencies listed in Paragraph 1.06 above E above.

F. Recognized Standards:
1. In addition to standards that may be referenced in Division 1 Specification Sections, luminaires shall comply with the applicable standards of the following organizations:
   a. ANSI C78.379 – Electric Lamps – Incandescent and High-Intensity Discharge Reflector Lamps – Classification of Beam Patterns
   b. ANSI C82.1 – Ballasts for Fluorescent Lamps – Specifications.
   c. ANSI C82.4 – Ballasts for High-Intensity Discharge and Low Pressure Sodium Lamps (Multiple Supply Type)
   d. ANSI/NFPA 70 – National Electric Code.
   e. ANSI/NFPA 101 – Life Safety Code.
   f. NEMA WD 6 – Wiring Device – Dimensional Requirements.
   g. ASHRAE/IESNA – Standard 90.1
   h. Underwriters Laboratories (UL).
   i. National Electrical Code (NEC).
   j. Certified Ballast Manufacturers Association (CBM).
   k. Illuminating Engineering Society (IES).
   l. IESNA LM-79-08 IESNA - Approved Method for Electrical and Photometric Measurements of Solid-State Lighting Products; 2008
   m. IESNA LM-80-08 IESNA - Approved Method for Measuring Lumen Maintenance of LED Light Sources
   n. IESNA TM-21-2011 – Projecting Long Term Lumen Maintenance of LED Light Sources
   o. UL 8750 – Light Emitting Diode (LED) Equipment for Use in Lighting Products
   p. OSHA 29CFR1910.7 – luminaires shall be listed by national recognized testing laboratory approved by United Stated Department of Labor, Occupational Safety and Health Administration (OSHA
   q. American Society for Testing and Materials (ASTM).
   r. American National Standards Institute (ANSI).

1.7 SUBMITTALS

A. General:
1. Shop drawings, samples, test data and certificates shall be submitted for approval in accordance with the requirements of Division 1 in the Contract Documents. Fixtures or other materials shall not be shipped, stored or installed into the work unless prior approval has been received, based upon the submittal of shop drawings, samples, catalogue cuts, test data, certificates or other material submitted for approval. Make modifications to fixtures in accordance with Architect's comments concerning submittals, as a part of the work of this Section.

B. Submittal Schedule:
1. Within 30 calendar days after award of General Contract, a List of Intended Manufacturers and estimated fabrication lead times shall be submitted to the Architect. "Lead times" shall be measured in weeks, beginning from the manufacturer's receipt of approved shop drawings and release, and ending at shipment. Architect shall approve or disapprove each manufacturer.
2. Within 15 days after Contractor's receipt of the Architect's response to the List of Intended Manufacturers, copies of purchase orders and manufacturers' acknowledgements for all fixtures specified, conforming to the Architect's responses, shall be forwarded to Architect.
3. The purchase orders and the manufacture acknowledgements need not list prices, but shall contain a warranted fabrication lead time, in weeks, as defined above. These fabrication times shall be adequate for the timely completion of the job.
4. Within 30 days after date of manufacturer's acknowledgement of order, Contractor shall forward to the Architect complete shop drawings, and/or catalogue cuts for all specified fixtures.
5. Within 15 days after receipt of "approved" or "approved as noted" shop drawings, Contractor shall forward to the Architect a warranted shipment date for each specified fixture, as well as forwarding samples, texts, or any outstanding data required for approval.
6. Within 15 days after Contractor's receipt of disapproved shop drawings, revised shop drawings shall be resubmitted to the Architect.
7. Contractor shall call to the attention of the Architect any submittals that have not been returned to him in a timely manner and that might affect the appropriate delivery of fixtures.

C. Shop Drawings:
1. Submit shop drawings for each type of fixture, except where specified fixtures are standard, unmodified, "off-the-shelf" units, fully described by catalogue cuts. If allowed by the Architect, such catalogue cuts may be substituted for shop drawings. Submit shop drawings in the form of four (4) prints, and catalogue cuts in nine (9) photocopies, or as otherwise called for in the General Requirements.
2. Shop drawings shall show all luminaire components, including but not limited to lamp-holders, reflectors, louvers, lenses, fuses, junction boxes, ballasts and lamps. Shop drawings shall show materials, finishes, metal gauges, overall and detailed dimensions, sizes, electrical and mechanical connections, fasteners, welds, joints, any exposed hardware, and conditions, or provisions for the work of others, and similar information. Indicate complete details of the luminaire, including manufacturer's name and catalogue numbers for sockets, ballasts, light shields, switches and type of wiring, and targeting and

locking devices for adjustable luminaires. Indicate that lamp type specified is acceptable for luminaire design. Indicate type and extent of approved inert insulating materials to prevent electrolytic corrosion at junctions of dissimilar metals. Include pertinent mounting details including hung ceiling construction. Standard catalogue cuts shall be supplemented by additional drawings if information or descriptions listed above are not included in the cuts. Photometric documentation and finish samples shall be provided upon request. Samples shall be provided if indicated in the Lighting Fixture Schedule or luminaire descriptions. No luminaires will be approved without the previous described submission of data. Submissions may be modified by the Architect before approval. Luminaires or other materials shall not be fabricated, shipped, stored or installed unless prior written approval from the Architect has been received.

3. Submit lamp/fixture layouts for continuous luminaires, fixture runs, or coves, indicating overall field measurements, proposed fixture lengths and all components required for a fully functional system.

D. Data: Submit independent laboratory photometric data in the directed number of copies and in format as directed by the Architect. Photometric data shall be submitted for standard, "off-the-shelf" units, at the time the manufacturer's cuts are submitted. Photometric testing and reporting shall conform to IES procedures.

E. Manufacturer's Catalogue Sheets shall indicate input and load electrical characteristics, ambient temperature rating, noise level rating, mounting methods and U.L. listing for use with required lamp and ballast as applicable.

1.8 SAMPLES

A. After shop drawings, data and any other required submissions have been approved, submit to Architect samples of each of the following components:

1. Samples demonstrating the finishes of any custom metal, paint color or finish requested by Architect. Sample size to be a minimum of four square inches.
2. Material samples of any transmitting media, such as plastic, glass, perforated metal and the like. Sample size to be a minimum of six square inches.
3. Any other luminaires or components requested in the luminaire descriptions or schedule.

B. Submit two (2) samples unless otherwise indicated. If luminaire samples are requested, supply a completely operable luminaire with the specified lamp and a 10'-0" cord and plug for standard 120 volt service. For 277 volt luminaires, also supply a completely wired or plug-wired step-up transformer to convert 277 to 120 volts. Provide component parts as specifically requested.

C. Where a sample is submitted or requested, do not fabricate that luminaire type until the sample is approved. Submit and resubmit a sample as required, until samples are approved.

D. Submit complete and operable sample luminaires for any proposed substitution as indicated in Section 1.06 above. Samples pertaining to substitutions shall be received within the [90] day substitution period. Acceptance of substitution samples received after this period shall not be binding on the Construction Manager, Architect or Owner.

E. Provide samples as called for in the General Requirements. Tag samples with the name of the project, referenced specification, paragraph or drawing number, the luminaire type number and

any other identifying data. Ship the samples to two separate addresses as specified by Architect. After review, the samples shall be shipped to the Architect at the project site for use as standards. All transportation charges for samples shall be paid by Contractor. Make luminaires supplied under the Work of this Section identical with approved samples. Do not install any sample luminaires in the project.

F. If sample submissions are not approved, samples shall be returned to Contractor, at Contractor's expense. Upon receipt of sample disapproval, immediately make a new submission of samples meeting the contract requirements, as called for in the General Requirements.

1.9 MOCK-UP

A. As a part of the work of this Section, where specifically called for in the Fixture Descriptions or Light Fixture Schedule, and at no additional cost to Owner, temporarily install, connect and adjust a reasonable number of fixtures, three (3) unless otherwise stated, of each type listed in the Fixture Descriptions or Lighting Fixture Schedule where a mock-up is specified, to verify specified requirements. Place the mock-up fixtures where and when directed by Architect. Remove and store mock-up fixtures, when approved, as necessary to complete the work, at Contractor's expense.

B. Exposed finishes shall be protected during manufacture, transport, storage and handling. Delivered materials shall be identical to the approved samples. Materials which become damaged shall be repaired and/or replaced as directed.

C. Fixtures shall be stored under cover, above the ground, in clean, dry areas, and shall be tagged and/or marked as to type and location.

D. Delivered fixtures shall include wiring, sockets, ballasts, shielding, channels, lenses and other parts and appurtenances necessary for fixture installation of each fixture type.

PART 2 - PRODUCTS

2.1 GENERAL

A. Provide materials, equipment, appurtenances and workmanship for the work of this Section conforming to the highest commercial standards, as specified and indicated on the drawings. Make fixture parts and components not specifically identified or indicated on the drawings, of materials most appropriate to their use or function, and resistant to corrosion and to thermal and mechanical stresses encountered in the normal application and function of the fixtures.

B. Provide recessed fixtures that are constructed to be suitable for and compatible with the ceiling, wall or pavement materials and construction in which they will be installed.

2.2 MARKING OF FIXTURES

A. Plainly mark fixtures equipped with ballasts for operation of rapid start lamps "Use Rapid Start Lamps Only." Similarly, mark other fixtures according to proper lamp type. Clearly mark ballasts that have multi-level outputs as such, and indicate proper terminals for the various outputs. Provide markings that are clear and that are located to be readily visible to service personnel, but invisible from normal viewing angles when lamps are in place.

2.3 MATERIALS AND FABRICATION

A. General Description: Provide fixtures, completely factory-assembled and wired and equipped with necessary sockets, ballasts, wiring, shielding, reflectors, channels, lenses and other parts and appurtenances necessary to complete the fixture installation and deliver to project site ready for installation.

B. Unless otherwise noted, use only completely concealed hardware. Weld exposed metal at joints, fill with weld material, grind smooth, and make free from light leaks by the inherent design of the fixture body and frame. Bond gaskets, when used, to the fixture metal. Gasket incandescent fixtures with overlapping trim. Weld ballast support studs, socket saddle studs and reflector support studs to fixture body. Self-threading screws are not approved. Make flexible leads enter fixtures at sides, unless otherwise noted. Ventilate ballast compartments and fixtures using bottom re-lamping, unless otherwise noted.

C. Minimum gauges sheet steel: 20 gauge unless otherwise specified.

D. Construct fixtures with the minimum number of joints. Make unexposed joints by approved method such as welding, brazing, screwing or bolting. Soldered joints are not acceptable. Do not use self-tapping methods or rivets for fastening parts which shall be removed to gain access to electrical components requiring service or replacement, or for fastening any electrical components or their supports.

E. Provide metallic cast or extruded parts of fixtures that are close grained, sound, and free from imperfections or discolorations. Provide cast or extruded parts that are rigid, true to pattern, and of ample weight and thickness. Provide cast or extruded parts that are properly fitted, filed, ground, buffed and chased to provide finished surfaces and joints free of imperfections. Make thickness on cast parts not less than 1/8 inch.

F. Provide housings for fixtures that make electrical components easily accessible and replaceable, without removing the fixture body from its mounting.

G. Provide luminaires indicated as "continuous" on drawings or specifications with finished end-to- end or wall-to-wall appearance. Do not overlap single rows of fixtures, unless otherwise specified. Maximize lighted length to nearest whole foot, with equally spaced unlighted portions at each end, not to exceed 6" each. Provide continuous louvers and/or lenses into unlighted ends and at corners.

2.4 FINISHES

A. Apply fixture finishes after fabrication in a manner that assures a durable wear-resistant surfacing. Prior to finishing, hot clean the surfaces by accepted chemical means, and treat them with corrosion inhibiting (phosphating) treatment to assure positive paint-adhesion. Give exposed metal surfaces (brass, bronze, aluminum and others) and finished castings accept chromium-plated or stainless steel parts an even coat of high grade methacrylate lacquer, or transparent epoxy. Anodize exposed aluminum surfaces for corrosion resistance. Make sheet steel fixture housing, and iron and steel parts which have not received phosphating treatment, or which are to be utilized in exterior applications corrosion resistant by zinc or cadmium plating or hot-dip zinc galvanizing after completion of all forming, welding, or drilling operations. Provide minimum thickness of protective coatings:
   1. Hot galvanized zinc coating 0.0005 inch
   2. Cadmium plating 0.00015 inch

B. Electroplate parts operated under temperatures injurious to hot-dipped galvanizing.

C. Cadmium plate screws, bolts, nuts and other fastening or latching hardware.

D. Except where otherwise indicated provide fixtures with a final synthetic, high-temperature baked enamel coating of color and finish as specified or directed. Unless otherwise specified, provide white baked enamel reflective surfaces, with a minimum reflectance of 86%. Unless otherwise specified, provide matte black non-reflective surfaces. Prior to painting give all parts proper etched surface preparation to assure paint adherence and durability. See paragraphs above.

2.5 FIXTURE WIRING

A. Provide luminaire wiring between lamp-holders and associated operating and starting equipment in compliance with UL 1570 and NEC. (Provide wiring between fluorescent lamp-holders and associated operating and starting equipment of similar or heavier gauge than the leads furnished with the approved types of ballasts and having equal or better insulating and heat resisting characteristics. Provide internal wiring of fixtures containing a minimum number of splices. Make splices with approved mechanical insulated steel spring type connectors, suitable for the temperature and voltage conditions to which the splices are to be subjected.)

B. Make connections of wires to terminals of lamp-holders and other accessories in a neat and workmanlike manner and which are electrically and mechanically secure, with no loose strands protruding. Provide a number of wires extending to or from the terminals of a lamp-holder or other accessory that does not exceed the number which the accessory is designed to accommodate.

C. Provide proper contact force for oxide disruption to mitigate fretting at all electrical connections. Ensure use of proper electrical connectors based on wire size, type and coatings. Provide proper wiping of wire prior to final connection. Ensure maximum temperatures are not exceeded for all wiring and connections.

D. When allowed by local code, use of connectors meeting self-extinguishing UL 94 standards shall prevent flaming particles from exiting fixture openings and/or make contact with combustible materials.

E. Provide wiring channels and wireways free from projections and rough or sharp edges throughout. At points or edges over which conductors shall pass and may be subject to injury or wear, grind to make a smooth contact surface with the conductors.

F. Install insulated bushings at points of entrances and exit of flexible wiring.

2.6 SOLID STATE LIGHTING (LED)

A. General:

1. Performance and Design Requirements.
    a. LED systems shall include a luminaire, transformer/drivers as requires, wiring components, jacks compatible with project control system, to make a complete and functioning unit.
    b. Where specified, controls shall allow smooth and even color fade between colors, including white.
    c. All LED luminaires shall be photometrically tested. Photometric testing shall be performed in accordance with IESNA LM-79-08.
    d. LED chips supplied with luminaires shall be tested in accordance with IENSA LM-80-08. Average rated life shall be 70% of the initial lamp lumen output at 50,000 hours.
    e. Life Estimation Test Method of all LED systems shall be performed in accordance with IESNA TM-21 (Pending).
    f. All LED circuit boards and electrical components shall be RoHS Compliant (Restriction of Hazardous Substances).
    g. Manufacturer to supply CQS (Color Quality Scale) measurements upon request.
    h. Data interface (as required) shall be as specified.
    i. Color range for all “white” LEDs shall not deviate more than ±200K. Where specified, color range for “white” LEDs shall not deviate more than ±100K.
    j. Where specified, LEDs shall be binned with a minimum CRI (not an average).
    k. Where specified, luminaires shall be full range dimmable, smooth without flicker.
    l. Individual LEDs shall be connected such that a catastrophic loss or the failure of one LED will not result in the loss of the entire luminaire.
    m. Shop drawings are required and shall include life (hours) at 70% and 50% lumen maintenance with plot graph of measured and extrapolated data. Initial lumens for each LEDs color temperature shall be listed individually.
    n. Ambient temperatures surrounding the fixture shall not exceed 120°F.
    o. The thermal management (of the heat generated by the LEDs) shall be of sufficient capacity to assure proper operation of the luminaire over the expected useful life.
    p. Luminaires shall be U.L. listed and labeled.
    q. Luminaires, LEDs and labor, shall be under full warranty for a period of not less than two years from the date of written final acceptance.
2. Drivers
    a. Drivers shall have reverse polarity protection, open circuit protection and require no minimum load.
    b. Drivers shall be a minimum of 85% efficient.

c. When specified in an outdoor location, drivers shall be impervious to harsh environments, be waterproof and use plug and play connections.
d. Where specified, drivers shall be 100%-1% dimmable, unless otherwise noted in the Light Fixture Schedule. Coordinate with lighting control system.
e. Drivers, and labor, shall be under full warranty for a period of not less than one year from the date of written final acceptance.
f. Sound rating A+.
g. Driver shall operate with less than 5% flicker (maximum 0.20 Flicker index) for generated light at full output and all dimmed levels.

2.7 EMERGENCY DRIVERS AND INVERTERS

A. Where emergency fixtures are indicated on plans, provide fixture with emergency driver and inverter as required for a code compliant installation.

B. Drivers and inverters shall be N.Y. State approved and capable of operation for 90 minutes.

2.8 REFLECTORS

A. Aluminum Reflectors:
1. Provide reflectors and reflecting cones or baffles fabricated from #12 aluminum reflector sheet, 0.057 inch (15 gauge) or heavier; and absolutely free of tooling marks including spinning lines, and free of marks or indentation caused by riveting or other assembly techniques. No rivets, springs, or other hardware shall be visible after installation.
2. Provide reflectors and baffles of first-quality polished, buffed and anodized finish, "Alzak" or approved equal, and with specular finish color as selected by Architect. Provide reflector and baffles which produce neither apparent brightness from nadir to 45 degrees above nadir, nor a lamp image nor may any part of the lamp be visible from nadir to 45 degrees above nadir.
3. Provide other aluminum reflectors where required, and formed and finished as noted on drawings and elsewhere in the specifications. Provide only reflectors free from blemishes, scratches, or indentations which would distort their reflective function and finished by means of the "Alzak" process, or approved equal, unless otherwise noted. Techniques: no rivets, springs, or other hardware shall be visible after installation
4. Aluminum Reflector Characteristics:

Min. Weight of Coating Class (mg/in^2)	Service	Min. Reflectivity Specular / Diffuse
MI 5.0	Normal interior	83% / 75%
SI 7.5	Medium interior, industrial, exterior when operating within glass, metal or plastic enclosure	82% / 73%

Min. Weight of Coating Class (mg/in²)	Service	Min. Reflectivity Specular / Diffuse
SE 10.0	Exterior, industrial or commercial, exposed to atmosphere. Marine service in enclosure	78% 65%

1. Provide reflectors, cones, or baffles for use with triphosphor fluorescent lamps with low iridescent coating on surfaces seen from normal viewing angles.

B. Painted Reflectors:
   1. Provide painted reflectors completely formed before application of primer and enamel color coat or coats. Make reflectors and reflector bodies for fluorescent lamp fixtures, having baked-on white synthetic enamel finish, of steel, of the thickness specified or noted and given a suitable primer and white color coat or coats, applied to meet the following requirements and tests described below.
   2. When requested by Architect, submit a sufficient quantity of flat steel panels having the identical primer and color coat or coats applied in the same manners as proposed for the contract items, for subjection to any one or all of the tests listed herein by an approved independent testing laboratory. Provide panels of suitable size and drilled as necessary for a particular test procedure.
   3. Tests will be required only in case of dispute about reflector characteristics. Tests may be required at any time before or during Contractor's guarantee period. Contractor will pay the cost of tests, if required. Reflectors which do not meet the criteria expressed here will be replaced at Contractor's expense, with reflectors meeting specified requirements.
   4. Tests:
      a. Provide an initial reflection factor not less than 86%. After 100 hours exposure to a fade- o-meter, reflection factor may not be less than 86%, and finish can show no visible color change.
      b. Specular Gloss, in accordance with ASTM Method D-523-T, Procedure A, may be a minimum of 80.
      c. Exposure for 48 hours to either hydrogen sulfide or sulphur dioxide may cause no more than slight yellowing and no blistering.
      d. A spot test with 5% potassium hydroxide at room temperature for four hours may show no effect other than a loss of not over 15% gloss.
      e. Contact with 5% soda ash solution at room temperature for 24 hours may show no effect.
      f. Exposure to 100% humidity at 100 degrees F., for 100 hours (Cook Box Test) may show no blistering or other effects.
      g. Salt spray (20% sodium chloride) for 150 hours may cause no breakdown of film. Talbor Abrasion Test may show no more than 15 mgm. per 300 cycles, using CS-10 wheel.
      h. Erickson Bump Test may show a minimum of 3 millimeters of penetration before cracking.
      i. Sward Harness Test may show a minimum of 30.

2.9 LENSES / FACEPLATES / TRIM

A. Where plastic lenses are indicated, provide lenses of 100% virgin methyl methacrylate, unless otherwise indicated. Lens is to be strain-free, uniform in appearance, and destaticized.

B. Make lenses, louvers, or other light diffusing elements contained in frames removable, but positively held within the frames so that hinging or other motion of the frame will not cause the diffusing element to drop out.

C. Provide faceplates of incandescent recessed fixtures which open for access to the interior of the fixture, serve as a ceiling trim, and are positively held to the fixture body by adjustable means that permit the faceplate to be drawn up to the ceiling as tight as necessary to ensure complete contact of faceplate with ceiling surrounding the fixture.

2.10 EXIT SIGNS

A. General Requirements for Exit Signs: Comply with UL 924; for sign colors, visibility, luminance, and lettering size, comply with Building Code of the State of New York and/or local Authorities Having Jurisdiction.

B. Internally Lighted Signs:
1. Lamps for AC Operation: LED, 70,000 hours minimum rated lamp life.
    a. Individual LED modules shall not be visible.

C. Self-Powered Exit Signs (Battery Type): Integral automatic charger in a self-contained power pack.
1. Battery: Sealed, maintenance-free, nickel-cadmium type.
2. Charger: Fully automatic, solid-state type with sealed transfer relay.
3. Operation: Relay automatically energizes lamp from battery when circuit voltage drops to 80 percent of nominal voltage or below. When normal voltage is restored, relay disconnects lamps from battery, and battery is automatically recharged and floated on charger.
4. Test Push Button: Push-to-test type, in unit housing, simulates loss of normal power and demonstrates unit operability.
5. LED Indicator Light: Indicates normal power on. Normal glow indicates trickle charge; bright glow indicates charging at end of discharge cycle.
6. Integral Self-Test: Factory-installed electronic device automatically initiates code-required test of unit emergency operation at required intervals. Test failure is annunciated by an integral audible alarm and a flashing red LED.
7. Individual LED modules shall not be visible.

2.11 EMERGENCY LIGHTING UNITS

A. Product Description: Self-contained LED emergency lighting unit.

B. Battery: 12 volt, nickel-cadmium type, with 1.5 hour capacity.

C. Battery Charger: Dual-rate type, with sufficient capacity to recharge discharged battery to full charge within twelve hours.

D. Lamps: LED.

E. Housing: Steel with gray hammer tone finish.

F. Indicators: Lamps to indicate AC ON and RECHARGING. Voltmeter to indicate battery voltage.

G. TEST switch: Transfers unit from external power supply to integral battery supply.

H. Electrical Connection: Conduit connection.

I. Input Voltage: [120] [277] volts.

2.12 FIXTURE DESCRIPTIONS

A. Provide fixtures which conform to the above standards and criteria, as indicated on the drawings, and as indicated below. Contractor to verify ceiling conditions for all fixture types.

B. Catalogue or series numbers, when shown, are intended to provide assistance in establishing general type or category of lighting fixtures. These are not part of specification nor are they to be used to order fixtures. Contractor shall provide a fixture that meets the complete performance descriptions below.

C. Standard catalogue cuts, when included, are for general assistance only, and are not a part of these specifications. Written fixture descriptions below are the basis for fixture specification. When custom sketches or drawings are part of the contract documents, bring any discrepancies between drawing and specifications to the attention of the Architect before submitting bids.

D. Fixture Descriptions:
   1. See Light Fixture Schedule on Electrical Drawing Sheet(s).

E. Lighting Fixture Cut Sheets:
   1. See Attached Manufacturer Cut Sheets for Reference

PART 3 - EXECUTION

3.1 GENERAL

A. Install fixtures complete with lamps, as indicated, and with equipment, materials, parts, attachments, devices, hardware, hangers, cables, supports, channels, frames and brackets necessary to make a safe, complete, and fully operative installation.

B. Verify and provide fixtures that are appropriate for the ceiling and mounting conditions of the project.

C. Reject and do not install blemished damaged or unsatisfactory fixtures. Replace imperfect or unsatisfactory fixtures, if installed, as directed by Designer.

D. Set fixtures, when installed, to be true, and free of light leaks, warps, dents, or other irregularities. No light leaks are permitted at the ceiling line or from any visible part or joint of the fixtures.

E. Provide finish for exposed parts or trims as specified so indicated, provide a finish as directed by Designer.

F. Do not install reflector cones, aperture plates, lenses, diffusers, louvers, and decorative elements of fixtures until completion of wet work, plastering, painting and general clean-up in the area of the fixtures.

G. Mount fixtures at heights and locations indicated on the Contract Drawings, or as required by Designer.

H. Adequately protect the housing of recessed lighting fixtures during installation by internal blocking or framing to prevent distortion of sides, or dislocation of threaded lugs, which, upon completion, shall be in perfect alignment and match the corresponding holes in frames or rims. Holding screws shall be inserted freely without forcing, and shall remain easily removable for servicing. Threads intended to receive holding installation and removal of knurled headed screws.

I. Upon completion of the installation, the lighting fixtures and lighting equipment shall be in first class operating order and free from defects in condition and finish. At time of final inspection, all fixtures and equipment shall be clean, fully lamped, and be complete with required lenses or diffusers, reflectors, side panels, louvers, or other components necessary for the function of the fixtures. Any reflectors, lenses, diffusers, side panels or other parts damaged prior to the final inspection shall be replaced by Contractor prior to inspection.

3.2 ACCESSIBILITY

A. Install equipment such as junction and pull boxes, fixture housings, transformers, ballasts, switches and controls, and other apparatus that shall be reached from time to time for operation and maintenance, to be easily accessible and appropriate for mounting and ceiling conditions.

3.3 SUPPORTS

A. Provide plaster frames or mounting frames for fixtures that require them. Such frames shall be appropriate for the ceiling construction in which they shall be installed.

B. Provide necessary hardware with fixtures, such as stems, plates, plaster frames, hangers and similar items, for safe support of the fixture. Provide plaster frames made of non-ferrous metal, or of steel that has been suitably rust proofed after fabrication, as described above.

C. Provide supports for fixtures that are adequate to support the weight of the fixtures.

D. Provide visible hanging devices that are finished to match the fixture finish, unless indicated otherwise.

E. Where necessary to meet fire resistance requirements of Building Code authorities, provide enclosures housing recessed fixtures that are constructed to provide required fire resistance rating.

F. Provide attachment devices including brackets, plastic or cast metal shapes with the requisite rigidity and strength to maintain continuous alignment of installed fixtures. Attach fixtures to ceiling supporting members, and do not depend upon lathing, plaster or ceiling tile for alignment or support.

G. Provide fixtures mounted in suspended ceilings that are supported by saddle hangers or the bars attached to runners or between crossbars of ceiling systems. Provide mounting splines or other positive means of maintaining alignment and rigidity.

H. Provide supporting members that are surface passivated, and which are primed or paint-dipped to resist corrosion.

I. Provide fastening devices of a positive locking type, which do not require special tools to apply or remove them. Do not use tie wires in place of fastening devices.

J. Contractor is responsible for the necessary suspension system; Contractor shall ascertain the structural reliability of supports provided under other Sections of the specification.

K. Attach reflectors to housings by means of safety chains, which shall prevent reflectors from falling. No part of the chain may be visible after installation, when viewed from any angle up to 45 degrees from the horizontal.

L. Provide pendant or surface mounted fixtures with required mounting devices and accessories, including hickeys, stud-extensions, ball aligners, canopies, and stems. Uniformly maintain the fixture heights shown on the Contract Drawings or established in the field. The allowable variant tolerance in mounting individual fixtures shall not exceed 1/4 inch and may not vary more than 1/2 inch from the floor mounting height shown on the drawings. Install fixtures hung in continuous runs absolutely level, and in line with each other. Hanging devices shall comply with code requirements.

M. Provide hanging devices which, if visible from normal viewing angles, exactly match fixture finishes.

N. Provide an approved ceiling canopy for each stem, exactly matching fixture finishes.

O. Place stems to be plumb vertical.

P. Provide at least two supports for individually mounted fixtures. Where fixtures are ganged, provide supports at least at 8 ft. intervals, unless otherwise indicated.

3.4 ADJUSTMENT

A. Provide manpower and tools for final focusing and adjustment, under Lighting Designer's supervision, of all adjustable fixtures after regular working hours, whenever necessary, at no additional cost to Owner.

3.5 DISPOSAL

A. All ballasts/drivers containing PCB's and batteries shall be treated as hazardous waste and be disposed of as regulated by the Environmental Protection Agency's Universal Waste Rule. Any state regulations more stringent shall take precedence.

3.6 CLEANING

A. Immediately prior to occupancy, clean reflector cones, reflectors, aperture plates, lenses, louvers, lamps and decorative elements. Destaticize lenses after cleaning, installing them to leave no finger or dirt marks.

B. Upon completion of the fixture installation and at the time of final inspection, fixtures shall be clean, and free from marks, dust, spotting or other defects. Replace any broken or defective parts prior to final inspection. Replace or make good all defects revealed by final inspection.

3.7 MAINTENANCE MANUALS

A. The Contractor shall be responsible for obtaining from supplying lighting manufacturers, for each type of luminaire, a recommended maintenance manual including tools required, types of cleaners to be used, replacement parts identification lists and final, as built shop drawings, warranty information. These manuals shall be produced and delivered to the owner as specified in Division 1.

END OF SECTION 26 51 00

SECTION 28 31 00 - FIRE DETECTION AND ALARM

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:
1. Remote data gathering panels (DGP's).
2. Addressable manual fire-alarm stations.
3. Addressable smoke and heat detectors.
4. Addressable duct mounted smoke detectors.
5. Audible alarm notification appliances (Speakers).
6. Visual alarm notification appliances (strobe lights).
7. Combination audible/visual alarm notification appliances (speaker/strobe light).
8. Magnetic lock/card access release over-ride control.
9. Air handling system shutdown.
10. Sprinkler/standpipe valve supervisory (tamper) switches.
11. Sprinkler flow switches.
12. Auxiliary fire-alarm equipment.
13. Standby battery.
14. Power and signal wire and cable.
15. NYS Department of Building (DOB) requirements shall be complied with to obtain a fully functional Automatic and Manual Fire Alarm with Voice Evacuation, inspected by the FDNY and provided with an FDNY Letter of Approval and sign-off of the project at the DOB.

B. Related Sections:
1. Section 21 12 00 - Fire Suppression Standpipes.
2. Section 21 13 13 - Wet-Pipe Sprinkler Systems.
3. Section 26 05 19 - Low-Voltage Electrical Power Conductors and Cables.
4. Section 26 05 26 - Grounding and Bonding for Electrical Systems.
5. Section 26 05 33 - Raceways and Boxes for Electrical Systems.
6. Section 26 05 53 - Identification for Electrical Systems.

1.2 REFERENCE STANDARDS

A. National Fire Protection Association (NFPA):
1. NFPA 70 - The National Electrical Code.
2. NFPA 72 - National Fire Alarm and Signaling Code.
3. NFPA 262 - Standard Method of Test for Flame Travel and Smoke of Wires and Cables for Use in Air-Handling Spaces.

B. New York State:
1. NYSBC - New York State Building Code
2. NYSEC - New York State Electrical Code.
3. NYSFC - New York State Fire Code.

C. Underwriters' Laboratories, Inc.:
1. UL 38 - Manually Activated Signaling Boxes.
2. UL 228 - Door Holders for Fire Protective Signaling Systems.
3. UL 268 - Smoke Detectors for Fire Protective Signaling Systems.
4. UL 268A - Smoke Detectors for Duct Applications.
5. UL 464 - Audible Signaling Appliances.
6. UL 521 - Heat Detectors for Fire Protective Signaling Systems.
7. UL 864 - Control Units for Fire Protective Signaling Systems.
8. UL 1481 - Power Supplies for Fire Protective Signaling Systems.
9. UL 1638 - Visual Signaling Appliances.
10. UL 1711 - Amplifiers for Fire Protective Signaling Systems.
11. UL 1971 - Standard for Signaling Devices for the Hearing Impaired.

1.3 COORDINATION

A. Coordinate Work of this Section with Work of other Sections. Coordination shall include the installation and/or testing of sprinkler flow and valve tamper switches, the installation and testing of duct mounted smoke detectors, testing of control and monitor modules for proper operation of fan shutdown, smoke purge, and damper control and position indication.

1.4 SUBMITTALS

A. Product Data: Submit manufacturer's catalog information showing electrical characteristics and connection requirements.

B. Shop Drawings:
1. Floor Plans showing the location of all devices, routing of fire alarm cables and conduits, and riser conduits.
2. Riser diagram showing all devices on each floor, including alarm initiating and alarm indicating devices, control devices, monitoring devices, power supplies, amplifiers and DGP's.
3. Indicate system wiring diagram showing each device and wiring connections.
4. Panel interior drawings, showing the interior of each panel, interconnecting wiring and wiring from field devices.
5. Battery calculations for each set of batteries to document compliance with battery back-up requirements.

C. Manufacturer's Certificate: Certify that products meet or exceed specified requirements.

D. Delegated Design Submittals: Submit signed and sealed Shop Drawings with design calculations and assumptions for fire-alarm system.

E. Manufacturer Instructions: Submit detailed instructions on installation requirements, including storage and handling procedures.

F. Field Quality-Control Submittals: Indicate results of Contractor-furnished tests and inspections.

G. Manufacturer Reports:
   1. Certify that equipment has been installed according to manufacturer instructions.
   2. Indicate activities on Site, adverse findings, and recommendations.

H. Qualifications Statements:
   1. Submit qualifications for installer, including Manufacturer's approval of Vendor to provide installation, programming, service and maintenance of the proposed fire alarm system.

1.5 CLOSEOUT SUBMITTALS

A. Project Record Documents: Record actual locations of fire-alarm equipment.

1.6 MAINTENANCE MATERIAL SUBMITTALS

A. Spare Parts:
   1. Furnish three (3) automatic smoke detectors, without base, of each type provided.
   2. Furnish two (2) spare smoke/heat detector bases.
   3. Furnish one (1) visual (strobes) alarm indicating devices of each type provided.
   4. Furnish one (1) combination audible/visual (speaker/strobe) alarm indicating devices of each type provided.
   5. Furnish two (2) addressable control modules.
   6. Furnish two (2) multi-voltage relays.
   7. Furnish two (2) of each type addressable monitor modules provided.

1.7 QUALIFICATIONS

A. System Vendor: Company specializing in performing Work of this Section with minimum three (3) years documented experience and approved by manufacturer.

1.8 DELIVERY, STORAGE AND HANDLING

A. Inspection: Accept materials on Site in manufacturer's original packaging and inspect for damage.

B. Store materials according to manufacturer instructions.

C. Protection:
   1. Protect materials from moisture and dust by storing in clean, dry location remote from construction operations areas.
   2. Provide additional protection according to manufacturer instructions.

1.9 EXISTING CONDITIONS

A. Field Measurements:

1. Verify field measurements prior to fabrication.
2. Indicate field measurements on Shop Drawings.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

A. Manufacturers: The existing building Fire Alarm System is an Edwards Systems Technologies EST3 system. All fire alarm system components shall be manufactured by Edwards Systems Technologies or shall be approved for use with the Edwards EST3 system by Underwriters Laboratories, Inc. (UL).

B. No substitutions for the specified manufacturer will be allowed, as the devices are required to be compatible with the Edwards Fire Alarm System.

C. All programming of the fire alarm system shall be performed by ADT Commercial / Red Hawk Fire & Security, 6 Skyline Drive, Hawthorne, NY 10532. Telephone #914-769-8900.

2.2 SYSTEM DESCRIPTION

A. Fire-Alarm System:
1. The existing system is a manual and automatic fire-alarm system with voice evacuation and connection to a NYS approved central station for alarm reporting.
2. The system consists of the Fire Command Station (FCS), located in the main building lobby, remote data gathering panels (DGPs), area smoke detectors, area heat detectors, duct mounted smoke detectors, addressable manual pull stations, addressable monitor and control modules, multi-voltage control relays; audible, visual and combinations audible/visual alarm indicating devices, and warden telephones.
3. Comply with NFPA 72, as amended by Appendix Q of the New York State Building Code.

B. All products and components of the Fire Alarm System shall be provided by Edwards Systems Technologies, or shall be UL Listed as compatible with the existing fire alarm system. The Fire Alarm System Manufacturer shall assume all warranty requirements and responsibility for all fire alarm system devices and components supplied for this project. Warranty obligations assumed by multiple manufacturers are not acceptable.

2.3 INITIATING DEVICES

A. Manual Pull Stations:
1. Manual Pull stations shall be intelligent, addressable type. The station shall have a metal case with an internal switch. The finish of the station shall be red with white lettering indicating “Pull in Case of Fire”. The station shall be capable of mounting on a 2-1/2” deep outlet box with a single gang plaster ring. LED indicator(s) green LED shall flash to indicated communication with the control panel; Red LED shall be flash to indicated alarm (either two LEDs or a single multi-color LED shall be acceptable). Manual

Stations shall be suitable for operation in temperatures of 32 deg. F to 120 deg. F, 0 to 93% relative humidity (non-condensing).

B. Addressable Area Smoke Detectors:
   1. Addressable photoelectric analog smoke detectors shall be utilize light scattering type detectors to sense changes in air samples from the surrounding. The detectors shall contain an integral microprocessor analyze the environment and initiate an alarm. The detector shall continuously monitor changes in sensitivity due to dirt, smoke, temperature, aging and humidity. Smoke obscuration per foot alarm set points shall be field selectable from 1.0% to 3.5%. Temperature range shall be 32 deg. F to 120 deg. F; 0 to 93% relative humidity, non-condensing.

C. Addressable Duct Detector Housing:
   1. Addressable duct detector shall be a low-profile unit with air sampling and exhaust tubes that extend into the duct air stream up to 10-feet. The duct housing shall be suitable for extreme environments, including a temperature range of -20 deg. F to 158 deg. F and a harsh environment gasket option. The housing shall accept a remote LED alarm indicator light or a remote alarm indicator light/remote test station where indicated on the plans.

D. Addressable Area Heat Detectors:
   1. Addressable heat detectors shall be combination fixed temperature/rate of rise heat detectors. The detector shall continuously monitor the temperature of its surroundings to minimize thermal lag time. The detector shall have an internal microprocessor to determine if an alarm condition exists and initiate an alarm. The nominal fixed temperature set point shall be 135 deg. F and a rate-of-rise alarm point of 15 deg. F per minute. Heat detectors shall be designed for ceiling installation at a minimum of 70 feet on center.

E. Standard Detector Mounting Bases:
   1. Provide detector mounting bases suitable for mounting on 3-1/2” or 4” octagonal box or 4” square box. The base shall contain no electronics, shall support all smoke and heat detectors. The base shall allow the removal of the detectors without affecting communication to other detectors. Terminals shall be on the room side of the base and shall be capable of supporting a remote LED alarm indicator, where required.

F. Addressable Input Modules:
   1. Addressable input modules shall be utilized to connect and supervise non-intelligent contact devices (valve tamper switches, water flow switches, etc.). The input module shall connect to the fire alarm system signaling line circuit for supervision of the device, monitor the state of the contact and provide supervision of the wiring, for open and ground fault, between the input module and the contact device. Modules shall provide either one or two Class B input circuits for monitoring contacts. Each module shall be provided with LED(s); flashing green to indicated communication, flashing red to indicate alarm. Addressable input modules shall mount on a standard 1-1/2 deep, 4-inch square box with a single gang plaster ring. Input modules shall support normally-open, latching contacts (manual stations, heat detectors, etc.), normally-open delayed latching (waterflow switches), normally-open active non-latching (monitor, fans, dampers, doors, etc.), and normally-open active latching (supervisory, tamper switches). Temperature range shall be 32 deg. F to 120 deg. F; 0 to 93% relative humidity, non-condensing.

2.4 CONTROL DEVICES

A. Addressable Relay Module:
1. Addressable relay module shall provide control of multi-voltage relays to interface with line voltage controlled equipment. The relay module shall have one form "R" dry relay contact rated 2 amperes at 24VDC. The relay shall be rated for pilot duty and releasing systems. The position of the relay shall be confirmed by the system firmware. The relay module shall mount on a 1-1/2" deep, 4-inch square outlet box with a single gang plaster ring.

B. Addressable Input Signal Module:
1. Addressable single input module shall provide one (1) Class B output circuit. The signal module shall operate as a telephone power selector, capable of generating a "ring tone". The module shall also be capable of providing 24VDC to operate audible/visual alarm indicating devices. The module shall mount on a 1-1/2" deep, 4-inch square outlet box with a single gang plaster ring.

C. Multi-Voltage Relays:
1. Multi-voltage relays shall be utilized to interface line-voltage control system with addressable relay modules to provide control of dampers, motor starters, etc. Relays shall be DPDT and shall be rated at 10 amperes, 115 VAC. A single relay shall be energized from a source of 24 VDC, 24 VAC, 115 VAC or 230 VAC. A red LED shall indicate the relay is energized. The relay shall be mounted in a metal enclosure.

2.5 ALARM INDICATING DEVICES

A. All visual alarm indicating devices shall be UL 1971 Listed and shall be installed in accordance with NFPA 72, as modified by Appendix Q of the New York State Building Code.

B. Alarm indicating devices (visual, audible and combination visual/audible) shall be of the same manufacture as the Fire Alarm System or shall be UL Listed as compatible with the fire alarm system.

C. Visual alarm indicating devices shall be strobe lights, white in color with a red faceplate or housing, labeled "FIRE" in white letters, oriented for wall mounting. Screw terminals shall be provided for terminating wiring. Strobes shall mount on a standard 4-inch square box, with or without a single gang plaster ring. The light output (candela rating) shall be as indicated on the drawings. Strobe units with a switch to set the candela output of the strobe unit are acceptable. All strobe lights shall be synchronized.

D. Audible alarm indicating devices shall be speakers with a red housing, labeled "FIRE" in white letters, oriented for wall mounting. Screw terminals shall be provided for wiring. Speakers shall be provided for use with 70V systems and shall provide power taps at 1/4w, 1/2w, 1w, and 2w. Speakers shall provide UL confirmed 90 dBA sound output at 2w. Speakers shall mount on a 4-inch square, 1-1/2-inch deep outlet box.

E. Combination visual/audible alarm indication units shall combine the horn and strobe light into a common housing. The combination unit shall have the same technical requirements as the

individual devices indicated above. Wiring terminals shall allow the horn and strobe to be wired separately or on a common circuit. All strobe lights shall be synchronized.

2.6 WIRE AND CABLE

A. Description:
1. Power-limited, fire-protective signaling cable.
2. Conductor: Copper, not less than No. 16AWG.
3. Insulation Rating: 300 V at 150 degrees C.
4. The cable shall be provided with a red overall jacket. The cable shall be UL 1424 Listed and shall be labeled as follows: NYS Certified Fire Alarm Cable.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Verify that products and systems receiving devices are ready for installation.

3.2 PREPARATION

A. Existing Work:
1. Remove exposed abandoned fire-alarm wiring, including abandoned wiring above accessible ceiling finishes.
2. Cut cable flush with walls and floors, and patch surfaces.
3. Disconnect and remove abandoned fire-alarm equipment.
4. Access:
   a. Maintain access to existing fire-alarm equipment and other installations remaining active and requiring access.
   b. Modify installation or provide access panel.
5. Extend existing fire-alarm installations using materials and methods compatible with existing installations, or as specified.
6. Clean and repair existing fire-alarm equipment that is to remain or to be reinstalled.

3.3 INSTALLATION

A. Install manual station with operating handle 4 feet above floor (to be measured to the top of the operating handle).

B. Install audible and visual signal devices 80-inches to 96-inches above the finished floor to the bottom of the strobe light. Mounting height shall be consistent throughout the project.

C. Install 16-AWG minimum size conductors for fire-alarm detection and signal circuit conductors.

D. Mount end-of-line devices in box, with last device or separate box adjacent to last device in circuit.

E. All wiring installed in mechanical rooms, loading docks, and stairways shall be in rigid galvanized steel. Wiring concealed in stud walls shall be installed in electrical metallic tubing (EMT). Where flexible connections are required for service and maintenance, provide liquid-tight flexible metal conduit. Above suspended ceilings, cables may be run open. Open cables shall be independently supported from the structure on dedicated supports. The use of ducts, pipes, or threaded rods supporting mechanical, plumbing, fire protection or electrical work is not permitted.

F. Connect conduit and wire to magnetic door locks, sprinkler flow switches, valve tamper switches, duct smoke detectors, addressable control modules and multi-voltage relays.

G. Automatic Detector Installation.

H. Install engraved plastic nameplates as specified in Section 26 05 53 - Identification for Electronic Safety and Security.

I. Ground and bond fire-alarm equipment and circuits as specified in Section 26 05 26 - Grounding and Bonding for Electrical Systems.

3.4 FIELD QUALITY CONTROL

A. Test fire detection and alarm devices and systems according to NFPA 72.

B. Manufacturer Services: Furnish services of authorized manufacturer's representative experienced in installation of products furnished under this Section for not less than two days (8 hours per day) on Site for installation, inspection, startup, field testing, adjustments, and instructing Owner's personnel in maintenance of equipment.

C. Equipment Acceptance:
1. Adjust, repair, modify, or replace components failing to perform as specified and rerun tests.
2. Make final adjustments to equipment under direction of manufacturer's representative.

D. Furnish installation certificate from equipment manufacturer's representative attesting that equipment has been properly installed and is ready for startup and testing.

3.5 DEMONSTRATION AND TRAINING

A. Demonstrate equipment startup, shutdown, routine maintenance, and emergency repair procedures to Owner's personnel.

3.6 MAINTENANCE

A. Provide service and maintenance of fire-alarm equipment for one year from date of Substantial Completion.

END OF SECTION 28 31 00