ELECTRICAL SPECIFICATIONS FOR

FIRST BAPTIST CHURCH
BATESVILLE, ARKANSAS

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DIVISION 26 - ELECTRICAL

Table of Contents

Division 26 – Electrical Specifications

Section 26 00 10 – Basic Requirements for Electrical Work

Part 1.00 - General

1. - Scope of Work

A. Provide all materials, labor, and equipment in accordance with these specifications and the accompanying drawings to provide a safe, complete, and properly operating electrical system for the building(s). All work described in the specifications and not shown on the drawings, or vice versa, shall be furnished in complete working order. If mention has been omitted of any item of material or work necessary for completion of the system, then such items must be and are hereby included.
   1. Unless otherwise specified elsewhere, the scope of work includes, but is not limited to, the following: Service and Distribution Equipment; Grounding system; safety and disconnect switches; load distribution panels; wire and cable; circuit breakers; fuses; raceways; wiring devices; device plates; device, pull, and junction boxes; wire and cable terminations; connections to individual units of equipment; lighting fixtures; lamps; lighting controls; photoelectric cells; site lighting; equipment identification (nameplates and directories); temporary lighting and power; all excavation and backfill and concrete work necessary for electrical equipment such as transformer pads and bases for site lighting poles. All concrete work shall be designed by others.
   2. The following items (if required for the project) will be designed by qualified others: smoke and fire detection and notification equipment; telephone systems, security/alarm systems, internet service, sanctuary audio and video systems, stage lighting design and control, arc flash study, and lightning protection system.

B. All materials and equipment shall be new and of the quality indicated by the listed brand names or specifications. Unless otherwise noted, substitutions of materials by other major manufacturers of commercial equipment meeting the exact same listed specifications are acceptable.

C. Electrical Contractor shall verify all local city code requirements of the Authority Having Jurisdiction (AHJ) are met before submitting bid. If additional items, such as a single main service disconnect are required, these items shall be included in bid package.

D. Electrical Contractor must verify breaker size, wire size, disconnect requirements, and any other special installation requirements for all actual purchased equipment such as: HVAC equipment, signs, appliances, cooking equipment, etc. Changes in breaker size shall be approved by electrical engineer to verify load capacity. All manufacturer's written installation instructions and specifications shall be adhered to.

E. Perform all necessary excavating and back-filling required for this installation. All excavations below the bottom of footings shall be back-filled with 2000 PSI concrete. Where ditches are cut for outside runs of conduit, replace and tamp the earth in 12" layers and leave the ground level and equal to its original condition.

F. Electrical Contractor shall furnish and locate sleeves and inserts required before floors and walls are built, or he shall be responsible for the cost of all cutting and patching required where such items were not installed or were incorrectly located. Penetration sleeves shall be waterproof when penetrating exterior wall or any floor. Area around all penetrations shall be repaired as deemed appropriate by architect or general contractor.

G. All penetrations of fire and/or smoke rated walls, partitions, floors, and/or ceilings shall be accomplished in such a manner as to maintain the integrity of the fire rating and to meet UL requirements. All penetrations shall be sealed with a fire stop material acceptable to the local AHJ.
H. In general, all floor mounted equipment shall be installed on raised concrete bases. Concrete bases shall not be less than 4" in height. Consult with general contractor.
I. It shall be the responsibility of each bidder to visit the project site to acquaint himself with existing conditions prior to submitting bid.
J. Electrical contractor shall be held responsible for damage to other work from negligence of his employees.
K. Electrical contractor shall receive, store, and protect all materials delivered to jobsite.
L. Maintain as-built drawings, updated daily during construction, and present the owner with one set upon completion. Provide the owner's personnel with on-site instruction in the operation and maintenance of the completed electrical system.

M.Provide all test/inspection reports, O&M manuals, etc. to Owner in a neat organized format.

2. - Quality Assurance and Standards

A. All work shall be performed by skilled, licensed electricians in accordance with the best practices of the trade, meeting the requirements for commercial work of the latest edition of the National Electrical Code, Applicable Federal, State, and Local codes, the requirements of the electrical utility company providing the service, and all specific requirements of all local authorities having jurisdiction.
B. All Electrical Equipment, materials, and appliances shall be U.L. listed and labeled.
C. The following specifications and standards shall be considered part of these specifications. All materials and installations shall meet the appropriate sections of these standards/ specifications:

1. National Electrical Code (NEC) NFPA-70
2. National Fire Protection Association's Recommended Practices
3. National Electrical Safety Code NFPA-70E
4. Underwriter's Laboratories, Inc. (UL)
5. Institute of Electrical and Electronic Engineers (IEEE)
6. Illuminating Engineering Society (IES)
7. Insulated Power Cable Engineers Association
8. National Electrical Manufacturers Association (NEMA)
9. American National Standards Institute (ANSI)
10. American Society for Testing Materials (ASTM)
11. Occupational Health and Safety Act (OSHA)
12. International Building Code (IBC)
13. Life Safety Code NFPA-101
14. Americans with Disabilities Act (ADA)
15. Arkansas School Facility Manual
16. Arkansas State Fire Prevention Code
17. Local, City, and State Codes and Ordinances
18. Service Requirements of Utility Provider

3. – Inspection and Tests

A. Make all tests necessary to ensure that the entire installation is free of improper grounds and of shorted and/or open conductors. Voltage and rotation tests shall be made before any motors are placed in operation. All loads shall be balanced across phases. Verify all lights work and are controlled by switches indicated on drawings or circuit breakers indicated on panel schedule.
B. Provide operational check of all equipment in the presence of the architect/Owner to demonstrate compliance with this specification. Furnish all instruments and personnel required to perform such tests.
C. Perform an insulation test of all feeders with a 500 V Megger. Test shall be performed with feeder disconnected and safely secured at each end. Test phase to phase and phase to ground. Document results and present to architect/Owner.

4. – Permits, Certifications, and Fees

A. This work shall include the procurement of and payment for all permits, certifications, and fees for the performance of the electrical work in compliance with all codes, applicable laws and municipal regulations including those from local Utilities for services.
B. Obtain and deliver a final certificate of approval from the applicable inspection authority having jurisdiction.

5. - Guarantee

A. Contractor shall furnish a guarantee in writing to the owner that all work executed under this section is free from defects of materials, workmanship, and performance for a period of one (1) year from date of final acceptance. In addition, during the term of this guarantee, the repair and/or replacement of any defective work and all resulting damages shall be made at no additional expense to the owner.

6. - Submittals

A. It is the intent of these specifications to establish quality standards of materials and equipment.
B. Submittals shall be arranged in sets and bound. Materials shall be organized into indexed sections corresponding to specification sections. All data shall be submitted at the same time. No partial submittals are accepted.
C. All submittals shall be signed by electrical contractor indicating electrical contractor has reviewed submittals and found them to meet these Specifications and to be dimensionally correct with reference to available space and to related trades.
D. Submittals must clearly indicate any item not meeting specifications of originally specified equipment. All changes or alternates must be clearly identified.
E. When substitutions alter the design or space requirements indicated on the drawings, Contractor shall include all necessary changes for all trades and any associated costs.

7. - Deviations

A. Specifications and drawings are to be used together to describe the details of the project. Any item identified or noted in either shall be considered to be required by both. Any conflicts or discrepancies shall be brought to the attention of the architect/engineer.
B. All drawings shall indicate general layout and arrangement.
C. Field verification of scale dimensions on the drawings is directed since the actual locations and distances will be governed by actual field conditions.

D. Contractor shall check all architectural, structural, plumbing, and HVAC drawings to avoid possible installation conflicts. Any major changes necessary to resolve such conflicts shall be brought to the attention of the architect/engineer.
E. Where outlets are shown to be above countertops, coordinate with millwork drawings to prevent conflicts between electrical cover plates and back splashes.
F. The drawings may be superseded by later revised drawings or specifications by addenda provided by the architect/engineer. Contractor shall conform to all reasonable changes without extra cost to Owner. All items not specifically mentioned in the specifications or indicated on the drawings, but which are normally required to build a complete, working installation shall be included.

8. – Temporary Lighting and Power

A. Provide a 100 amp, 120/240 volt AC, single phase service with power outlets adequate for temporary construction power. Temporary lighting shall be maintained in all areas of the building until permanent power sources have been energized. All temporary receptacles shall be grounded and shall have ground fault protection, as required by OSHA.

9. – Nameplates

A. Furnish a nameplate for all equipment including, but not limited to, the following: service disconnects, power/lighting panels, stand-by generator, transfer switch, safety and disconnect switches, push-button stations, equipment enclosures, and any other electrical equipment.
B. Nameplates shall be white laminate with black letters, sized to be easily visible.
C. Inscriptions shall consist of name and number of equipment. Inscriptions for service disconnects shall indicate panel or equipment fed from disconnect.
D. Junction box covers shall be identified with the system served (i.e., FA for fire alarm, IC for intercom). All fire alarm junction boxes shall be painted RED.

End of Section 26 00 10

Section 26 05 19 – Low Voltage Power Conductors and Cables

Part 1.00 - General

A. All wire, cable, raceways, and associated components shall be U.L. listed and labeled and shall only be used for the listed use.
B. All installations shall comply with the latest edition of the National Electric Code and with all local and state code requirements.

Part 2.00 – Materials

2.01 – Wire and Cables

A. All conductors shall be copper, minimum 600 VAC rating, and shall be rated for 90 degree C, THHN/THWN. The one exception to this requirement is Aluminum Stabilloy may be utilized for the service entrance conductors from the utility transformer to the building main service disconnect switch(es). Terminations must be listed compression connectors using a compatible oxide inhibitor.
B. All conductors installed in wet or damp locations shall be U.L. listed and labeled for such use.
C. Insulation color code shall be black, red, and blue (Phase); white or gray (Neutral); and green or bare copper (Ground).
D. Minimum conductor size is #12 AWG except for systems wiring such as fire alarm, data, telephone, etc.

E. Wire sizes of #12 and #10 AWG must be solid type, except where flexibility is required such as at motors.
F. Wire sizes larger than #10 AWG shall be stranded copper.

Part 3.00 – Installation

3.01 – Wire and Cables

A. Unless noted otherwise, all interior conduits for branch and feeder circuits shall be routed above ceilings and within walls. Conduits shall only be routed under concrete slab where absolutely necessary. Conduits from MDP to secondary distribution panels may be routed under slab.
B. All wiring shall be installed in appropriate raceway.
C. Install wire and cable in accordance with the latest edition of the National Electric Code, the National Electrical Contractors Association's "Standard of Installation", and the Manufacturer's written instructions.
D. Wire lubricating compound shall be suitable for the wire insulation and conduit with which it is used, and shall not harden or become adhesive.
E. Wire and cable shall not be drawn into conduit and raceways until the conduit is complete with all joints made up tightly and the entire run secured in place.
F. All branch circuits shall have a dedicated ground conductor. Provide green, insulated ground conductor in all raceways, cable assemblies, and where noted. Size equipment ground conductor per Table 250-122 of the 2023 National Electric Code.
G. Where conductors are to be connected to metallic surfaces, any coating on surfaces shall be removed and metal shall be polished for good connection.
H. Dedicated Neutral conductors are preferred. If multiwire branch circuits (Shared Neutrals) are used, installations must comply with Articles 200.4 and 210.4 of the 2023 National Electric Code. If multiwire branch circuits are used, the circuit breaker for the circuits utilizing the shared neutral shall disconnect all circuits utilizing the shared neutral. This may be accomplished through the use of a 2 pole circuit breaker, 3 pole circuit breaker, or single pole circuit breakers with approved handle ties.
I. All splices and taps shall be made in accessible boxes, panel boards, fittings, gutters, terminal panels, etc. only. Splice materials shall be compatible with the conductor and insulation.
J. Splices and joints shall be insulated with materials approved for the particular use, voltage, temperature, and environment. Insulation shall not be less than that of the conductors being joined.
K. All branch and feeder circuit wiring shall be sized by electrical contractor to meet minimum ampacities as required by the latest edition of the NEC and to provide a maximum of 3% voltage drop at actual field installed length. Any wire sizes provided shall be verified by electrical contractor to provide a maximum of 3% voltage drop at actual field installed length.

End of Section 26 05 19

Section 26 05 26 – Grounding and Bonding for Electrical Systems

Part 1.00 – General

A. Grounding shall comply with Article 250 of the latest edition of the National Electric Code. All ground conductors shall be sized based on the appropriate table of Article 250 of the latest edition of the National Electric Code.

B. The main facility grounding electrode system shall have 5 Ohms or less resistance to ground.

Part 2.00 – Materials

A. Ground Rods shall be copper clad steel not less than ¾" inch diameter and a minimum of 10 feet in length.
B. Ground clamps shall be bronze, solder less type with Bronze screws suitable for direct burial and for receiving required conductors.

Part 3.00 – Installation

3.01 - General

A. The following components shall be bonded together to form the grounding electrode system: Metal underground water pipe, metal frame of building or structure, foundation rebar (assuming foundation is in direct contact with the earth), ground ring (if available), and ground rods.
B. If a ground rod is the only grounding electrode, a supplemental ground rod shall be installed at a distance of 20 feet from the initial ground rod. Ground rods shall be bonded together with unspliced 4/0 AWG bare copper ground conductor. All connections to ground rods shall be made by the exothermic process.
C. The complete electrical installation shall be permanently and effectively grounded on utility side of the water meter and grounded in accordance with all code requirements, whether or not such connections are specifically shown or specified. Measured resistance to ground shall be 5 ohms, maximum.
D. Bond the water piping (if conductive) to the building ground with approved grounding clamps.
E. All ground connections shall be executed with the same thorough workmanship as the connections for the normal current carrying components.
F. Ground conductors shall be sized in accordance with Article 250 of the latest edition of the National Electric Code.
G. Where ground connections will be permanently concealed, make the connections by the exothermic welding process to form solid metal joints. Make accessible ground connections with mechanical pressure type ground connections or by the exothermic welding process.
H. Ground wires shall be continuous without splices. There shall be no soldered joints in any ground connection. All connectors, clamps, etc. shall be the solder less type.

3.02 - Ground Rod Electrodes

A. Ground rods shall be vertically driven with tops below grade. Where required to obtain the specified ground resistance or when specifically listed, install multiple rods. When multiple rods are required or are specified, ground rods shall be a minimum of 20 feet apart and shall be bonded together with unspliced 4/0 AWG bare copper ground conductor. All connections to ground rods shall be made by the exothermic process.
B. Where rock prevents the driving of vertical ground rods. Install grounding electrodes in horizontal trenches to achieve the specified resistance.

3.03 – Foundation Rebar Grounding

A. Grounding electrode conductor shall be installed and connected to reinforcing steel in foundation footing. All steel shall be bonded together.
B. Embedded ground cables and fittings shall be securely attached to concrete reinforcing steel by the exothermic process and prevented from displacement during concrete placement.

C. Grounding conductors which are extended beyond the concrete surfaces for equipment connection shall be extended a sufficient length to reach the final connection point without splicing. Minimum extension shall be 3 feet.
D. Grounding conductors which project from a concrete surface shall be located as close as possible to a corner of the equipment pad or protected by conduit.
E. Exposed grounding conductors shall be supported by noncorrosive metallic hardware at 4-foot intervals maximum.
F. All structural steel components of building shall be bonded to the foundation rebar.

3.04 – Raceway Grounding

A. Metallic raceway shall be installed with double lock nuts or hubs at enclosures. Metallic conduits shall be assembled to provide a continuous ground path. Metallic conduits shall be bonded using insulated grounding bushings and shall be connected to the grounding system. Where insulated bushings are required, they shall be installed in addition to double lock nuts.
B. Insulated grounding bushings shall be employed for all grounding connections to metal conduits in switchboards, in motor control centers, in pull boxes, and elsewhere where conduits do not terminate at a hub.
C. Interrupted metallic raceways shall be grounded with ground conductors connected to metallic raceway at each end.

3.05 – Bonding

A. Bond all conductive piping systems in the buildings to the electrical system ground at service entrance.
B. Electrical and distribution equipment and metal equipment platforms which support any electrical equipment shall be bonded to the nearest ground bus or to the nearest switchgear or service ground bus. This grounding requirement is in addition to the indicated raceway grounding.
C. Non-electrical equipment with metallic enclosures shall be bonded to the grounding system when there is a possibility of these enclosures becoming inadvertently energized by an electrical conductor.
D. Metal siding not attached to grounded structure shall be bonded together and to ground.
E. Reinforcing steel and metal accessories shall be bonded to structures.
F. An intersystem bonding termination shall be provided at the service disconnect, accessible and external to service equipment enclosures. System shall consist of a bonding bus having the capacity of at least three conductors. The bonding bus shall be connected with a minimum of # 6 AWG copper conductor to an equipment grounding bus in the service disconnect, main distribution panel, meter enclosure, etc.

End of Section 26 05 26

Section 26 05 33 – Raceways for Electrical Systems

Part 1.00 - General

A. All raceways and associated components shall be U.L. listed and labeled and shall only be used for the listed use.
B. All installations shall comply with the latest edition of the National Electric Code and with all local and state code requirements.

Part 2.00 – Materials

2.01 – Raceways

A. Unless prohibited by local codes, the following conduits are permitted:
   1. Rigid Steel Conduit
   2. Intermediate Metal Conduit
   3. Electric Metallic Tubing (EMT)
   4. PVC Conduit (underground or under slab only). Where panel feeder conduits are routed under slab, exposed PVC may be used to connect to panel, but length shall be minimized.
   5. Type MC Cable where concealed in walls or above ceiling.
   6. Liquidtight Flexible Steel (Flexibility Required Use Only)

B. Minimum conduit size ¾".

C. All junction boxes, pull boxes, raceways, enclosures, etc. shall be sized in accordance with Article 314.16 and 314.24 of the 2023 National Electric Code.

D. All thread compound shall be U.L. approved and conductive type to insure low resistance ground continuity through the conduit.

E. All raceway systems installed in wet or damp locations shall be U.L. listed and labeled for such use.

Part 3.00 – Installation

3.01 – Raceways

A. Install raceways in accordance with the appropriate Articles of the latest edition of the National Electric Code, the National Electrical Contractors Association's "Standard of Installation", the Manufacturer's written instructions, and recognized industry practices.

B. All raceways shall be field routed as necessary. Electrical contractor shall familiarize himself with all architectural and structural drawings for information regarding slab thickness, chases, reinforcements, furrings, ceiling construction and finishes and shall plan accordingly the installation of his work. All ceiling outlets shall be located symmetrically within areas and with respect to HVAC outlets, ceiling patterns, etc. Any errors shall be corrected at electrical contractor's expense.

C. Layout all conduit runs to avoid proximity to hot water piping. A minimum distance of 4" shall be maintained between parallel runs of conduit and hot water piping.

D. Use fittings compatible with raceway and suitable for use and location. Make all joints tight. Use insulating bushings to protect conductors.

E. Install raceway sealing fittings where required by the latest edition of the National Electric Code, at wiring entrances to refrigerated spaces, and where raceways pass from warm to cold areas or outside to inside areas. Locate at suitable, approved, accessible locations and fill with U.L. listed sealing compound.

F. Seal all conduits entering a building from an underground distribution system per Articles 225.27 (Outside Branch Circuits and Feeders), 230.8 (Services), and 300.5 (G) (Underground Installations) of the 2023 National Electric Code.

G. All raceways shall be concealed, unless otherwise specified or where exposure is necessary for equipment terminations. Install exposed raceways parallel to or at right angles to nearby surfaces or structural members, and follow the surface contours as much as possible.

H. All raceways shall be supported at intervals required by the National Electric Code and manufacturer's recommendations. All exposed conduits shall be supported at intervals not exceeding five (5) feet. Conduits shall be supported with straps, Caddy clips, or ¼" galvanized rods. Perforated strap or steel tie wire is not permitted. One hole straps may be

used for securing and supporting conduit up to 1". Two hole straps shall be used for all larger conduits.

I. All conduits shall be electrically continuous from the service equipment to all outlet boxes, and shall be secured to all metal boxes with one lock nut outside and one inside the box, and with a reinforced bakelite bushing. Maintain ground continuity of interrupted metallic raceways with appropriately sized ground conductors.

J. All PVC conduits shall have an appropriately sized, electrically continuous, bond wire run from the service equipment to all outlet boxes, secured to each wiring device per the latest edition of the National Electrical Code.

K. Where connections are to be made between conduit terminations and motors, equipment, or apparatus necessitating flexibility, approved flexible conduit shall be used. Outdoor connections to fans, HVAC units, or rotating equipment shall be made with helical wound, liquidtight, flexible steel conduit. Flexible Metal Conduit (Type FMC) shall not be used in wet locations.

L. Conduits shall not be supported by the suspended ceiling or its supporting members, lighting fixtures, mechanical piping or air conditioning ducts. Where independent support wires are used in any floor-ceiling or roof-ceiling assembly, support wires shall be distinguishable by color, tagging, or other effective means per Article 300.11(B) of the 2023 National Electric Code.

M. Damaged or deformed (dents, kinks, etc.) raceway is not permitted and shall be removed.

N. During construction, conduits shall be kept free of all foreign material by use of capped bushings on all turned up ends. Paper or wood plugs are not acceptable for this purpose.

O. All empty conduits shall have a #12 AWG pull wire installed.

P. Conduits located underground beyond the building shall be installed as follows:
   1. Install at a minimum depth of 36".
   2. For all underground Service conduits not encased in concrete and buried 18 inches or more below grade, provide a warning ribbon in trench at least 12 inches above the conduit.
   3. Plug all empty raceways.
   4. Seal all conduits, including spares, at building entrances and at outdoor terminations with a suitable compound to prevent the entrance of moisture and gases.

R. Provide Expansion/Deflection Fittings at expansion joints and on length of runs in accordance with manufacturer's recommendations. Expansion/Deflection fittings shall be sized as required, complete with bonding jumper.

S. Install pull boxes in convenient locations for all conduit runs longer than 100 feet and for conduit runs with more than three (3) right angle bends.

End of Section 26 05 33

Section 26 05 35 – Outlet Boxes and Cabinets

Part 1.00 - General

A. All outlet boxes shall be standard galvanized, minimum of 1-1/2" deep, single or gangable as needed to install indicated devices. Outlet boxes shall be equipped with plaster ring or cover as necessary. Outlet boxes shall not be less than 1-1/2" deep unless shallower boxes are required by the structural conditions and installation is approved by architect.

B. Electrical contractor shall review all plans in order to make sure all outlet boxes are located as needed to avoid interferences with trim, plumbing, HVAC, etc. Once installed all fixtures, controls, etc. shall be symmetrically located. All outlet boxes located in concrete or damp or wet locations shall be of the cast metal type with threaded entries.
C. Each outlet box shall have sufficient volume necessary to comply with all requirements of the latest edition of the NEC.
D. Ceiling and wall bracket outlet boxes shall not be less than 4" octagonal except where small boxes are required for the listed fixture.
E. Sectional switch boxes shall NOT be used.

Part 2.00 – Materials

A. Concealed or flush mounted outlet boxes shall be zinc-coated or cadmium plated steel suitable for the conditions of the application.
B. Surface mounted outdoor boxes shall be cast type with threaded entries.
C. All floor receptacles shall be installed in a floor box assembly complying with Article 314.27(B) of the 2023 National Electric Code. See P/Ns for floor box assemblies listed in wiring device section below.

Part 3.00 – Installation

A. Concealed boxes shall be set flush with finish surface and shall be provided with proper extension/plaster ring as necessary. All installations in plaster shall utilize plaster rings.
B. Outlet boxes shall be rigidly supported from a structural member of the building, either directly or by using metal or wood braces per Article 314.23 of the 2023 NEC.
C. All outlet boxes for luminaries shall be supported per Article 314.23 of the 2023 National Electric Code. All boxes shall be designed for the purpose and shall be required to be listed to support a luminaire weighing a minimum of 50 pounds. Any luminaire weighing more than 50 pounds shall be supported independently of the outlet box unless the outlet box is listed and marked for the maximum weight to be supported.
D. Device plates shall be supplied as specified. Plates shall be installed with all four edges in continuous contact with finished surface. Plates shall be installed vertically with an alignment tolerance of 1/16". Sectional plates shall NOT be used.
E. Wall switch outlets shall be 45" above the finished floor to the center of the box, unless otherwise specified.
F. Telephone and convenient receptacle outlets shall be 18" above finished floor to the center of the box, unless otherwise specified.
G. All outlet boxes installed in a back to back fashion on opposite sides of the same wall shall be separated by a minimum of 12 inches of wall space for non-rated walls. For similar installations on fire or smoke rated walls, boxes shall be separated by a minimum of 24 inches per the International Building Code. Where this separation is not practical, install appropriately sized SPECSEAL FIRE STOP POWER SHIELD electrical box inserts in all outlet boxes.
H. Flush mounted outlet boxes shall have a maximum clearance of 1/8" between wall board facing and edge of box per Article 314.21 of the 2023 NEC.
I. Floor boxes shall be level and flush with floor.

End of Section 26 05 35

Section 26 05 73 – Power System Studies

Part 1.00 - General

A. No power system studies of any kind are included in the engineering scope of work for this project.
B. Since the specific details of installation are not known at the time of design, the electrical engineer is not responsible for an arc flash analysis or calculating the incident energy levels and required personal protective equipment ratings necessary for working on the equipment installed on this project.

End of Section 26 05 73

Section 26 09 23 – Lighting Control Devices

Part 1.00 - General

A. Section Includes
    1. Network lighting control system and components:
        a. Touch panel controls
        b. Lighting management panels
        c. Lighting management modules
        d. Low voltage wall stations
        e. Power interfaces
        f. Wired sensors
B. References
    1. Underwriters Laboratories (UL):
        a. UL 508 - Industrial Control Equipment American National Standards Institute (ANSI)
        b. UL 924 - Emergency Lighting and Power Equipment
    2. National Fire Protection Association (NFPA):
        a. NFPA 70 - National Electric Code
    3. IEC 61000-4-2 Electromagnetic Compatibility (EMC) – Part 4-2: Testing and Measurement Techniques-Electrostatic Discharge Immunity Test; 2008
C. Administrative Requirements
    1. Coordination
        a. Coordinate placement of daylight and occupancy sensors to achieve optimum performance. Proper sensor placement should be coordinated with others in order to avoid obstructions that would interfere with maintaining prescribed light levels
        b. Coordinate the work to provide luminaires and lamps that are compatible with the lighting controls to be installed
        c. Notify architect of any conflicts or deviations from the contract documents to obtain direction prior to proceeding with work
D. Submittals
    1. Submit under provisions of this Section
    2. Specification Conformance Document. Clearly define where the equipment submitted for review:
        a. Meets specification exactly as specified
        b. Meets specification as an alternate with clear definition of compliance
    3. Shop Drawings include:
        a. CAD renderings of the device with precise dimensions

b. System schematic/typical riser diagrams
4. Product Data Sheets

E. Project Closeout Documentation
1. Provide a factory published manual
2. Warranty
3. Technical support contact
4. Electronic manual on manufacturer's website for free download

F. Quality Assurance
1. Manufacturer: Minimum 10 years of experience designing and assembling architectural lighting controls
2. All devices are 100% factory function tested prior to delivery
3. Compliant with the requirements of NFPA 70
4. All power components UL listed for required loads

G. Project Conditions
1. Only install equipment after the following site conditions are maintained:
a. Ambient Temperature 14 to 105 degrees F (-10 to 40 degrees C)
b. Relative Humidity less than 90% non-condensing
2. Standard electrical enclosures are permanently installed
3. Equipment is protected from dust, debris and moisture

H. Warranty
1. Five (5) year 100% parts replacement

I. Maintenance & Sustainability
1. Provide new parts, upgrades, and/or replacements available for a minimum of 5 years available to the end user
2. Provide free telephone technical support

Part 2 - Products

A. Manufacturers

Acceptable: Acuity Brands Lighting, Inc. – System: Sensorswitch by Acuity Controls
1. Basis of controls design Manufacturer: Acuity Brands, One Lithonia Way, Conyers GA 30012 Troy Miller, Director of Product Market. One of the following may be acceptable with approval if compliant with this specification:

Sensorswitch
3. Substitutions:
a. All substitutions must be submitted in writing for approval at least 14 days prior to bid date.
b. Proposed substitute products must be documented with a line by line compliance review

B. General:
1. Provide system hardware that is designed, tested, manufactured, warranted by a single manufacturer
2. Operational Life: At least 10 years expected life while operating within the specified ambient temperature and humidity range
3. Power Failure Memory: automatically store system settings and recover from a power failure without requiring user input
4. Wireless devices:

a. Automatically sync for system operation without addressing
b. Send and receive messages for real-time operation and feedback
c. Use industry standard RF protocols
d. Be in compliance with FCC and IEE standards

C. Occupancy Detection Technology Requirements:
1. The occupancy sensor system shall sense the presence of human activity within the desired space and fully control the on/off function of the lights.
2. Sensors shall utilize passive infrared (PIR) technology, which detects occupant motion, to initially turn lights on from an off state; thus preventing false on conditions. Ultrasonic or Microwave based sensing technologies shall not be accepted.
3. For applications where a second method of sensing is necessary to adequately detect maintained occupancy (such as in rooms with obstructions), a sensor with an additional "dual" technology shall be used.
4. Dual technology sensors shall have one of its two technologies not require motion to detect occupancy. Acceptable dual technology includes PIR/Mircrophonics (also known as Passive Dual Technology or PDT) which both looks for occupant motion and listens for sounds indicating occupants. Sensors where both technologies detect mothing (PIR/ Ultrasonic) shall not be acceptable.
5. All sensing technologies shall be acoustically passive meaning they do not transmit sound waves of any frequency (for example in the Ultrasonic range), as these technologies have the potential for interference with other electronic devices within the space (such as electronic white board readers). Acceptable detection technologies include Passive Infrared (PIR), and/or Microphonics technology. Ultrasonic or Microwave based sensing technologies shall not be accepted.

D. Occupancy Sensor Operation Requirements:
1. Sensors shall offer a minimum on timer of at least 15 minutes, in order to prevent all cycling of lamps before they have burned for the lamp manufacturers minimum recommended time period. This timer shall be in addition to the regular occupancy time delay that keeps lights on after last detected occupancy. User shall be able to disable/ enable and change the value of this timer
2. Sensors shall utilize an occupancy time delay that keeps lights on after last detected occupancy. Factory default setting of the occupancy time delay shall be 10 minutes. Sensors with a longer factory default setting shall not be permitted as they greatly restrict energy savings potential.
3. Manual adjustment to the occupancy time delay so as to increase it shall be accommodated, but shall not be allowed unless a calculation showing the resulting energy savings loss is presented to the building owner and specifying engineer.
4. Automatic adjustments to the occupancy time delay shall only be permitted if the controlling algorithm maximizes both lamp life and energy savings. For example a shorter more energy saving time delay setting shall only be allowed if the resulting lamp life is also improved.
5. Installer, in accordance with manufacturer's recommendation, shall determine final sensor location. All sensors shall be factory calibrated for optimum performance for its installed PIR lens, and shall not require initial or subsequent field adjustment of detection sensitivity.

6. All sensor setting adjustments shall be digital and made using a push-button. Dip switches, analog dials, and/or the need for tools of any kind shall not be accepted.
7. The installing contractor shall be responsible for a complete and functional system in accordance with all applicable local and national codes.

E. Wall Switch Occupancy Sensors – Small Areas
1. Sensor shall provide wall-to-wall PIR detection such that small hand motions are detected out to 20 ft (6.10 m).
2. In areas with periodic or permanent obstruction to a sensor's field of view, sensors that utilize dual technology (PIR/Microphonics) detection shall be used.
3. For applications requiring independent control of two loads, a sensor with two dual relays and dual override switches shall be required. Each relay shall have independent programmable occupancy time delays.
4. Sensors shall be capable of switching both 120 VAC and 277 VAC and run off of 50/60 Hz power. A version capable of switching 347 VAC shall also be available. Load ratings shall be 800 W @ 120 VAC, 1200 W @ 277 VAC, 1500 W @ 347 VAC, and ¼ HP motor load.
5. Sensor shall recess into single gang switch box and fit a standard GFI opening.
6. Sensor shall meet NEC grounding requirements by providing a dedicated ground connection and intrinsically grounding through its mounting strap.
7. Line and load wire connections shall be interchangeable, such that installer cannot make an improper connection to a line/load in a manner that will cause malfunction or damage to the sensor.
8. Sensor shall not require a neutral connection regardless of number of poles and/or detection technology (only exception is versions with lighted push-buttons).
9. Sensor shall not allow any leakage of current to pass to the load when sensor is in the unoccupied (off) condition. Sensor shall not require a minimum load to be connected in order to function.
10. Sensor shall have optional features for photocell/daylight override, vandal resistant lens, low temperature/high humidity operation.
11. All sensor settings, including time delay and photocell settings shall be digital and accessible for adjustment via a push-button without requiring removal of cover plate or tools of any kind.
12. Wall Switch sensors shall have field programmable adjustments for selecting operational modes, occupancy time delays, minimum on time, and photocell set-point as applicable.
13. All models shall be capable of both Auto-On and Manual On operation.
14. All models shall be capable of a "Reduced Turn On" operation where the initial PIR turn on level is higher in order to eliminate PIR from reflective surfaces from being detected. PIR shall be returned to normal levels upon initial PIR detection.
15. All models shall have a "Predictive Off" mode where user can manually turn the lights off when leaving the room and still have them come on automatically when they return to space.
16. All models shall be capable of disabling override switch.
17. Sensor shall be the following Sensor Switch model numbers. Device color and optional features as specified on individual datasheet.
    a. WSX (PIR)
    b. WSX 2P (PIR, Dual Relays, Auto On Pole 1/Manual On Pole 2)

c. WSX PDT (PIR/Microphonics)
d. WSX PDT 2P (PIR/Microphonics, Dual Relays, On Pole 1/Manual On Pole 2)

F. Wall Switch Occupancy Sensors – Large Areas
1. Sensor shall provide wall-to-wall PIR detection such that small hand motions are detected out to 40 ft (12.19 m).
2. In areas with periodic or permanent obstruction to a sensor's field of view, sensors that utilize dual technology (PIR/Microphonics) detection shall be used.
3. For applications requiring independent control of two loads, a sensor with two dual relays and dual override switches shall be required. Each relay shall have independent programmable occupancy time delays.
4. Sensors shall be capable of switching both 120 VAC and 277 VAC and run off of 50/60 Hz. A version capable of switching 347 VAC shall also be available. Load ratings shall be 13A each pole, ¼ HP motor load.
5. Sensor shall meet NEC grounding requirements by providing a dedicated ground connection and intrinsically grounding through its mounting strap.
6. Line and load wire connections shall be interchangeable, such that installer cannot make an improper connection to a line/load in a manner that will cause malfunction or damage to the sensor.
7. Sensor shall not require a neutral connection regardless of number of poles and/or detection technology.
8. Sensor shall not allow any leakage of current to pass to the load when sensor is in the unoccupied (Off) condition. Sensor shall not require a minimum load to be connected in order to function.
9. Sensor shall be the following Sensor Switch model numbers. Device color and optional features as specified.
    a. LWS(H) (PIR)
    b. LWS(H) 2P (PIR, Dual Relays)
    c. LWS(H) PDT (PIR/Microphonics)
    d. LWS(H) PDT 2P (PIR/Microphonics, Dual Relays)

G. Low Voltage Occupancy Sensors
1. The installing contractor shall install one or more sensors with PIR coverage areas that cover the entire space and all entrance points. Exact placement and quantity required shall be per manufacturer's best practice recommendations.
2. In areas with periodic or permanent obstruction to a sensor's field of view, sensors that utilize dual technology (PIR/Microphonics) detection shall be used.
3. Sensors shall utilize a digital PIR detector (dual element pyro-electric detector) component, so as to provide a high degree of RF immunity.
4. Sensors shall interconnect with other sensors and power/relay packs with class 2, three-conductor wire.
5. Sensors shall operate on 12 to 24 VAC or VDC and consume no more than 5 mA so that up to 14 sensors may be connected to a single power pack.
6. Upon initial power up, sensors must immediately turn on. Power packs may be wired on the line or load side of local switching and must not exhibit any delays when switch is energized.

7. Each designated zone shall contain one sensor with a SPDT class 2 auxiliary relay, providing an input to building automation system (BAS). All sensors in designated zone shall communicate to sensor with relay for status to BAS. Sensor relay coil shall energize in the unoccupied state to load share the low voltage current from power pack. Note that power pack must be installed on the Line side of the local toggle switch for auxiliary relay to work properly.
8. Sensors shall have test mode that temporarily shortens/disable all time delays (e.g., minimum on, occupancy, photocell transition, dimming rates) such that an installer can quickly test operation of sensor. Test mode shall time out and return sensor to normal operation should the installer forget to disable test mode after installation.
9. Sensors shall have optional features for on/off photocell control, automatic dimming control photocell, high/low occupancy based dimming, and usage in low temperature/high humidity environments.
10. Sensors shall be the following Sensor Switch model numbers.
    a. CM 9 (PIR, Ceiling Mount, Standard Range)
    b. CM PDT 9 (PIR/Microphonics, Ceiling Mount, Standard Range)
    c. CM 10 (PIR, Ceiling Mount, Extended Range)
    d. CM PDT 10 (PIR/Microphonics, Ceiling Mount, Extended Range)
    e. WV 16 (PIR, Corner Mount, Wide View)
    f. WV PDT 16 (PIR/Microphonics, Corner Mount, Wide View)
    g. HW13 (PIR, Wall Mount, Hallway View)
    h. HM 10 (PIR, Surface Mount Box, High Bay Aisle Way)
    i. CM 6 (PIR, Ceiling Mount, High Bay 360 deg)
11. Sensors with a recessed profile are acceptable substitutes for above ceiling mount sensors (e.g. CM 9 => RM 9)
12. Fixture mounted box sensors are acceptable substitutes for above ceiling mount sensors (e.g. CM 9 => CMB 9)

H. Power Packs
1. Power packs shall accept and switch 120 or 277 VAC, be plenum rated, and provide class 2 power for up to 14 remote sensors.
2. Power pack shall securely mount to junction location through a threaded ½ inch chase nipple. Plastic clips into junction box shall not be accepted. All class 1 wiring shall pass through chase nipple into adjacent junction box without any exposure of wire leads. Note: UL Listing under Energy Management or Industrial Control Equipment automatically meets this requirement, whereas Appliance Control Listing does not meet this safety requirement.
3. When required by local code, power pack must install inside standard electrical enclosure and provide UL recognized support to junction box. All class 1 wiring is to pass through chase nipple into adjacent junction box without any exposure of wire leads.
4. Power pack shall incorporate a Class 1 relay and an AC electronic switching device. The AC electronic switching device shall make and break the load, while the relay shall carry the current in the on condition. This system shall provide full 20 Amp switching of all load types, and be rated for 400,000 cycles.
5. Power packs shall be single circuit, or two circuits. Slave packs may be used to control additional circuits. When two circuit power packs, or slave packs are used, the power packs

must be wired directly to circuit breaker. Otherwise, power packs may be wired on the line or load side of the local switch.

6. Power packs shall be the following Sensor Switch model numbers.
    a. PP20 (Single Pole)
    b. PP20 2P (Two Pole)
    c. SP20 (Slave Pack)

I. Indoor Photocells and Daylight Harvesting Controls

1. Low voltage photocell shall accept 12 to 24 VAC or VDC and provide a SPDT relay for interface with remote switching system. Sensor shall interface with occupancy sensors, directly with power pack, or other system as shown.
2. Photocell shall provide for an on/off set-point, and a deadband to prevent the artificial light from cycling. Delay shall be incorporated into the photocell to prevent rapid response to passing clouds.
3. Photocell set-point and deadband shall be automatically calibrated through the sensor's microprocessor by initiating an "Automatic Set-point Programming" procedure. Further adjustment may be made manually if needed.
4. Deadband setting shall be verified and modified by the sensor automatically every time the lights cycle to accommodate physical changes in the space (i.e., furniture layouts, lamp depreciation, or lamp outages).
5. Low voltage dimming sensors shall accept 12 to 24 VAC or VDC (from power pack or other low voltage source) and control 0 to 10 VDC dimmable ballasts by sinking up to 20 mA of class 2 current (typically 40 or more ballasts).
6. Low voltage dimming sensor's set point shall be automatically calibrated through the sensor's microprocessor by initiating the "Automatic Set-point Programming" procedure. Min and max dim settings as well as set-point may be manually entered.
7. Low voltage dimming sensors shall be equipped with an automatic override for 100 hour burn-in of lamps. This feature must be available at any time for lamp replacements. (Note: This function should be performed prior to any dimming of the lamps including the "auto set-point" setting.)
8. Combination photocell/dimming sensors shall accept 12 to 24 VAC or VDC (from power pack or other low voltage source) and control the on/off function as well as the dimming function of 0 to 10 VDC dimmable ballasts.
9. Combination photocell/dimming sensor's set-point and deadband shall be automatically calibrated through the sensor's microprocessor by initiating the "Automatic Set-point Programming" procedure. Min and max dim settings as well as set point may be manually entered.
10. Combination photocell/dimming sensors shall be equipped with an automatic override for 100 hour burn-in of lamps. This feature must be available at any time for lamp replacements. (Note: This function should be performed prior to any dimming of the lamps including the "auto set-point" setting.)
11. Dual zone option shall be available for photocell, dimming, or combination units. The second zone shall be controlled as an "offset" from the primary zone and shall be the zone farthest from the natural light source.
12. Standalone ambient light sensors (CM ALC version only) shall interface directly with the 0 to 10 VDC, without any other power source connection, and control dimmable ballasts by

sinking up to 20 milliamps of class 2 current. Sensor shall incorporate a photodiode viewing out of a ceiling enclosure at a 30 degree angle from horizontal to detect diffused light from the ambient and artificial sources. Sensor shall allow for removal of response delays for adjustment, however provide dampening delay for normal operation. Settings shall be made manually.

13. Line voltage versions of the above described photocell and combination photocell/dimming sensors shall be capable of switching both 120 VAC and 277 VAC and run off of 50/60 Hz power. A version capable of switching 347 VAC shall also be available. Load ratings shall be 800 W @ 120 VAC, 1200 W @ 277 VAC, 1500 W @ 347 VAC, and ¼ HP motor load.
14. Line voltage versions of the above described dimming sensors shall be capable of powering off 120/277 VAC.
15. Line voltage versions of the above described photocell and combination photocell/dimming sensors shall be capable of switching 5 Amps of two phase power (208/240 or 480 VAC) shall be available. These sensors shall always simultaneously switch both phases as per NEC guidelines.
16. Sensors shall be the following Sensor Switch model numbers.
    a. CM PC (Photocell, On/Off, Low Voltage, Ceiling Mount)
    b. CM ADC (Dimming Photocell, Low Voltage, Ceiling Mount)
    c. CM PC ADC (Combination Photocell/Dimming Sensor, Low Voltage, Ceiling Mount)
    d. CM PC DZ, CM ADC DZ, or CM PC ADC DZ (Dual Zone, Low Voltage)
    e. CM ALC (Stand Alone Ambient Light Sensor for Daylight Harvesting)
    f. CMR PC (Photocell, On/Off, Line Voltage, Ceiling Mount)
    g. CMR ADC (Dimming Photocell, Line Voltage, Ceiling Mount)
    h. CMR PC ADC (Combination Photocell/Dimming Sensor, Line Voltage, Ceiling Mount)
    i. CMR PC DZ, CMR ADC DZ (Dual Zone, Line Voltage)
17. Sensors with a recessed profile are acceptable substitutes for above ceiling mount or fixture mount sensors (e.g. CMR PC => RMR PC)
18. Fixture mounted box sensors are acceptable substitutes for above ceiling mount sensors (e.g. CMR PC => CMRB PC)

Part 3 - Execution

A. Installation

1. Follow manufacturer's instructions for all installation steps
2. Provide a complete installation per Contract Documents
3. All occupancy sensors shall be mounted as indicated on plans, per these specifications, and per all manufacturer's recommendations.
4. Clean photocell lens as recommended by manufacturer.
5. All low voltage conductors shall be installed in conduit system dedicated for low voltage conductors. No 120 VAC conductors shall be installed in low voltage conduit system.
6. Photocell shall be mounted in a suitable location on the outside of the building. Location should allow proper detection of sunrise and sunset while minimizing the chance of interference from other lighting.
7. Contactors and timers shall be mounted in a suitable enclosure near the appropriate lighting panel or as indicated on appropriate schematic diagrams.

B. Startup and Programming
   1. Provide telephone support via toll free line
   2. Factory trained service available for purchase
C. Maintenance
   1. Factory trained service technicians available within the continental US
   2. Offer integrated help on-screen and via online videos

Factory telephone support via toll free line
End of Section 26 09 23

Section 26 09 43 – Lighting Control Panelboards

1.GENERAL

1. SUMMARY
   A. Section Includes:
      1. System Software Interfaces.
      2. System Backbone and Integration Equipment.
      3. Wired Networked Devices.
      4. Wireless Networked Devices.
2. DEFINITIONS
   A. Data Bus: A wired interface used to communicate with connected devices.
   B. Device: A collective term for bus or wireless connected devices, including fluorescent ballasts, LED drivers, incandescent luminaires, manual switches, switching relays, sensors, and similar.
   C. Global: Communication between devices in otherwise separate spaces using a bridging device or system controller.
   D. Group: A set of devices that communicate together.
   E. Monitoring: Acquisition, processing, communication, and display of equipment status data, metered electrical parameter values, power quality evaluation data, event and alarm signals, tabulated reports, and event logs.
   F. Scene: Digital light level associated with a preset.
   G. System Backbone: Devices used to connect and manage otherwise separate spaces, including bridging devices and gateways or system controllers. Used to expose devices to software configuration via TCP/IP.
3. PREINSTALLATION MEETINGS
   A. Preinstallation Conference: Conduct conference at location determined by owner.
   B. Preinstallation Coordination Meeting(s): For digital-network lighting controls. Conduct meeting(s) as videoconference or at Project site (as directed by owner) before construction activity begins.
      1. Attendees: Installers, fabricators, representatives of manufacturers, and administrants for field tests and inspections. Notify Architect, Construction Manager, and Owner's Commissioning Authority of scheduled meeting dates.
      2. Engage factory-authorized service representative to attend preinstallation conference and review the submittal drawing, sequence of operation, and device installation best practices with Project team.
      3. Engage factory-authorized service representative to perform cellular signal strength measurements during site walk through and compare to Project plans to

verify the placement of cellular antennas and quantity of lighting control system RF access points.

4. ACTION SUBMITTALS
   A. Product Data:
      1. Bill of Materials necessary to install the networked lighting control system.
      2. Product Specification Sheets indicating general device descriptions, dimensions, electrical specifications, wiring details, and nomenclature.
      3. Information Technology (IT) connection information pertaining to interconnection with facility IT networking equipment and third-party systems.
      4. Other Diagrams and Operational Descriptions - as needed to indicate system operation or interaction with other system(s).
   B. Shop Drawings:
      1. Riser Diagrams showing device wiring connections of system backbone and typical per room/area type.
5. INFORMATIONAL SUBMITTALS
   A. Contractor Startup/Commissioning Worksheet.
   B. Service Specification Sheets indicating general service descriptions, including startup, training, post-startup support, and service contract terms.
   C. Field quality-control reports.
   D. Sample Warranty: For manufacturer's special warranty.
6. CLOSEOUT SUBMITTALS
   A. Maintenance Contracts:
      1. Hardware and Software Operation Manuals
      2. Maintenance service agreement (if desired by owner).
      3. Software service agreement (if desired by owner).
   B. Warranty documentation.
7. QUALITY ASSURANCE
   A. Manufacturer Qualifications:
      1. Phone Support: Toll-free technical support available from manufacturer through an online tool to schedule a technical support appointment and provide 24/7 emergency support.
      2. Remote Support: Manufacturer capable of providing remote support and ability to virtually connect with customers to address issues with visual guidance overlaid on images of real-world objects.
      3. Cellular Connectivity: Manufacturer capable of cellular connectivity to a networked lighting control systems available to provide remote support within the continental United States.
      4. On-Site Support: Manufacturer capable of providing a 72-hour, on-site response time within the continental United States.
      5. Service Contracts (if desired by owner): Manufacturer capable of providing service contracts for continued on-site and remote support of the lighting control system post-installation for terms up to 10 years from substantial completion, including:
         a. Remote and on-site emergency response.
         b. Remote system performance checks.

c. Remote diagnostics.
d. Replacement parts.

8. WARRANTY

A. Warranty: Manufacturer and Installer warrant that installed lighting control devices perform in accordance with specified requirements and agree to repair or replace, including labor, materials, and equipment, devices that fail to perform as specified within extended warranty period.

1. Failures include, but are not limited to, the following:
   a. Faulty operation of lighting control hardware.
   b. Faulty operation of lighting control firmware.
2. Minimum Warranty Period: Five years from date of shipment.
3. Optional Extended Warranty Period: Five additional years from date of shipment.

2.PRODUCTS

1. SYSTEM COMPLIANCE

A. System components manufactured in accordance with UL 916 and UL 924 standards where applicable.

B. System components manufactured in accordance with CFR Title 47, Part 15 standards where applicable.

C. System components manufactured in accordance with ISED Canada RSS-247 standards where applicable.

D. System components manufactured in accordance with IFT-008-2015 and NOM-208-SCFI-2016 standards where applicable.

E. System listed as qualified under DesignLights Consortium Networked Lighting Control System Specification v5.0.

F. Performance Criteria:

1. Regulatory Requirements:
   a. Listed and labeled in accordance with NFPA 70, by qualified electrical testing laboratory recognized by authorities having jurisdiction, and marked for intended location and application.

2. SYSTEM PERFORMANCE REQUIREMENTS

A. System Architecture:

1. System architecture based upon the following concepts:
   a. Networkable intelligent lighting control devices.
   b. Standalone lighting control zones using distributed intelligence.
   c. Optional system backbone for remote, time-based, and global operation.
2. Intelligent lighting control devices with individually addressable network communication capability and having one or more basic lighting control components including: occupancy sensor, photosensor, relay, dimming output, contact closure input, analog 0-10 V(dc) input, and manual wall station capable of indicating switching, dimming, and/or scene control. Combining one or more of these components into a single device enclosure permissible to minimize overall system device count.
3. System capable of interfacing directly with networked luminaires such that either low-voltage network cabling or wireless RF communication is used to

interconnect networked luminaires with control components such as sensors, switches, and system backbone.

4. Networked luminaires and intelligent lighting control devices support individual (unique) configuration of device settings and properties, with such configuration residing within the networked luminaires and intelligent control devices.
5. Lighting control zones consisting of one or more networked luminaires and intelligent lighting control devices capable of providing automatic control from sensors (occupancy and/or photosensor) and manual control from local wall stations without requiring connection to a higher-level system backbone.
    a. Lighting control zones (wired and wireless) support at least 128 devices per zone.
    b. Capable of being networked with a higher-level system backbone to provide time-based control, control from inputs or systems external to control zone, and remote configuration and monitoring through a software interface.
6. Networked luminaires and intelligent lighting control devices with distributed intelligence programming stored in non-volatile memory, such that following any loss of power the lighting control zones operate according to their defined default settings and sequence of operations.
7. System to include one or more system controllers that provide time-based control.
8. System controller provides means of connecting the lighting control system to a system software interface and building management systems via BACnet/IP or BACnet MS/TP protocol.
9. System controller supports both low-voltage wired and wireless RF communication within a single controller device.
10. System devices support firmware update, either remotely or from within the application space, for purposes of upgrading functionality at a later date.
11. System capable of reporting lighting system events and performance data to management software for display and analysis.

B. Wired Networked Control Zone Characteristics:

1. Connections to devices within a wired networked lighting control zone and to backbone components accomplished with a single type of low-voltage network cable, compliant with CAT5e specifications or higher. Use of mixed types of low-voltage network cables is unacceptable.
2. Devices connected in "daisy-chain" topology. "Hub-and-spoke" topology, requiring all individual networked devices to be connected to a central component, is unacceptable, to reduce the total amount of network cable required for each control zone.
3. Pre-terminated, plenum-rated, low-voltage network cabling supplied with hardware.
4. Following proper installation and provision of power, all networked devices connected with low-voltage network cable must automatically form a functional lighting control zone without requiring any type of programming, regardless of the programming mechanism (e.g. software application, handheld remote, pushbutton).

a. The "out of box" default sequence of operation is intended to provide typical sequence of operation to minimize the system startup and programming requirements and to also have functional lighting control operation prior to system startup and programming.

5. System software capable of automatic discovery of all connected devices without requiring any provisioning of system or zone addresses.
6. Networked devices capable of detecting improper communication wiring and LED notification to alert installation/startup personnel.
7. Networked control devices suitable for control of egress or emergency light sources without additional, externally mounted UL 924 shunting or 0-10 V(dc) disconnect devices, to provide a compliant sequence of operation while reducing the overall installation and wiring costs of the system. Capable of supporting the following sequence of operation:
    a. Low-Voltage Power Sensing: Devices automatically provide 100 percent light level upon detection of loss of power sensed via low-voltage network cable connection where applicable.
    b. Line-Voltage Power Sensing: Devices listed as UL 924 emergency relays which automatically close load-control relay and provide 100 percent light output upon detection of loss of power sensed via line voltage connection to normal power.
8. Global Control Zones: Networked luminaires and intelligent lighting control devices located in different areas able to transmit and track information within at least 128 system-wide control zones to support required sequences of operation that may span multiple areas. Occupancy, photosensor inhibit, and switch commands available across multiple controllers.
9. Wired Networked Wall Station Scene-Control Capabilities:
    a. Preset Scenes that activate a specific combination of light levels across multiple local and global channels.
    b. Local Profile Support: Profile Scenes that modify the sequence of operation for devices in the area (group) in response to a button press to dynamically optimize occupant experience and lighting energy usage.
        1) Wall stations able to manually start and stop local profiles, or local profile capable of ending after a specific duration of time between five minutes and 12 hours.
        2) Configurable Parameters:
            a) Fixture light level.
            b) Occupancy time delay.
            c) Response to occupancy sensors (including enabling/disabling response).
            d) Response to daylight sensors (including enabling/disabling response).
            e) Enabling/disabling wall stations.
    c. Three-Way or Multi-Way Control: Multiple wall stations capable of controlling the same local and global control zones, to support "multi-way" preset scene and profile scene control.

C. Wireless Networked Control Zone Characteristics:
   1. No wired connections between networked devices required for the purposes of system communications.
   2. Multiple wireless networking protocols supported:
      a. Standards-based, distributed star topology type of protocol for 900 MHz communication, to support lighting control applications and IoT applications.
      b. Bluetooth standard protocol for 2.4 GHz communication that supports direct connection to smartphone or tablet, to support device configuration, control applications, and IoT without requiring the use of a system backbone.
   3. Wireless network must be self-healing, such that the loss of backbone or local communication between devices does not result in the loss of local control of lights in the space.
   4. Wireless network communication must support uniform and instant response such that all luminaires in a lighting control zone respond immediately and synchronously in response to a sensor or wall station signal.
   5. Communication of control signals from sensors and wall stations to networked luminaires and wireless load-control devices occur directly, without any communication, interpretation, or translation of information through a backbone device such as a wireless access point, communication bridge, or gateway.
   6. All wireless communication between lighting control components supports the following five tiers of security measures.
      a. Data encryption.
      b. Firmware protection.
      c. Tamper-proof hardware.
      d. Authenticated user access.
      e. Mutual device authentication.
   7. Wireless devices use AES encryption to secure communication with a unique encryption key generated for each programmed site.
   8. Wireless devices use signed firmware to ensure that unmodified, authentic software is always installed.
   9. Wireless networked devices capable of communicating a minimum distance of 150 ft. between devices under typical site conditions accounting for typical environmental conditions and building construction materials encountered within commercial indoor lighting environments.
   10. Minimum Line-of-Sight Communication Range: 1000 ft. under ideal environmental conditions.
   11. Wireless devices self-identify when communication to system controller cannot be accomplished or when communication to the system controller is lost.
      a. Self-identification not required for wireless switches or battery-powered devices.
   12. Wireless devices self-establish connection to system controller through other devices if direct communication cannot be accomplished or when communication to system controller is lost.

a. Communication path formation to utilize existing, wireless networked devices located between system controller and respective end devices.
b. No additional hardware for formation of networked communication path between a system controller and end devices required.
c. Automatic connection not required for wireless switches or battery-powered devices.

13. Networked control devices suitable for control of egress or emergency light sources without additional, externally mounted UL 924 shunting or 0-10 V(dc) disconnect devices, to provide a compliant sequence of operation while reducing the overall installation and wiring costs of the system. Capable of supporting the following sequence of operation:
    a. Line-Voltage Power Sensing: Devices listed as UL 924 emergency relays that automatically close load-control relay and provide 100 percent light output upon detection of loss of power sensed via line voltage connection to normal power.
    b. Normal-Power-Broadcast Sensing: Devices listed as UL 924 emergency relays that automatically close load-control relay and provide 100 percent light output upon loss of a wireless normal-power broadcast from devices connected to normal power.

D. System Integration Capabilities:
    1. Capable of interface with third-party building management systems (BMS) to support two-way communication using BACnet/IP protocol, BACnet MS/TP protocol, and RESTful API including the following system integration capabilities:
        a. "Write" messages for control of individual devices, including control of relay and dimming output.
        b. "Write" messages for control of groups of devices through a single command, including control of relay and dimming output of all devices.
        c. "Read" messages for individual device status information.
            1) Available status will vary based on device type and capabilities, which may include relay state, dimming output, power measurement, occupancy sensor status, and photosensor light measurement.
        d. "Read" messages for group status information for occupancy, relay state, and dimming output.
        e. Activation of pre-defined system Global Profiles.
    2. Activation of Global Profiles from third-party systems via dry contact closure output signals or digital commands via RS-232 or RS-485.
    3. Activation of demand response levels from Demand Response Automation Servers (DRAS) via OpenADR 2.0a protocol.

E. Supported Sequence of Operations:
    1. Control Zones:
        a. Local Control Zones: Networked luminaires and intelligent lighting control devices installed in an area (also referred to as a group of devices) capable of transmitting and tracking occupancy sensor, photosensor, and manual switch information within at least 48 unique control zones to support

different and reconfigurable sequences of operation within area. These will also be referred to as local control zones.

b. Adjacent Control Zones: Networked luminaires and intelligent lighting control devices capable of tracking occupancy broadcasts from adjacent zones. When this feature is enabled, luminaire output for a vacant zone will reduce to a configurable dimmed state if one or more adjacent zones are occupied. Luminaires will turn off when both primary and adjacent zones are vacant.

c. Global Control Zones: Networked luminaires and intelligent lighting control devices located in different areas able to transmit and track information within at least 128 system-wide control zones to support required sequences of operation that may span across multiple areas. Occupancy, photosensor inhibit, and switch commands available across multiple controllers.

2. Wall Station Capabilities:
   a. Wall stations support the following capabilities:
      1) On/Off of a local or global control zone.
      2) Continuous dimming control of light level of a local or global control zone.
   b. Multi-Way Control: Multiple wall stations capable of controlling the same local or global control zones, to support "multi-way" switching and dimming control.
3. Occupancy Sensing Capabilities:
   a. Occupancy sensors configurable to control a local or global zone.
   b. Multiple occupancy sensors capable of controlling the same local or global zones. This capability combines occupancy sensing coverage from multiple sensors without consuming multiple control zones.
   c. Occupancy sensing sequence of operation modes:
      1) On/Off Occupancy Sensing.
      2) Partial-On Occupancy Sensing.
      3) Partial-Off Occupancy Sensing.
      4) Vacancy Sensing (Manual-On / Automatic-Off).
   d. On/Off, Partial-On, and Partial-Off Occupancy Sensing Modes Sequence of Operation:
      1) Occupancy automatically turn lights on to a designated level when occupancy is detected. Designated occupied light level support at least 100 dimming levels.
      2) Occupancy sensors automatically turn lights off or to a dimmed state (Partial-Off) when vacancy occurs or if sufficient daylight is detected. Designated unoccupied dim level support at least 100 dimming levels.
      3) System capable of combining Partial-Off and Full-Off operation by dimming lights to a designated level when vacant and turning the lights off completely after an additional time delay.

4) Photosensor readings, if enabled in occupancy sensing control zone, automatically adjust light levels during occupied or unoccupied conditions as necessary.
5) Wall station activation changes the dimming level or turn lights off as selected by the occupant. Lights optionally remain in this manually specified light level until the zone becomes vacant. Upon vacancy, normal sequence of operation resumes.

e. Vacancy Sensing or Manual-On/Automatic-Off Mode Sequence of Operation:
1) Activation of a wall station is required turn lights on. System capable of programming the zone to turn on to either a designated light level or previous user-set light level. Initially occupying the space without using a wall station must not result in lights turning on.
2) Occupancy sensors automatically turn lights off or to a dimmed state (Partial-Off) when vacancy occurs or if sufficient daylight is detected. Designated unoccupied dim level support at least 100 dimming levels.
3) System capable of dimming the lights when vacant and then turning the lights off completely after an additional time delay.
4) System capable of an "automatic grace period" immediately following detection of vacancy, during which time any detected occupancy results in the lights reverting to the previous level. After the grace period has expired, the use of a wall station is required to turn lights on.
5) Photosensor readings, if enabled in the Occupancy Sensing control zone, capable of automatically adjusting the light level during occupied or unoccupied conditions as necessary.
6) Wall station interaction changes the dimming level or turn lights off as selected by occupant. Lights remain at manually specified light level until zone becomes vacant; normal sequence of operation resumes upon vacancy.

f. Occupancy time delays before dimming or shutting off lights separately programmable for all control zones from 15 seconds to 2 hours.

4. Photosensor Sensing Capabilities (Automatic Daylight Sensing):
a. Photosensor devices configurable to control a local zone.
b. Photosensor-Based Control:
1) Continuous Dimming: Control zone automatically adjusts dimming output in response to photosenor readings, to maintain a minimum light level consisting of both electric light and daylight sources. Photosensor response configurable to adjust set point and dimming rates.

5. Schedule Capabilities:
a. System capable of time schedules for time-of-day to override devices including offsets from dusk and dawn.
b. System capable of providing a visible "blink warning" five minutes prior to the end of the schedule.

c. Wall stations may be programmed to provide timed extensions/overrides that turn the lights on for an additional time period.
    1) Timed override/extension duration programmable for each individual device, zone of devices, or customized group of devices, from five minutes to 12 hours.

6. Global Profile Capabilities:
    a. System capable of automatically modifying the sequence of operation for selected devices in response to any of the following:
        1) Time-of-day schedule.
        2) Contact closure input state.
        3) Manually triggered wired wall station input.
        4) RS-232/RS-485 command to wired input device.
        5) BACnet input command.
    b. Global Profile Capabilities:
        1) Global Profiles stored within and executed from the system controller (via internal timeclock). Dedicated software host or server is not required to be online to support automatic scheduling and/or operation of Global Profiles.
        2) Global Profile time-of-day schedules capable of recurrence settings including daily, specific days of week, every "n" number of days, weekly, monthly, and yearly. Lighting control global profile schedules support definition of start date, end date, end after "n" recurrences, or never ending.
        3) Daylight savings time adjustments capable of being performed automatically, if desired.
        4) Global Profile holiday schedules follow recurrent settings for specific U.S. holiday dates regardless if they always occur on a specific date or are determined by day/week of the month.
        5) Global Profiles capable of being scheduled to run according to timed offsets relative to sunrise or sunset. Sunrise/sunset times automatically derived from location information using an astronomical clock.
        6) Software management interface capable of displaying a graphic calendar view of profile schedules for each control zone.
        7) Global Profiles capable of manual activation directly from system controller, specially programmed wired input devices, scene-capable wired wall stations, and software management interface.
        8) Global Profiles selectable to apply to a single device, zone of devices, or customized group of devices.
        9) Global Profile Configurable Parameters:
            a) Fixture light level.
            b) Occupancy time delay.
            c) Response to occupancy sensors (including enabling/disabling response).

d) Response to daylight sensors (including enabling/disabling response).
e) Enabling/disabling of wall stations.

c. Local and Global Profiles backed up and stored on software's host server such that Profile backup can be applied to a replacement system controller or wired wall station.

7. System supports automated demand response capabilities with automatic reduction of light level to at least three levels of demand response, configurable for each output device.

3. SYSTEMS SOFTWARE INTERFACES

A. Management Interface:

1. Web-based management interface for remote system control, live status monitoring, and configuration of lighting control settings and schedules.
2. Compatible with industry-standard web browser clients.
3. Minimum of 100 unique password-protected user accounts.
4. Minimum of three user permission levels: read-only, read and change settings, and full administrative system access.
5. Capable of restricting access for user accounts to specific devices within the system.
6. All system devices capable of being given user-defined names.
7. Device identification information displayed in the Management interface including:
   a. Model number.
   b. Model description.
   c. Serial number or network ID.
   d. Manufacturing date code.
   e. Custom label.
   f. Parent network device.
8. Management interface capable of displaying live status of a networked luminaire or intelligent control device including:
   a. Luminaire on/off status.
   b. Dim level.
   c. Power consumption.
   d. Device temperature.
   e. PIR occupancy sensor status.
   f. Microphonic occupancy sensor status.
   g. Remaining occupancy time delay.
   h. Photosensor reading.
   i. Active Profiles.
9. Management interface capable of displaying and modifying the current active settings of a networked luminaire or intelligent control device including:
   a. Dimming trim levels.
   b. Occupancy sensor and photosensor enable/disable.
   c. Occupancy sensor time delay and light level settings.
   d. Occupancy sensor response (normal or vacancy).

e. Photosensor setpoints and transition time delays.

10. Management interface capable of applying settings changes for a zone of devices or a group of selected devices using a single action that does not require the user to apply settings changes for each individual device.
11. Management interface capable of compiling a printable network inventory report.
12. Management interface capable of compiling a printable report detailing all system profiles.
13. All sensitive information stored encrypted.
14. System software updates available for automatic download and installation via the Internet.

B. System Energy Analysis and Reporting:
1. Intuitive graphical screens to facilitate simple viewing of system energy performance.
2. Energy Scorecard: Summarized display that indicates calculated energy savings in dollars or KWh.
3. Software calculates allocation of energy savings by control measures including occupancy sensors, photosensors, and manual switching.
4. Energy savings data calculated for the system as a whole.
5. Time-scaled graph showing all relay transitions.
6. Time-scaled graph showing zone occupancy time delays.
7. Time-scaled graph showing the total light level.
8. Software capable of storing information remotely onto an open-source, object-relational database, such as PostgreSQL.
9. Data stored in the database will be accessed utilizing an open standard, application programming interface, such as Open Database Connectivity (ODBC).

C. Visualization and Programming Interfaces:
1. System provides an optional web-based visualization interface that displays a graphical floorplan.
2. Graphical floorplan will offer the following types of system visualization:
a. Full Device Option: Master graphic of entire building, by floor, showing each control device installed with zones outlined including:
1) Controls embedded light fixtures.
2) Controls devices not embedded in light fixtures.
3) Daylight sensors.
4) Occupancy sensors.
5) Wall switches and dimmers.
6) Scene controllers.
7) Networked relays.
8) Wired bridges.
9) System Controllers.
10) Wired relay panels.
11) Group outlines.
b. Group-Only Option: Master graphic of the entire building, by floor, showing only control groups outlined.

c. Pan and zoom commands supported to allow smaller areas to be displayed on a larger scale simply by panning and zooming each floor's master graphic.
d. Selecting any control device displays the following as applicable:
1) Device catalog number.
2) Device name and custom label.
3) Device diagnostic information.
4) Link to further information on device including status or current configuration.

3. Programming capabilities through the application will include the following:
a. Switch, occupancy sensor, and photosensor zone configuration.
b. Manual-on or automatic-on modes.
c. Turn-on and dim to dimming levels.
d. Occupancy sensor time delays and PIR sensitivity.
e. Dual technology occupancy sensors sensitivity.
f. Photosensor calibration adjustment and auto-setpoint.
g. Multiple photosensor zone offset.
h. Trim level settings.
i. Preset scene creation and copy for scene-capable devices.
j. Application of custom device labels to the Bluetooth Low-Energy Programming Devices and individual connected lighting control devices.
k. Fade rate settings.

D. Smartphone Programming Interface for Wired and Wireless Devices:
1. Interface provided for both Apple iOS and Android operating systems that allows configuration of lighting control settings.
2. Application supports configuration of wireless networked control devices.
a. Application access granted with valid user name and password.
b. Access to program information governed by permission system that allows users to share access with other users and restrict access to those who should not be able to reconfigure the equipment.
c. Indication of signal strength where multiple Bluetooth Low-Energy Programming Devices are available for configuration.
3. Application supports configuration or wired networked control devices.
a. Connected device access granted through user-defined passcode at initial install.
b. Indication of signal strength where multiple Bluetooth Low-Energy Programming Devices are available for configuration.
4. Programming Capabilities:
a. Switch, occupancy sensor, and photosensor group configuration.
b. Manual-on or automatic-on modes.
c. Turn-on and dim to dimming levels.
d. Occupancy sensor time delays and PIR sensitivity.
e. Dual technology occupancy sensors sensitivity.
f. Photosensor calibration adjustment and auto-setpoint.
g. Multiple photosensor zone offset.

h. Trim level settings.
i. Preset scene creation.
j. Application of custom device labels for individual connected lighting control devices.
k. Fade rate settings.

4. SYSTEM BACKBONE AND SYSTEM INTEGRATION EQUIPMENT

A. System Controller: Multi-tasking, real-time digital control processor consisting of modular hardware with plug-in enclosed processors, communication controllers, and power supplies.

1. Basis-of-Design Product: Subject to compliance with requirements, provide nLight; Acuity Brands Lighting, Inc.; nECY or comparable product by one of the following:
   a. Cooper Industries, Inc.
   b. Leviton Manufacturing Co., Inc.
2. System Controller Processor: 32-bit microprocessor operating at a minimum of 1 GHz.
3. System Controller Memory: Minimum of 512MB memory, with a minimum of 4GB non-volatile flash, to support operating system and databases.
4. System Controller Functions:
   a. Time-based control of downstream wired and wireless network devices.
   b. Linking into an Ethernet network.
   c. Integration with Building Management Systems (BMS) and Heating, Ventilation and Air Conditioning (HVAC) equipment.
   d. Connection to various software interfaces, including management interface, historical database and analytics interface, and visualization interface.
5. Integral web server to support system controller configuration and diagnostics with control and visualization of connected devices.
   a. Web Server Control Interface:
      1) Display associated devices within the context of a graphical floorplan.
      2) Provide control of output-capable devices through virtual sliders, toggle buttons, preset level widgets, and transparent layers on floorplan.
      3) Control Capabilities:
         a) Control of individual output devices, including control of relay state and analog dimming level where applicable.
         b) Control of local lighting control zones, including control of relay state and analog dimming level where applicable.
         c) Control of global lighting control zones, including control of relay state and analog dimming level where applicable.
         d) Control of Global Profiles.
   b. Visualization Interface:
      1) Customizable display with the ability to superimpose colored, transparent layers representing real-time property values, including occupancy status, dimming level status, light level status, and online or offline status where applicable.

2) Ad hoc display of trended information via an intuitive values-over-time graph.
3) Report Creation:
    a) Reports accept and graphically display trended status datasets for creator selected devices or zones of devices.
    b) Report information displayed over a user-defined interval and date range.
    c) Reports exportable to a standard CSV format.

6. Graphical touch screen to support configuration and diagnostics.
7. Minimum of three RJ-45 networked lighting control ports for connection to any of the following:
    a. Graphical touch screen.
    b. Wired communication bridges.
    c. Direct connection to networked wired luminaires and intelligent lighting control devices (up to 128 total devices per port).
8. Device will automatically detect all network-connected devices.
9. Capable of managing and operating a minimum of 750 networked devices (wired or wireless) per system controller.
10. Multiple System Controllers capable of connection via LAN for scalability to a minimum of 20,000 networked devices.
11. Supports BACnet/IP and BACnet MS/TP protocols to directly interface with BMS and HVAC equipment without additional protocol translation gateways.
    a. BACnet MS/TP Connection Speed: 9600 to 115200 baud rate.
    b. BACnet Testing Laboratory (BTL listed) using Device Profile BACnet Building Controller (B-BC) with outlined enhanced features.
12. Integral FIPS 140-2, Level 1 cryptographic module.
13. Supports RESTful API for control of BACnet objects, user management, date and time, and file management.
14. NEMA 1 enclosure with Class 1 and Class 2 separation.
    a. Power Supply Voltage: 120 to 277 V(ac).
15. Automatic algorithm to eliminate redundant, wireless networked paths to streamline communication between the system controller and end devices.
16. System Controller Security Provisions:
    a. Disallow the use of default passwords and require passwords to be updated prior to use.
    b. Support user role-based access, such as administrator, user, and viewer.
    c. Signed firmware to ensure that unmodified, authentic software is always installed.
    d. IP-based communication protected with strong encryption algorithms such as AES or TLS1.2+.
    e. Prevent rollback of firmware to firmware versions with known, critical vulnerabilities.
    f. Valid cybersecurity listing through a third party.
17. Cellular Remote Access: Cellular router and modem for remote access.

a. Router supports remote access to at least five system controllers on its local area network or network subnet.
b. Remote access capable of device setting updates, schedule updates, system performance optimization, and diagnostics.
c. Remote access enabled through outbound communication from router to an outside source. Solutions that begin communication via inbound requests for network access are unacceptable.
d. Router supports outbound communication to manufacturer-hosted portal using TLS1.2 or greater in-transit encryption over a cellular or Ethernet connection.
e. Router with integral firewall to prevent unauthorized access to devices connected to its local area network port.
f. Router includes cellular SIM capable of connection to AT&T, T-Mobile, Sprint, US Cellular, Alaska Wireless, Telefonica, Tellus, Bell, or Sasktel networks where carrier service is available.
g. Outbound communication from the router limited to whitelisted endpoints. Devices that allow unrestricted communication are unacceptable.
h. Outbound communication from router includes only lighting control system information.

5. WIRED NETWORKED DEVICES

A. Wired Networked Wall Switches, Dimmers, Scene Controllers:

1. Basis-of-Design Product: Subject to compliance with requirements, provide nLight; Acuity Brands Lighting, Inc.; nPODM or nPODMA or comparable product by one of the following:
   a. Cooper Industries, Inc.
   b. Leviton Manufacturing Co., Inc.
2. Mounting: Suitable for installation in single-gang switch box.
3. Communication and low-voltage power delivered via standard low-voltage network cabling with RJ-45 connectors.
4. All switches detect valid communication and blink a unique LED pattern to visually indicate a potential wiring issue.
5. Devices with mechanical push buttons provide tactile and LED user feedback.
6. Devices with mechanical push buttons manufactured with custom button labeling.
7. Wall switch and dimmer options:
   a. Number of control zones: as needed for switch location.
   b. Control Types Supported:
      1) On/Off.
      2) On/Off/Dimming.
      3) On/Off/Dimming/Correlated Color Temperature Control for specific luminaire types.
   c. Color: as indicated by owner
8. Scene Controller Options:
   a. Number of Scenes: as needed for switch location.
   b. Control Types Supported:
      1) On/Off.

2) On/Off/Dimming.
3) Preset Level Scene Type.
4) On/Off/Dimming/Preset Level for Correlated Color Temperature.
5) Reprogramming of other devices within daisy-chained zone to implement user-selected lighting scene including manual start/stop from the scene controller, or optionally programmed automatic stop after a user-selectable duration between five minutes and 12 hours.
6) Selecting a lighting profile to be run by device's upstream controller to implement a selected lighting profile across multiple zones including manual start/stop from the scene controller, or optionally programmed automatic stop after a user selectable duration between five minutes and 12 hours.

c. Color: as indicated by owner

B. Networked Graphic Wall Stations:
1. Basis-of-Design Product: Subject to compliance with requirements, provide nLight; Acuity Brands Lighting, Inc.; nPOD TOUCH or comparable product by one of the following:
a. Cooper Industries, Inc.
b. Leviton Manufacturing Co., Inc.
2. Mounting: Suitable for installation in single-gang switch box.
3. Integral 3.5-inch capacitive full-color touch screen.
4. Power via polarity insensitive Class 2 low-voltage 15 to 24V (dc) power supply.
5. Device enables mobile application control of control zones and scenes through Bluetooth.
6. Communication over standard low-voltage network cabling with RJ-45 connectors.
7. User-customizable screen saver utilizing uploaded image file in common file format including jpg, png, gif, bmp, or tif.
8. Capable of configuration of all switches, dimmers, control zones, and lighting preset scenes via password-protected setup screens.
9. Graphic Wall Station Options:
a. Number of Control Zones: Up to 16.
b. Number of Scenes: Up to 16.
c. Profile Scene Duration: User configurable from five minutes to 12 hours.
d. Color: as indicated by owner

C. Digital Time Clock:
1. Basis-of-Design Product: Subject to compliance with requirements, provide nLight; Acuity Brands Lighting, Inc.; nDTC or comparable product by one of the following:
a. Cooper Industries, Inc.
b. Leviton Manufacturing Co., Inc.
2. Controls a linear bus of lighting devices suppling all time functions without connection to a system controller.

a. Programming of the linear bus of lighting devices must not require additional hardware, including computers, specialized dongles, or other connection devices.
b. Programming of the linear bus exclusively done through the touch-screen interface.

3. Capable of up to 32 schedules. Each schedule consists of one set of On and Off times per day for each day of the week and for each of two holiday lists. Schedules assignable to any individual relay or group of relays.
4. Operates from non-volatile memory so that all system programming is retained indefinitely.
5. Mounted inside a relay panel to eliminate the necessity for additional enclosures for complete installation.
6. Capacitive 3.5-inch, full-color touch screen.

D. Wired Networked DMX Interface Stations:

1. Basis-of-Design Product: Subject to compliance with requirements, provide nLight; Acuity Brands Lighting, Inc.; nPWDMX or comparable product by one of the following:
   a. ETC.
   b. Lutron.
   c. <Insert manufacturer's name>.
2. Description: Multi-protocol, bidirectional DMX512 playback (snapshot) and lighting control gateway.
   a. Capable of control of networked luminaire or all normal power lighting load types.
   b. Capable of control of DMX lighting through:
      1) DMX input for snapshot capture of lighting presets.
      2) Live control of intensity, hue, and saturation of configured DMX Zones from connected stations.
   c. Integral LED indicators for power, network traffic, processor health, identify, DMX port configuration and status.
   d. Support recall of up to 16 (total):
      1) Prerecorded scenes/snapshots for playback.
      2) DMX zones.
   e. Capable of preset playback as activated by any connected control station.
   f. Capable of DMX pass-through for real-time output of incoming DMX levels.
   g. Support four universes of ANSI E1.31 sACN-Streaming ACN (sACN), including priorities, for snapshot capture and recall.
   h. Support ANSI E1.20 RDM with PC-based software.
   i. Act as an ANSI E1.33 RDMnet controller.
3. General Requirements:
   a. Operating Voltages:
      1) PoE Class 2 Device.
      2) 24 V(dc) (not used if using PoE), 7 W maximum power consumption.
   b. Operating Temperature: Minus 32 to plus 113 deg F.

c. DIN-Rail Mounted on DIN 43880 (35/7.5) rail.
d. NEMA Type 1 enclosure.
1) Enclosure Size: 10 inches wide by 13 inches high by 4.5 inches deep.

4. Features:
a. Lighting control ports supports:
1) Communication through lighting control (RJ-45) ports that supply 40 mA of power to each device via standard Category 5e low-voltage network cabling.
2) Detection of valid communication and blinking of a unique LED pattern to visually indicate a potential wiring issue.
b. DMX Ports:
1) Comply with the requirements of ANSI E1.11 USITT DMX512-A standards.
2) Configurable as Input or Outputs.
3) Support ANSI E1.31 sACN.
4) Support Pathway Secure Streaming ACN (ssACN).
5) Comply with California Title 1.81.26.
6) Comply with ANSI E1.20 RDM.
7) Capable of withstanding fault voltages of up to 250 V(ac) without damage.
c. Dry contact closure input to connect with external control systems to control a lighting control zone or scene.
d. Ethernet Ports:
1) Support IEEE 802.3af Power-over-Ethernet in absence of 24 V(dc).
2) Support auto-negotiated 10/100MB connections speeds.
3) Support IEEE 802.1AB Link Layer Discovery Protocol.
e. Test Functions:
1) Operate without need of a configuration PC to check local wiring.
2) Test connectivity with DMX lights and networked luminaire or all normal power lighting load types.
f. Complies with the following:
1) RoHS 2011/65/EU + A1 2015/863.
2) FCC.

E. Wired Networked Occupancy and Photosensors:
1. Basis-of-Design Product: Subject to compliance with requirements, provide nLight; Acuity Brands Lighting, Inc.; nCM, nCMB, nRM, nWV, nHW, or comparable product by one of the following:
a. Cooper Industries, Inc.
b. Leviton Manufacturing Co., Inc.
2. Detect the presence of human activity within space and fully control the on/off function of lights.
3. Utilize passive infrared (PIR) technology, which detects occupant motion, to initially turn lights on from an off state, thus preventing false on conditions. Ultrasonic and Microwave-based sensing technologies are unacceptable.

4. Dual technology sensors used in locations where a second method of sensing is necessary to adequately detect maintained occupancy (such as in rooms with obstructions).
5. Dual technology sensors must have one sensing technology not motion dependent to detect occupancy. Acceptable dual technology includes PIR/Microphonics (also known as Passive Dual Technology or PDT), which detects both occupant motion and sounds indicating occupants. Sensors where both technologies detect motion (PIR/Ultrasonic) are unacceptable.
6. All sensing technologies are acoustically passive, meaning they do not transmit sounds waves of any frequency (for example in the Ultrasonic range), as these technologies have the potential for interference with other electronic devices within the space (such as electronic white board readers and hearing devices). Acceptable detection technologies include Passive Infrared (PIR), and/or Microphonic technology. Ultrasonic and Microwave-based sensing technologies are unacceptable.
7. Ceiling, fixture, recessed, and corner mounted sensors available, with multiple lens options available customized for specific applications.
8. Communication and low-voltage power delivered to each device via standard low-voltage network cabling with RJ-45 connectors.
9. All sensors detect valid communication and blink a unique LED pattern to visually indicate a potential wiring issue.
10. Sensor programming parameter available and configurable remotely from the software and locally via the device push button.
11. Ceiling mount occupancy sensors include one integrated dry contact switching relay, capable of switching 1 A at 24 V, resistive only.
12. Sensors available with one or two occupancy "poles," each of which provides a programmable time delay.
13. Photosensor/daylight override, automatic dimming control, and low temperature/ high humidity operation.
14. Photosensor provide one on/off set-point and include a dead band to prevent the artificial light from cycling. Delay incorporated into the photosensor to prevent rapid response to passing clouds.
15. Photosensor and dimming sensor's set-point and dead band automatically calibrated through the sensor's microprocessor by initiating an "Automatic Set-Point Programming" procedure. Min and max dim settings as well as set-point may be manually entered or modified.
16. Dead band setting verified and modified by the sensor automatically every time the lights cycle to accommodate physical changes in the space (i.e., furniture layouts, lamp depreciation, or lamp outages).
17. Dual zone option available for On/Off Photosensor, Automatic Dimming Control Photosensor, or Combination units. The secondary daylight zone capable of being controlled as an "offset" from the primary zone.

F. Wired Networked Wall Switch Sensors:

1. Basis-of-Design Product: Subject to compliance with requirements, provide nLight; Acuity Brands Lighting, Inc.; nWSX LV, nWSXA LV, or comparable product by one of the following:
    a. Cooper Industries, Inc.
    b. Leviton Manufacturing Co., Inc.
2. Mounting: Suitable for installation in single-gang switch box.
3. Communication and low-voltage power delivered via standard low-voltage network cabling with RJ-45 connectors.
4. All switches detect valid communication and blink a unique LED pattern to visually indicate a potential wiring issue.
5. Devices with mechanical push buttons provide tactile and LED user feedback.
6. Wall Switch Sensor Options:
    a. User Input Control Types: On/Off or On/Off/Dimming as needed for each application.
    b. Occupancy Sensing Technology: PIR or Dual technology as needed for each application.
    c. Daylight Sensing Option: Inhibit Photosensor.
    d. Color: as indicated by owner.

G. Wired Networked Embedded Fixture Sensors:
1. Basis-of-Design Product: Subject to compliance with requirements, provide nLight; Acuity Brands Lighting, Inc.; nES or comparable product by one of the following:
    a. Cooper Industries, Inc.
    b. Leviton Manufacturing Co., Inc.
2. Network system sensors with occupancy sensors and/or dimming photosensors that can be embedded into luminaire such that only the lens shows on luminaire face.
3. Occupancy sensor detection pattern suitable for 7.5 to 20-ft. mounting heights.
4. Embedded Sensor Options:
    a. Occupancy Sensing technology: **PIR or Dual technology as needed for each application**.
    b. Sensing Option: as needed for each application.

H. Wired Networked Power Packs:
1. Basis-of-Design Product: Subject to compliance with requirements, provide nLight; Acuity Brands Lighting, Inc.; nPP16 series or comparable product by one of the following:
    a. Cooper Industries, Inc.
    b. Leviton Manufacturing Co., Inc.
2. Plenum rated.
3. Communication will be delivered to each device via standard low-voltage network cabling with RJ-45 connectors.
4. Supply Voltage: 120 to 277 V(ac).
5. Relay Output: Class 1 relay rated for 16 A at **277** V(ac) and 1/2 HP at 120 V(ac).
6. Dimming Output: 0-10 VDC Dimming output.
7. Sink Current: 100 mA at 0-10 V(dc).

8. Mounting: Integral 1/2-inch chase nipple. Plastic clips into junction box are unacceptable.

I. Wired Networked Relay and Dimming Panel:
   1. Basis-of-Design Product: Subject to compliance with requirements, provide nLight; Acuity Brands Lighting, Inc.; ARP or comparable product by one of the following:
      a. Cooper Industries, Inc.
      b. Leviton Manufacturing Co., Inc.
   2. Outputs: Individual relays per panel (as indicated by P/N for each application), with an equal number of individual 0-10 V(dc) dimming outputs.
   3. Field Configurable Relays (FCR):
      a. Field configurable to operate in single-, double-, or triple-pole relay groupings.
      b. Field configurable to operate as normally closed or normally open.
      c. Provides visual status of current state and manual override control of each relay.
      d. Minimum Relay Contact Ratings:
         1) 40 A at 120-480 V(ac) Ballast.
         2) 16 A at 120-277 V(ac) Electronic.
         3) 20 A at 120-277 V(ac) Tungsten.
         4) 20 A at 48V (dc) Resistive.
         5) 2 HP at 120 V(ac).
         6) 3 HP at 240-277 V(ac).
         7) 65kA SCCR at 480 V(ac).
   4. Dimming Output Rating: Minimum of 100 mA sink current per dimming output.
   5. Relay and dimming outputs individually programmable.
   6. Listing: UL 924 for control of emergency lighting circuits.
   7. Power Supply: Integrated 120-277 V(ac) supply.
   8. Low-Voltage Sensor Input:
      a. Configurable to support any of the following input types:
         1) Indoor Photosensor.
         2) Outdoor Photosensor.
         3) Occupancy Sensor.
         4) Contact Closure.
      b. Low-voltage sensor input provides 24 V(dc) power for sensor so additional auxiliary power supplies are not required.
      c. Sensor input supports all standard sequence of operations.
   9. Integrated Digital Time Clock for local schedule control.
   10. Contact Closure Input: One for each group of eight output relays that acts as a panel override to activate the normally configured state of all associated relays (i.e., normally open or normally closed).
   11. Panel supplies current limited low-voltage power to other networked devices connected via low-voltage network cable.
   12. Enclosure:
      a. Enclosure Rating: NEMA 1.

b. Mounting: as needed for each application.
c. Cover: Hinged cover with keyed lock.

J. Wired Networked Bluetooth Low-Energy Programming Device:
1. Basis-of-Design Product: Subject to compliance with requirements, provide nLight; Acuity Brands Lighting, Inc.; nIO BT or comparable product by one of the following:
a. Cooper Industries, Inc.
b. Leviton Manufacturing Co., Inc.
2. Plenum rated, inline wired, and screw mountable.
3. Communication and low-voltage power delivered to device via standard low-voltage network cabling with RJ-45 connectors.
4. Bluetooth communication allows connection from smartphone application for programming device settings within the local daisy-chain zone.
5. Device provides visual indication of remote Bluetooth connection via LED integrated into device enclosure such that it is visible from all angles while the zone is being programmed.

K. Wired Networked Communication Bridge:
1. Basis-of-Design Product: Subject to compliance with requirements, provide nLight; Acuity Brands Lighting, Inc.; nBRG or comparable product by one of the following:
a. Cooper Industries, Inc.
b. Leviton Manufacturing Co., Inc.
2. Suitable for surface mount to a standard 4 by 4-inch square junction box.
3. Communication Ports: Eight RJ-45 ports for connection to lighting control zones (up to 128 devices per port), additional network bridges, and System Controller.
4. Capable of aggregating communication from multiple lighting control zones for purposes of minimizing backbone wiring requirements back to System Controller.
5. Power Input: Class 2 low-voltage supplied locally via a directly wired power supply.
6. Wired Bridge capable of redistributing power from its local supply and connected lighting control zones with excess power to lighting control zones with insufficient local power. Architecture enables loss of power to a particular area to be less impactful on network lighting control system.

3.EXECUTION

1. INSTALLATION OF WIRING

A. Minimum conduit size is 1/2 inch.

B. Wiring within Enclosures: Bundle, lace, and train conductors to terminal points with no excess and without exceeding manufacturer's limitations on bending radii. Install lacing bars and distribution spools.

2. IDENTIFICATION

A. Identify system components, wiring, cabling, boxes, cabinets, and terminals. Comply with identification requirements specified in Section 260553 "Identification for Electrical Systems."

B. Identify field-installed conductors, interconnecting wiring, and components; install warning signs complying with Section 260553 "Identification for Electrical Systems."

C. Identify all controls with device address.
D. Label each device cable within 6 inch of connection to bus power supply or termination block.

3. FIELD QUALITY CONTROL
   A. Acceptance Testing Preparation:
      1. Test continuity of each circuit.
   B. Field tests and inspections must be witnessed by owner's representative.
   C. Tests and Inspections: Engage a factory-authorized service representative to perform test inspections.
      1. Test each zone using local and remote control hardware.
      2. Perform each visual and mechanical inspection and electrical test stated in NETA ATS. Certify compliance with test parameters.
   D. Nonconforming Work:
      1. Lighting controls will be considered defective if they do not pass tests and inspections.
      2. Correct malfunctioning units on-site, where possible, and retest to demonstrate compliance; otherwise, replace with new units and retest.
   E. Field Test Reports: Engage a factory-authorized service representative to prepare field test reports.
      1. Prepare functionality and inspection reports, including a certified report that identifies controls included and describes test results. Include notation of deficiencies detected, remedial action taken, and observations made after remedial action.
      2. Include list of all points created from actual tests of all addressed control points for lamps, ballasts, manual controls, and sensors.

4. REMOTE ACCESS
   A. Digital network lighting control system capable of remote access by manufacturer with the following features:
      1. System diagnostics including detection of fault condition in hardware or connected devices.
      2. Access to all connected devices for complete programming including scheduling of time-of-day events and device parameters necessary to meet required sequence of operations.
      3. Browser-based interface to verify system functionality.
      4. On-demand access to manufacturer technical support for remote troubleshooting, diagnostics, configuration, and programming.
      5. Owner training on the digital network lighting control system available remotely.
   B. Remote access system fully functional over commercial celluar connection or Internet-connected ethernet network.
   C. All hardware associated with remote access including cellular modem and cellular antenna are to remain on-site regardless of warranty or cellular contract status.

5. SYSTEM STARTUP
   A. Engage a factory-authorized service representative to perform startup service.
      1. Complete installation and startup checks in accordance with manufacturer's published instructions.

2. Activate luminaires and verify that all maximum output levels match output levels detailed in an Owner-approved sequence of operations.
3. Confirm correct communications wiring, initiate communications between control devices and controller/gateways, and program the lighting control system in accordance with approved configuration schedules, time-of-day schedules, and input override assignments.
4. Program network devices to meet required sequence of operations.
5. Program and verify all sequence of operations.
6. Create backup of system programming.
7. Assist in installation of system software on customer-provided workstation or server.
8. Verify bidirectional communication of manufacturer-provided cellular router with manufacturer-managed remote access portal.

B. Commissioning Walkthrough: Collaborate with third-party commissioning agent to demonstrate lighting control system functionality and verify the system meets the specified Project requirements.

6. CLOSEOUT ACTIVITIES

A. Enhanced Documentation: Engage lighting system manufacturer to provide comprehensive system documentation including detailed programming, sequence of operation data per Project specifications, and related code requirements.

B. Training: Engage lighting system manufacturer to provide comprehensive system overview, software overview, and documentation relating to system operation and maintenance.

7. PROTECTION

A. After installation, protect digital network lighting controls from construction activities. Remove and replace items that are contaminated, defaced, damaged, or otherwise caused to be unfit for use prior to acceptance by Owner.

8. MAINTENANCE (if required by owner)

A. Engage a factory-authorized service representative to perform on-site system adjustments.
1. On-Site Occupancy Adjustments: When requested within six months from date of Substantial Completion, provide on-site settings adjustments to suit actual occupied conditions. Provide up to two visits to Project during other-than-normal occupancy hours for this purpose.
2. Prepare and submit report after each visit that details activities performed.

B. Engage a factory-authorized service representative to perform remote system adjustments.
1. Remote Occupancy Adjustments: When requested within twelve months from date of Substantial Completion and project registration with lighting control system manufacturer, provide remote settings adjustments to suit actual occupied conditions. Provide up to four sessions to Project during other-than-normal occupancy hours for this purpose.
a. System to include manufacturer-provided cellular communication hardware and connection to the system for a minimum of twelve months after

substantial completion to allow for factory representative assistance with settings adjustments and system sustainment.

b. For the remaining duration of the maintenance term, or in the event cellular connectivity is not available, manufacturer assistance must be available through an Owner-provided, Internet-connected network.

2. Prepare and submit report after each session that details activities performed.

C. Maintenance Service Agreement:

1. Beginning at Substantial Completion, verify that maintenance service agreement includes 12 months' full maintenance by manufacturer's authorized service representative.
2. Include preventive maintenance as recommended by manufacturer.
3. Preventative maintenance to include:
   a. System diagnostic reports.
   b. System performance checks.
   c. Device firmware updates.
   d. Programming adjustment as required for proper lighting system operation.
   e. Expedited factory direct warranty processing, replacement, and programming of defective components.
4. Verify that parts and supplies are manufacturer's authorized replacement parts and supplies.

End of Section 26 09 43

Section 26 21 00 – Low Voltage Electrical Service Entrance

Part 1.00 – General

A. Unless otherwise noted on Power Riser Diagram, these specifications and any attached drawings are designed based on an underground building service of 120/208 volt, three phase, 60 hertz, four wire. All HVAC equipment has been designed for use on this electrical system. The contractor shall contact the electrical utility company and verify all of the above service characteristics and the available fault current.

B. The service shall be located as shown on the site plan, or as indicated in the instructions to bidders. Utility poles, pads for utility transformers, current transformer enclosures, metering equipment, service masts, and other related materials and equipment shall be approved, furnished, and installed as required. Include the costs of all of the above items, service connections, installation of service conduit from utility pole or transformer, and meter charges in the base bid. When required, main service switches and current transformer enclosures shall be included in the base bid. All service and distribution equipment must be either fully rated or a listed Series Rated combination suitable for the available fault current provided by the local electrical utility company. Electrical contractor shall be responsible for obtaining available fault current from utility provider before submitting bid.

C. Service installation shall meet all requirements of the latest edition of the National Electric Code as well as all state and local codes. All work shall be performed in accordance with all rules, regulations, and standards of the electrical utility company.

Part 2.00 – Materials

A. All panels or disconnects used for service entrance equipment shall be UL listed and labeled as suitable for use as service entrance equipment and must be suitable for use in outdoor, wet locations.
B. The equipment must be rated for the voltage, current and available fault current of the particular application.
C. All top entries into outdoor equipment shall be thru bolt-on factory supplied screwed hub connections.
D. All circuit breakers and/or disconnects shall be identified with engraved laminated nameplates, attached with Stainless Steel fasteners, identifying the equipment fed from the breaker/disconnect.
E. When fused disconnects are utilized, all fuses shall be of the current limiting type.
F. Approved manufacturers of service equipment include: Square D, Cutler-Hammer, Siemens, General Electric, and Westinghouse. Electrical design for this project and all associated dimensions for service equipment mounting wall are based on Siemens equipment.

Part 3.00 – Installation

A. Provide a concrete pad for electrical Utility transformer per Utility company specifications, if required. Contractor shall install appropriate grounding means per Utility specifications.
B. Furnish and install all service entrance switchgear including meter bases and/or CT enclosures as required.
C. Provide sleeves for service entrance raceways. Coordinate installation with appropriate subcontractor.
D. Furnish and install all service underground raceways including riser length at pole and/or elbows at transformer pad.
E. Where equipment is furnished and/or installed by the electrical Utility provider, the electrical contractor shall pay all charges and coordinate work as required.
F. Coordinate Service connection with Utility provider and pay all charges.
G. Obtain electrical Utility provider approval for all electrical service work.
H. For all underground installations, provide warning ribbon in trench 12” above conduit.
I. Furnish and install arc flash hazard warning labels per Article 110.16 of the 2023 NEC on all service equipment enclosures, load distribution panels, and as indicated in service notes.
J. Furnish and install Available Fault Current Labels on all service equipment per Article 110.24 of the 2023 NEC. Label shall indicate the maximum available fault current and the date the fault current calculation was performed. Electrical contractor shall obtain maximum available fault current from electrical utility provider.

End of Section 26 21 00

Section 26 22 00 – Low Voltage Transformers

Part 1 - General

1.1 Description

This specification describes the design of a copper wound, multi-shielded, three phase, high efficiency, K-factor rated, power conditioning isolation transformer. The power conditioning transformer shall be continuous duty rated, 600 volt class, convection cooled, dry type, isolation transformer designed to support harmonic rich non-linear loads while maintaining safe operating temperatures, and shall include superior common and transverse mode noise attenuation. The power

conditioning transformer shall meet the efficiency specified in 2.4 I of this specification, which meets and exceeds the U.S. Department of Energy (DOE) 2016 high efficiency standards identified under DOE 10 CFR Part 431, and complies with the Canadian Energy Efficiency Standard C802.2-12.

1.2 Standards

The power conditioning system shall be designed in accordance with applicable portions of the following standards:

A. U.S. Department of Energy (DOE) 2016 high efficiency standards identified under DOE 10 CFR Part 431
B. Canadian Energy Efficiency Standard C802.2-12
C. American National Standards Institute (ANSI C57.110 & C62.41-2002)
D. Institute of Electrical and Electronic Engineers (IEEE 519-2014)
E. National Fire Protection Association (NFPA) 70, National Electrical Code (NEC)
F. Federal Information Processing Standards Publication 94 (FIPS Pub 94)
G. UL Listed to Standard 1561
H. C-UL listed to CSA Standard C22.2, No. 47-13
I. RoHS compliant

1.3 Submittals

A. Manufacturer Requirements:
   1. The manufacturer shall be ISO 9001:2015 “Quality Assurance Certified” and shall upon request furnish certification documents.
   2. The manufacturer shall be a United States based manufacturer with at least 15 years of experience in the design and fabrication of K-rated, shielded, power conditioning isolation transformers.

B. Product Data:
   1. The manufacturer shall supply documentation for the installation of the system, including wiring diagrams and cabinet outlines showing dimensions, weights, BTUs, input/output connection locations and required clearances.
   2. Factory test results and design data shall be provided to show compliance with the requirements.
   3. The supplier shall furnish (6) equipment submittal copies. Submittals shall be specific for the equipment furnished and shall include as-built information.

Part 2 - Products

1. Manufacturers

The equipment specified is the Ultra-K, Series 600K-*he*, manufactured by Trystar. Alternate, equivalent manufacturers may be submitted. With any alternate submissions, all variations or exceptions to this specification shall be identified and submitted with alternate submittals.

2. Input Specifications

A. The nominal AC input voltage rating of the power conditioner shall be 208 VAC, 3 phase with sufficient margin to sustain a constant input of +10% without saturation.
B. The nominal operating frequency shall be 60 hertz $\pm$ 5%.

C. The power conditioning transformer primary shall be configured in a three phase delta. Transformers rated 15kVA to 75kVA shall include full capacity taps at 2.5% increments, two (2) above and four (4) below the nominal voltage tap.
D. When energized, the current inrush shall not exceed a maximum of 10 times the full load input current for ½ cycle.

2.3 Output Specifications

A. The nominal AC output voltage rating of the power conditioning transformer shall be 208 VAC wye derived, 60 hertz.
B. The output impedance of the power conditioning transformer shall be 2% to 3.5% typical.
C. The power conditioning transformer shall be K-13 rated in accordance with: $K = å I_h(pu)^2h^2$
D. The power conditioning transformer shall provide a continuous duty, full load output power of 30 kVA.

2.4 Performance Specifications

A. The output voltage of the power conditioning transformer shall be maintained within 2.5% or less of nominal, from no load to full load.
B. The overload rating of the power conditioning transformer shall be 500% for 10 seconds, and 1000% for 1 cycle.
C. The power conditioning transformer shall add no more than 1% total harmonic distortion to the output waveform under a linear load.
D. Output voltage shall remain sinusoidal with no flat topping when high crest factor (3.0 : 1), non-linear loads are present at the output.
E. The audible noise of the power conditioning transformer shall be no greater than 45 dBA, measured at 1 meter from the unit with the transformer at full load and rated K factor.
F. The power conditioning transformer shall incorporate 3 solid copper foil, full-length electrostatic shields to minimize inner winding capacitance and noise coupling between primary and secondary windings.
G. Transformer shall be triple-shielded and capable of 146dB common mode noise attenuation.
H. Transformer shall be capable of transverse mode noise attenuation of 3 dB down at 10kHz, decaying 20 dB per decade.
I. The power conditioning transformer shall have an efficiency of 98.23% or greater, which meets and exceeds U.S. Department of Energy (DOE) 2016 high efficiency standards. Efficiency value is at 35% of nameplate-rated load with a transformer operating temperature of 75°C, determined according to the DOE Test Method for Measuring the Energy Consumption of Distribution Transformers under Appendix A to Subpart K of 10 CFR part 431.

2.5 Main Transformer Construction

A. The transformer windings shall be all copper conductor construction, with separate primary and secondary, isolated windings. The transformer shall conform to NEC

article 250, that specifies a separately derived power source. The neutral conductor shall be provided at 2 times the ampacity of the phase conductor.

B. Copper bus connections shall be provided for isolated three phase output conductors, neutral conductor, and ground.
C. Output neutral shall be bonded to ground via a removable jumper wire or bus bar.
D. All leads, wires and terminals shall be labeled to correspond with the circuit wiring diagram.
E. Basic impulse level shall be no less than 10,000 Volts.
F. Mean Time Between Failure (MTBF) shall be no less than 200,000 hours.
G. Grain oriented, M3 grade, silicon transformer steel and miter cut joint construction shall be utilized to provide maximum efficiency. Flux density shall not exceed 15k gauss. Core losses shall be limited to 0.4% or less of the kVA rating.
H. Class N, 200°C insulation system shall be utilized throughout with a maximum temperature rise above ambient of 115°C under a linear load, not to exceed 135°C under non-linear loading per UL 1561 standard.
I. The transformer shall be designed for natural convection cooling.

2.6 Cabinet Construction

A. The cabinet shall be a NEMA 1 general purpose, floor mounted, indoor enclosure. Dimensions shall not exceed 23”W x 20”D x 28”H.
B. Cabinets shall be manufactured from 14 gauge steel with base sub-structure suitable for fork lifting.
C. The cabinet shall have a baked on powder coat paint finish with proper pre-treatment.
D. Provisions shall exist to hardwire input and output to copper bus connections located behind the front panel of the transformer cabinet. Input and output landing locations shall be available on either side of the transformer cabinet.

2.7 Environment

A. Temperature: The power conditioning system shall be required to operate without overheating in an ambient temperature range of -25°C to +40°C.
B. Humidity: The power conditioning system shall operate in a relative humidity of 0 to 95% non-condensing.
C. Altitude: The power conditioning system shall operate up to 5000 feet above sea level without de-rating.

2.8 Warranty

The manufacturer shall warrant the transformer (core and coil) to be free from defects in material and workmanship for a period of 1 year full, and an additional 24 years prorated. All other unit components shall be covered by a 2 year full replacement warranty. The warranty periods shall commence following the original factory ship date.

End of Section 26 22 00

Section 26 24 16 – Panelboards

Part 1.00 – General

A. Panelboards, enclosures, and accessories shall be U.L. listed and labeled, and shall comply with standards of NEMA and the latest edition of the National Electric Code for construction and installation.
B. Each panelboard shall have typewritten circuit directories with clear plastic protectors.
C. All wires shall be tagged with panel and circuit numbers.
D. Residential Only panels shall NOT be used in Commercial applications. Residential panels may be used in dwelling units for this project.
E. All panelboards shall be rated for the available fault current provided by the utility provider. Panelboards shall be either fully rated or Series/Combination rated with the panelboard main breaker or an upstream feeder overcurrent device. If a Series/Combination rating is utilized, the electrical contractor is responsible for specifying the proper equipment and ensuring compliance with Articles 110.22 and 240.86 (B) and (C) of the 2023 NEC.
F. All panelboards shall be labeled indicating the device or equipment where the power supply originates per Article 408.6 of the 2023 National Electric Code.
G. Approved manufacturers of panelboards are: Square D, Cutler-Hammer, Siemens (ITE), General Electric, Westinghouse, and Challenger. Electrical design for this project and all associated dimensions are based on Siemens equipment.

Part 2.00 – Materials

2.01 – Panelboards

A. Electrical panels shall be dead-front type construction equipped with overcurrent protective devices as shown on panel schedules. Panels shall be complete with cabinet, trim, hinged door, directory, and additional features as listed on the panel schedules. Spaces scheduled on the panel schedules as spare shall have all required busing provided for the installation of future circuit breakers.
B. Unless otherwise specified, all lighting panels (LP) used only for lighting and general purpose receptacles may utilize push-on style breakers. All power panels (PP) and main distribution panels (MDP) feeding electrical equipment shall utilize bolt-on style breakers.
C. Full sized insulated neutral bars shall be included. Bus Bar taps for panels with single pole breakers shall be arranged for sequence phasing of the branch circuit devices. Neutral bussing shall have a suitable lug for each outgoing feeder requiring a neutral connection.
D. A ground bus shall be included in all panels. An extra isolated ground bus shall be added, as needed, when listed on the Grounding Notes.
E. All power panels (PP) and main distribution panels (MDP) located outdoors shall be at minimum NEMA 3R rated.

2.02 – Circuit Breakers

A. Panel circuit breaker overcurrent protective devices shall be as shown on the panel schedules. All breakers shall be thermal magnetic type carrying the U.L. label. Each breaker shall have the following features:
    1. Magnetic blow-out or other approved arc-quenching device.
    2. Two and three-pole breakers shall have non-conductive barriers between the poles with separate tripping element in each leg, and with common trip operation.
    3. A single-operating handle shall open all poles. Two and three-pole breakers with several handles connected with handle ties are not acceptable.

4. All handles shall have clearly marked “ON” and “OFF” positions.
5. Breaker shall be designed such that it is impossible to maintain breaker in closed position under overload condition.

B. Where specified on panel schedules, provide a combination circuit breaker and ground fault interrupter. Such units shall be single-pole, 120 V molded case breakers with U.L. label or listing.
C. Where circuit breakers are used as switches for 120 V fluorescent Lighting circuits, circuit breakers shall be approved for switching duty and shall be marked “SWD”.
D. Where circuit breakers are providing overcurrent protection for HVACR equipment, circuit breakers shall be approved for such equipment and shall be marked as “HVACR”.
E. Where circuit breakers are feeding appliances or equipment that is not cord and plug connected and does not have a local disconnect shown on the power plan, this circuit breaker(s) shall be lockable in the “OFF” position.
F. Panel circuit breakers shall be fully rated or part of a listed Series Rated combination of main breaker or fuse/circuit breaker suitable for the available fault current provided by the electrical utility provider.
G. Tandem circuit breakers shall not be utilized.

Part 3.00 – Installation

A. Installation shall comply with the requirements of the latest edition of the National Electric Code.
B. Anchor panels and enclosures firmly to walls and structural surfaces, ensuring panels and enclosures are permanently and mechanically secured.
C. Where ceiling space exists, recessed mounted panelboards shall have spare conduits stubbed above ceiling. Install one ¾” conduit for every two (2) spare breakers and/or blank spaces.
D. Measure steady state currents at each panelboard feeder; re-arrange circuits in the panelboard to balance the phase loads within 20% of each other. Maintain proper phasing for multi-wire branch circuits.
E. Check tightness of bolted connections and circuit breaker connections using calibrated torque wrench or torque screwdriver per manufacturer’s written specifications.

End of Section 26 24 16

Section 26 27 26 – Wiring Devices

Part 1.00 - General

A. All Wiring Devices shall be U.L. listed and labeled for commercial use. All devices shall be installed in compliance with the latest edition of the National Electric Code, manufacturer’s written instructions, and recognized industry practices.
B. Device Plates in indoor areas shall be nylon, color as approved by the architect or owner. Plates will completely hide cutouts at all wall and ceiling box cutouts. Device color shall be as acceptable to the customer and/or architect.
C. Where shown near doors, wall switches shall be mounted not less than 2” and not more than 12” from door trim.
D. All listed part numbers in this specification section are to indicate grade of device only.

Part 2.00 – Materials

2.01 - Receptacles

A. Standard receptacles shall be 20 Amp, 125 V AC, duplex, grounding type, NEMA 5-20R, unless otherwise noted.
B. Ground Fault Circuit Interrupter Receptacles shall be 20 Amp, 125 V AC, duplex, Feed-Through Type, NEMA 5-20R.
C. Isolated Ground Receptacles shall be 20 Amp, 125 V AC, duplex, NEMA 5-20R.
D. Floor Receptacles shall be 20 Amp, 125 V AC, duplex, grounding type, NEMA 5-20R.
E. Weatherproof outlet covers on outdoor receptacles shall be weatherproof whether or not the attachment plug cap is inserted as required per Article 406.9 (B)(1) of the 2023 National Electrical Code.
F. Receptacles shall be as indicated below or equal:
    1. 20 Amp, 125 V Duplex Receptacle – Leviton P/N – BR20
    2. 20 Amp , 125 V Duplex Ground Fault Receptacle – Leviton P/N – 8899
    3. 20 Amp, 125 V Duplex Isolated Ground Receptacle – Leviton P/N – 5380-IG
    4. 20 Amp, 125 V Duplex Tamper Resistant Receptacle – Leviton P/N – TDR20
    5. 20 Amp, 125 V Duplex Weather Resistant Receptacle – Leviton P/N – WBR20
    6. 20 Amp, 125 V Duplex Tamper & Weather Resistant Receptacle – Leviton P/N – TWR20
    7. 20 Amp, 125 V Duplex Floor Receptacle & Box Assembly for wood floors – Leviton P/N – 25349-FBA (with Tamper Resistant Receptacle)
    8. 20 Amp, 125 V Duplex Floor Receptacle & Box for concrete floors –
    Hubbell P/N – PFB1, Round PVC Floor Box
    Hubbell P/N – PFBA1A, Floor Box Adapter Ring
    Hubbell P/N – SF3925, Floor Flange/Cover for Duplex Receptacle
    Leviton P/N – TDR20, 20 A, 125 V Duplex Tamper Resistant Receptacle
    9. 20 Amp, 125 V Single Receptacle – Leviton P/N - 5891
    10. Weatherproof Cover for Vertical Duplex GFI Receptacle – Leviton P/N – 5976-CL

2.02 – Wall Switches

A. Switches shall be heavy duty, toggle, quiet type, fully enclosed composition cases.
B. Switches shall be rated 20 Amp, 120/277 VAC.
C. Switches in the same location shall be ganged behind a single plate.
D. Gang Switch Plates for five or more switches shall be engraved with titles as directed by customer and/or architect.
E. Switches shall be as indicated below, or equal:
    1. Single Pole – Leviton P/N – CS120-2
    2. Double Pole – Leviton P/N – CS220-2
    3. 3 Way – Leviton P/N – CS320-2
    4. 4 Way – Leviton P/N – CS420-2

Part 3.00 – Installation

3.01 – General

A. Receptacles shall be side-wired using pigtails. Back-wiring or thru-wiring on device terminals is not acceptable.
B. Upon completion of installation of wiring devices and installation components, and after connection to power source, test wiring devices to demonstrate compliance with operating requirements.

C. Test wiring devices and installation components to ensure electrical continuity of grounding connections.
D. Device plates shall be installed plumb with all edges in continuous contact with finished surface.
E. Outdoor receptacles shall be GFCI type in 4" Square flush mounted box.
F. Surface mounted outlets shall be mounted in cast boxes.
G. All mounting heights shall be in accordance with all ADA requirements.
H. Where switches control lighting loads, the neutral shall be provided at the switch location per Article 404.2 of the 2023 National Electric Code.

3.02 – Isolated Ground Receptacles

A. Isolated Ground Receptacles shall have the normal equipment ground conductor terminated to the device box and a separate green, insulated ground wire from the main service entrance terminated to the receptacle ground connection.

3.03 – Floor Receptacles

A. All floor receptacles shall be installed in a floor box assembly complying with Article 314.27(B) of the 2023 National Electric Code.
B. All floor receptacles shall be fed from a GFCI circuit breaker.

End of Section 26 27 26

Section 26 28 16 – Enclosed Switches and Circuit Breakers

Part 1.00 – General

A. Safety and Disconnect switches shall be Heavy Duty or General Duty type switches.
B. Safety and Disconnect switches shall comply with applicable standards of NEMA and shall be U.L. listed and labeled for the application and environment. Where used for Service disconnect, switches shall be listed for use as a service disconnect.
C. When fused disconnects are utilized, all fuses shall be of the current limiting type and shall be provided by electrical contractor. Fuses shall be Class R and shall withstand up to 200,000 amps RMS symmetrical.
D. All switches shall have a nameplate on switch indicating equipment served.
E. Electrical contractor shall verify all specifications of disconnects listed on drawings meet the requirements of actual purchased equipment. Any discrepancies shall be brought to the attention of the electrical engineer and resolved before purchasing materials.

Part 2.00 – Materials

2.01 – Switch Interior

A. All switches shall have switch blades which are fully visible in the OFF position when the door is open.
B. Lugs shall be U.L. listed for aluminum and/or copper cables and front removable.
C. Switches shall include solid neutral when neutral is required.

2.02 – Switch Mechanism

A. Switches shall have a quick-make and quick-break operating handle and mechanism which shall be an integral part of the box, not the cover. Switches shall have an interlock to prevent unauthorized opening of the switch door in the ON position or closing of the switch mechanism with the door open.
B. Handle position shall indicate ON or OFF position of switch. Handle shall be lockable in the OFF position.

2.03 – Enclosures

A. All enclosures shall be the NEMA types which are most suitable for the environmental conditions. For exterior installations, the enclosures shall be NEMA 3R (rain-tight) at a minimum.

2.04 – Ratings

A. Switches shall be rated for the voltage, 115% of the full load amperage, and horsepower as required or as shown on drawings. Switch Ratings shall be calculated per Articles 430.110 and 440.12 of the 2023 National Electrical Code.
B. All switches shall be rated for the maximum available fault current as provided by the electrical utility provider.
C. All circuit breakers used as HVACR disconnects shall be listed as “HACR”.
D. Switches shall have the required number of poles for the application.

Part 3.00 – Installation

A. Install safety and disconnect switches as required by all applicable codes and as shown on drawings. Install all switches in accordance with manufacturer’s written instructions, the applicable requirements of the latest edition of the National Electric Code, and recognized industry practices.
B. Disconnect switches for appliances and/or specific equipment shall be installed at (within sight of) the equipment served per Articles 430.102 and 440.14 of the 2023 National Electrical Code. If circuit breakers in panel are used for disconnect requirements, breakers shall have a permanently installed device in panel to accept padlock.
C. Install fusible disconnects, with properly sized fuses, for all equipment requiring fuses as overload protection device. Check manufacturer’s written installation instructions and specifications.
D. For all installed switches, check proper operation by verifying that all blades are disengaged in the OFF position and all blades are engaged in the ON position.

End of Section 26 28 16

Section 26 29 13 – Enclosed Controllers

Part 1.00 – General

1. – Summary

A. This Section includes motor controllers rated 600 V and less that are not supplied with equipment furnished by other Divisions.

1.02 – Submittals

A. General: Submit the following in accordance with conditions of Contract, Division 01 Specification Sections and Division 26 "Basic Division 26 Requirements."

1.03 – Action Submittals:

A. Product Data: For each type of enclosed controller. Include dimensions and manufacturer's technical data on features, performance, electrical characteristics, ratings, and finishes.
B. Shop Drawings:
    1. Layout Drawings: Include dimensioned plans, elevations, sections, and details, including required clearances and service space around equipment. Show tabulations of installed devices,
    equipment features, and ratings. Include the following:
        a. Each installed unit's type and details.

b. Nameplate legends.
c. Short-circuit current rating of integrated unit.
d. Features, characteristics, ratings, and factory settings of individual overcurrent protective devices in combination controllers.

1.04 – Closeout Submittals

A. Operation and Maintenance Data: For enclosed controllers to include in emergency, operation, and maintenance manuals. In addition to items specified in Division 01 Section "Operation and Maintenance Data," include the following:

1. Routine maintenance requirements for enclosed controllers and all installed components.
2. Manufacturer's written instructions for testing and adjusting overcurrent protective devices.

B. Record Documents:

1. Load-Current and Overload-Relay Heater List: Compile after motors have been installed and arrange to demonstrate that selection of heaters suits actual motor nameplate full-load currents.

1.05 – Quality Assurance

A. Source Limitations: Obtain enclosed controllers of a single type through one source from a single manufacturer.

B. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, Article 100, by a testing agency acceptable to authorities having jurisdiction, and marked for intended use.

C. Comply with NFPA 70.

D. Comply with ANSI/NETA ATS – Standard for Acceptance Testing Specifications for Electrical Power Equipment and Systems for field testing.

1.06 – Delivery, Storage, and Handling

A. Store enclosed controllers indoors in clean, dry space with uniform temperature to prevent condensation. Protect enclosed controllers from exposure to dirt, fumes, water, corrosive substances, and physical damage.

1.07 – Coordination

A. Coordinate layout and installation of enclosed controllers with other construction including conduit, piping, equipment, and adjacent surfaces. Maintain required workspace clearances and required clearances for equipment access doors and panels.

B. Coordinate features of enclosed controllers and accessory devices with pilot devices and control circuits to which they connect.

D. Coordinate features, accessories, and functions of each enclosed controller with ratings and characteristics of supply circuit, motor, required control sequence, and duty cycle of motor and load.

Part 2.00 – Products

2.01 – Manufacturers

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

1. ABB Power Distribution, Inc.; ABB Control, Inc. Subsidiary.
2. Eaton Corporation; Cutler-Hammer Products.
3. General Electrical Company; GE Industrial Systems.

4. Rockwell Automation; Allen-Bradley Co.; Industrial Control Group.
5. Siemens/Furnas Controls.
6. Square D.

2.02 – Motor Controllers, General

A. Controller shall be manual type for motors 1/3 HP and smaller and magnetic type for motors 1/2 HP and larger.

B. Coordinate the features of each motor controller with the ratings and characteristics of the supply circuit, the motor, the required control sequence, the duty cycle of the motor, drive, and load, and the pilot device, and control circuit affecting controller functions. Provide controllers that are horsepower rated to suit the motor controlled.

C. Contacts shall open each ungrounded connection to the motor.

D. Controller contacts shall be twin-break, silver-to-silver, renewable contacts with one set of contacts for each phase.

E. Overload Relays: Ambient-compensated type with inverse-time-current characteristic. Provide with heaters or sensors in each phase matched to nameplate full-load current of the specific motor to which connected with appropriate adjustment for duty cycle.

F. Phase Loss Protection: Provide phase loss protection for all motors 5 HP and above.

G. Enclosures: For individually mounted motor controllers and control devices, comply with NEMA Standard 250, "Enclosures for Electrical Equipment (1000 Volts Maximum)." Provide enclosures suitable for the environmental conditions at the controller location. Provide NEMA Type 1 enclosures except as otherwise indicated.

H. The coverplate shall have a lock-off tab for a padlock.

2.03 – Manual Fractional Horsepower Motor Controllers

A. Description: Quick-make, quick-break toggle action.

B. Single-phase motor control switches (thermal switches) for fractional horsepower motors. Single pole for 120 volt, two pole for 208 volt operation. Mount flush in finished areas and surface otherwise.

C. Trip-free, toggle operated with on-off-reset position clearly indicated.

D. Thermal overload shall be ambient compensated, plug-in type element with heater rating clearly indicated. Provide one overload for single pole switch and two overloads for two pole switch.

E. Where the motor is interlocked and controlled by another device, the motor controller shall be marked "Hand-Off-Auto."

2.04 – Combination Magnetic Motor Controllers

A. Description: Provide full-voltage, nonreversing, across-the-line, magnetic controller, except where another type is indicated.

B. Control Circuit: 120 V. Provide control power transformer integral with controller where no other supply of 120 V control power to controller is indicated. Provide control power transformer with adequate capacity to operate connected pilot, indicating and control devices, plus 100 percent spare capacity

C. Enclosure door shall be interlocked with the operating handle to prevent opening of doors with handle in the on position.

2.05 – Auxiliary Control Devices

A. General: Factory installed in controller enclosure except as otherwise indicated. Where separately mounted, provide NEMA 1 enclosure except as otherwise indicated.

1. Control circuit shall be a maximum of 120 volts with individual control power transformer having Class CC dual primary and single secondary fused protection. Provide terminal lugs for connection to wiring from external remote located controls. Where indicating lights, solenoid valves and additional control components are energized from the control transformer, the control power transformer will be increased in size to handle its normal load plus the other indicated loads.

B. Control devices such as pushbuttons and selector switches shall be heavy-duty, oil-tight, and be key operated or lockable where shown on Drawings.

C. Control selector switches shall be as shown on Drawings and shall be one of the following:
1. Start-Stop.
2. Off-Auto (O-A).
3. Hand-Off-Auto (H-O-A).

D. Provide each H-O-A switch with momentary stop and start push buttons located in the "H" leg to prevent accidental starting when the switch is turned to the "H" position.

E. Control devices shall be mounted in starter cover and be labeled with the motor or assembly which they service.

F. Pilot lights shall be transformer type, heavy-duty, oil tight.

H. Provide 1 "NO" and 1 "NC" isolated auxiliary contacts in addition to the normal hold-in contact and auxiliary contacts required for interlocks and pilot lights.

I. Provide Phase-Failure and Undervoltage Relays: Solid-state sensing circuit with isolated output contacts for hard-wired connection. Provide adjustable undervoltage setting. Provide phase loss protection for all motors 5 HP and above.

J. Provide Ground Fault Relays: With sensing circuit and adjustable trip settings.

Part 3.00 – Execution

3.01 – Examination

A. Examine areas and surfaces to receive enclosed controllers for compliance with requirements, installation tolerances, working space requirements, and other conditions affecting performance.
1. Proceed with installation only after unsatisfactory conditions have been corrected.

3.02 – Applications

A. Coordinate motor control equipment with the motor being supplied

B. Select features of each enclosed controller to coordinate with ratings and characteristics of supply circuit and motor; required control sequence; duty cycle of motor, controller, and load; and configuration of pilot device and control circuit affecting controller functions.

C. Select horsepower rating of controllers to suit motor controlled.

3.03 – Installation

A. Location: Locate controllers as indicated and within sight of motors controlled (if required) approximately where shown on Drawings.

B. For control equipment at walls, bolt units to wall or mount on lightweight structural-steel channels bolted to wall. For controllers not at walls, provide freestanding racks.

C. Enclosed Controller Fuses: Install fuses in each fusible switch.

D. For magnetic controller/controllers, combination fused or motor circuit protector type shall be used. If fuses are indicated, the motor circuit protector shall be equipped with current limiters.

F. Where interlocking or sequence starting of motors is shown on Drawings, it shall be done such that when the circuit feeding a starter is open, no part of the controller/controllers shall be

energized. Furnish any relates, auxiliary contacts or disconnect switches necessary to implement the indicated sequences and interlocks.

G. Provide permanent wiring diagrams showing all internal starter controller within each motor controller/controllers compartment. Glued-on blueline prints are not acceptable. Also provide interlock wiring diagrams between controller/controllers.

H. Minimum controller/controllers size shall be NEMA 1.

I. Provide wiring from the controller to the motor. For 2-speed, 3-phase controller/controllers, provide three or six wires as required by the controller/controllers type.

3.04 – Ground Connections

A. Ground equipment according to Division 26 Section "Grounding and Bonding for Electrical Systems."

3.05 – Field Quality Control

A. Prepare for acceptance tests as follows:

1. Test insulation resistance for each enclosed controller element, bus, component, connecting supply, feeder, and control circuit.
2. Test continuity of each circuit.

B. Tests and Inspections:

1. Perform inspections and test procedures as required by ANSI/NETA ATS “Motor Control, Motor Starters, Low-Voltage”, and “System Functional Tests” requirements and the following additional requirements.
    a. Correct malfunctioning units on-site, where possible, and retest to demonstrate compliance; otherwise, replace with new units and retest.
    b. Prepare test and inspection reports.

3.06 – Adjusting

A. Set field adjustable switches and circuit-breaker trip ranges.

End of Section 26 29 13

Section 26 41 00 – Facility Lightning Protection (IF REQUIRED BY OWNER)

Part 1.00 – General

A. If required by owner, Electrical Contractor is responsible for obtaining a lightning protection system designed by a qualified designer per the latest edition of NFPA 780.

B. Electrical contractor shall submit approved drawings of lightning protection design from certified designer.

Part 2.00 – Materials

A. All materials shall be UL listed for use in lightning protection systems (as applicable).

B. All materials shall meet requirements of design from certified designer.

Part 3.00 – Execution

A. Electrical contractor shall install lightning protection system as designed by certified designer.

End of Section 26 41 00

Section 26 43 00 – Surge Protection Devices

Part 1.00 – General

A. Surge protection devices shall be installed as required per the lightning protection design as described in Section 26 41 00 or as indicated on drawings.

B. If surge protection is required per the lightning protection design, surge protection device shall be installed in the Main Distribution Panel (MDP).

Part 2.00 – Materials

A. If required, surge protection device shall be specified by certified lightning protection system designer.
B. If required, surge protection device shall be supplied by Distribution Panel manufacturer with Distribution Panel.
C. All surge protection devices shall be rated for available fault current at the respective Distribution Panel.
D. All surge protection devices shall be UL listed.

Part 3.00 – Execution

A. Electrical contractor shall install surge protection device as designed by certified designer and per the manufacturer's installation instructions.

End of Section 26 43 00

Section 26 50 00 – Lighting

Part 1.00 – General

A. All lighting fixtures shall be U.L. listed and labeled for the particular service and shall comply with standards of NEMA, ANSI, and the latest edition of the National Electric Code for construction and installation.
B. All Exit and/or emergency light fixtures shall comply with U.L. 924. All exit lights shall be LED type.

Part 2.00 – Materials

2.01 – Lighting Fixtures

A. All fixtures shall be U.L. listed for commercial use. All fixtures installed in either damp or wet locations shall be U.L. listed and labeled for the installation.
B. All fixtures shall be rated for operation in temperatures expected at the location of the fixture.
C. All recessed fixtures shall have UL listed thermal cut-out protection.
D. All "Non-IC" rated fixtures shall be installed per Article 410.116 (A) & (B) of the 2023 National Electrical Code.
E. All LED lighting shall be supplied by an established manufacturer who has been in business for a minimum of 10 years.
F. Unless noted otherwise, approved manufacturer's are as follows:
    1. LED fixtures – LUX Dynamics, Lithonia Gotham, Halo, General Electric, or equal
    2. Exit/Emergency fixtures - Lithonia, Emergi-Lite, Hubbell, or equal

Part 3.00 – Installation

A. Installation of lighting fixtures shall comply with NEMA standards, the applicable sections of the latest edition of the National Electric Code, and the manufacturer's written instructions.
B. All penetrations of fire and/or smoke rated ceilings for recessed lights shall be accomplished in such a manner as to maintain the integrity of the fire rating and to meet UL requirements. All penetrations shall be sealed with a fire stop material acceptable to the local AHJ. Fixtures listed by UL as maintaining the integrity of the fire rating of the ceiling may be used to eliminate the need to build boxes around fixtures.
C. All fixtures installed in T-bar type ceiling grids shall be installed as required by Article 410.36(B) of the 2023 NEC.

D. Electrical contractor shall coordinate with the ceiling contractor before ordering fixtures to ensure fixtures are ordered with necessary mounting configurations or options to be compatible with ceiling type.
E. All fixtures shall be protected from general construction and shall be thoroughly cleaned prior to final inspection.

End of Section 26 50 00

Section 27 00 00 – Communications

Part 1.00 – General

A. System Equipment Manufacturer/Provider shall be chosen by owner.
B. Coordinate premises wiring with requirements of local telephone exchange carrier satellite provider, and internet provider.

Part 2.00 – Materials

A. For the incoming fiber optic cable, an underground and under slab 1" PVC conduit with long radius sweeps shall be routed from the southwest corner of the property (verify exact location with Ritter Communications) to the communications equipment location in office area. A similar conduit shall route from this communications equipment under the slab and underground to near the back of the ministry building for the routing of a fiber optic cable to the ministry Building. Provide pull boxes as needed and a minimum #12 AWG pull wire in conduit. Verify location of communications equipment with owner. Verify all requirements with Ritter Communications before conduit rough-in.
B. PVC conduit (3/4") shall be installed from each internet outlet connection, shown on drawings, to above the drop ceiling. In areas where there is not a drop ceiling, EMT conduit shall be used for all portion of communication conduit.
C. Install ERICO Caddy "J" hooks (or equivalent) to neatly secure and bundle all cables above the drop ceiling.
D. Internet Communication data cables shall be multi-twisted pair, # 24 AWG, listed for compliance with CAT 6 requirements. Verify exact specifications of cable with owner. Cable in plenums shall be listed for use in plenums.
E. Wall plates shall match the material and color of the wall plates for the power receptacle outlets in the same area.

Part 3.00 – Installation

A. Comply with Ritter Communications' requirements.
B. Install wiring in compliance with all CAT 6 requirements.
C. Wiring shall be installed in raceway in walls. Terminate raceway with a bushing above drop ceiling, unless otherwise indicated. Install flush outlet boxes with jack assemblies at outlets.
D. Install a minimum # 6 AWG ground wire from the intersystem bonding termination strip (at electrical service entrance) to the ground terminal at local exchange carrier service location (DMARC) if applicable. Also provide a # 6 AWG ground wire from the intersystem bonding termination strip (at electrical service entrance) to the communication equipment in office area.

End of Section 27 00 00