SECTION 26 00 02
ELECTRICAL PREFERRED ALTERNATES

PART 1 GENERAL

1.01 LIST OF ALTERNATES

A Refer to Architect's Division 01 Specification for Bid Alternates.

END OF SECTION 26 00 02 26 00 02

SECTION 26 01 00
ELECTRICAL GENERAL PROVISIONS

PART 1 GENERAL

1.01 SCOPE OF WORK

A This Contractor shall provide all materials, equipment and labor necessary to install and set into operation the electrical equipment as shown on the Engineering Drawings and as contained herein.

1.02 QUALITY ASSURANCE

A See the General and Supplementary General Conditions and Architectural Divisions.

B All work shall be in accordance with the North Carolina State Building Code, which includes the 2020 edition of the National Electrical Code.

C The Contractor shall be responsible for obtaining all permits and shall notify inspection departments as work progresses.

D Wherever the words "Approved", "Approval", and "Approved Equal" appear, it is intended that items other than the model numbers specified shall be subject to the approval of the Engineer.

E "Provide" as used herein shall mean that the Contractor responsible shall furnish and install said item or equipment. “Furnish" as used herein shall mean that the Contractor responsible shall acquire and make available said item or equipment and that installation shall be by others. "Install" as used herein shall mean that the Contractor responsible shall make installation of items or equipment furnished by others.

F All personnel under this Contractor’s supervision shall be qualified to perform those portions of the work assigned to them. Personnel (including project managers) deemed to be negative to the overall success of the project shall be removed from the project and replaced with qualified personnel who will be positive for the project. Upon written notification that particular personnel have been deemed negative to the overall success of the project, this Contractor shall immediately replace such particular personnel. The engineer shall be sole arbiter and any decision regarding fitness of this Contractor’s personnel for this project shall not be subject to appeal.

1.03 SUBMITTALS

A See General and Supplementary General Conditions and Division 1.

B Within ten (10) days after notification of the award of the Contract and written notice to begin work, the Contractor shall submit for approval to the Architect/Engineer a detailed list of equipment and material which he proposes to use.

C The Contractor shall provide an electronic pdf copy of the submittal data on the products, methods, etc. proposed for use on the project. The submittal shall contain complete submittal data on all products, methods, etc. proposed for use on the project.

D Each submittal shall bear the approval of the Contractor indicating that he has reviewed the data and found it to meet the requirements of the specifications as well as space limitations and other project conditions. The submittals shall be clearly identified showing project name, manufacturer's catalog number and all necessary performance and fabrication data. Detailed submittal data shall be provided when items are to be considered as substitution for specified items. Acceptance for approval shall be in writing from the Engineer.

E The Contractor shall submit to the Engineer a set of accurately marked-up plans indicating all changes encountered during the construction. Final payment will be contingent on receipt of these as-built plans.

F The Contractor shall furnish an electronic copy of maintenance and operating instructions.

G The Contractor shall submit to the Engineer a duplicate set of final electrical inspection certificates prior to final payment.

1.04 PRODUCT DELIVERY, STORAGE AND HANDLING

A All material and equipment shall be delivered and unloaded by the Contractor within the project site as noted herein or as directed by the Owner.

B The Contractor shall protect all material and equipment from breakage, theft or weather damage. No material or equipment shall be stored on the ground.

C The material and equipment shall remain the property of the Contractor until the project has been completed and turned over to the Owner.

D Where equipment cannot be stored at the site due to exposure to the elements or lack of storage space , the contractor shall store all equipment in a bonded warehouse until the time of installation.

1.05 WORK CONDITIONS AND COORDINATION

A The Contractor shall review the entire set of plans to establish points of connection and the extent of electrical work to be provided in his Contract.

B The contractor is responsible for reviewing the complete set of contract documents. Coordinate all phasing requirements with architectural drawings. Coordinate equipment locations and utility routing with all trades to ensure code compliance and constructibility.

C This Contractor shall be responsible for all electrical work and make final connections to equipment installed in his Contract.

D Pipe, conduit and duct chases required for installation of work shall be provided by the General Contractor unless otherwise noted. This Contractor shall be responsible for coordinating the location of all required chases.

E All work shall be coordinated with other trades. Cutting of new work and subsequent patching shall be approved by Architect/ Engineer and shall be at the Contractor's expense with no extra cost to the Owner.

1.06 GUARANTEE

A See the General and Supplementary General Conditions.

B Where extended warranties or guarantees are available from the manufacturer, the Contractor shall prepare the necessary Contract Documents to validate these warranties as required by the manufacturer and present them to the Architect/Engineer.

PART 2 PRODUCTS

2.01 MATERIAL QUALITY

A Material and equipment shall be new, unless noted otherwise, of the highest grade and quality and free from defects or other imperfections. Material and equipment found defective shall be removed and replaced at the Contractor's expense.

2.02 EQUIPMENT LISTINGS

A All materials and equipment shall be third party listed by an agency accredited by the NCBCC and NC Department of Insurance (NC DOI). The list of accredited agencies may be obtained on NCDOI's web site.

PART 3 EXECUTION

3.01 INSPECTION

A If any part of this Contractor's work is dependent for its proper execution or for its subsequent efficiency or appearance on the character or conditions of contiguous work not executed by him, the Contractor shall examine and measure such contiguous work and report to the Architect or Engineer in writing any imperfection therein, or conditions that render it unsuitable for the reception of this work. Should the Contractor proceed without making such written report, he shall be held to have accepted such work and the existing conditions and he shall be responsible for any defects in this work consequent hereon and will not be relieved of the obligation of any guarantee because of any such imperfection or condition.

B After the designer pre-final inspection and confirmation that the final punch list items have been completed. The contractor shall schedule a final electrical inspection with the local inspections office.

3.02 INSTALLATION

A All work shall be performed in a manner indicating proficiency in the trade.

B All conduit, pipes, ducts, etc., shall be either parallel to building walls or plumb where installed in a vertical position and shall be concealed when located in architecturally finished areas.

C Any cutting or patching required for installation of this Contractor's work shall be kept to a minimum. Written approval shall be required by the Architect/Engineer if cutting of primary structure is involved.

D All patching shall be done in such a manner as to restore the areas or surfaces to match existing finishes.

E The Contractor shall lay-out and install his work in advance of pouring concrete floors or walls. He shall furnish and install all sleeves or openings through poured masonry floors or walls above grade required for passage of all conduits, pipes or duct installed by him. The Contractor shall furnish and install all inserts and hangers required to support his equipment.

F The Contractor shall be responsible for removing all spray-on fireproofing overspray from all equipment, light fixtures, and all other materials provided as part of the electrical contract.

3.03 PERFORMANCE

A The Contractor shall perform all excavation and backfill operations necessary for installation of his work.

B Rock excavation shall be defined in the Supplementary General Conditions, Division 1 or Division 2. Unless specifically stated, neither rock excavation nor a unit price for rock excavation shall be required in the bid.

3.04 ERECTION

A All support steel, angles, channels, pipes or structural steel stands and anchoring devices that may be required to rigidly support or anchor material and equipment shall be provided by this Contractor.

3.05 FIELD QUALITY CONTROL

A The Contractor shall conform to the requirements of Division 3 for concrete testing.

B The Contractor shall test his entire installation and shall furnish the labor and materials required for these tests. Tests shall be performed in accordance with the requirements of the particular section of the specifications and in accordance with the requirements of the State Ordinances and Codes, and the National Electrical Code. The Contractor shall notify the Architect or Engineer of his readiness for such test. A final inspection by the Electrical Inspector or Local Authority Having Jurisdiction is required, and an inspection certificate is required prior to authorization of final payment.

C Testing required for compliance with the Contract shall be stated in subsequent sections.

D All tests specified shall be completely documented indicating time of day, date, temperature and all other pertinent test information including the entity conducting the test.

E All required documentation of readings required by each test shall be submitted to the Engineer prior to, and as one of the prerequisites for, final acceptance of the project.

3.06 ADJUST AND CLEAN

A All equipment and installed materials shall be thoroughly clean and free of all dirt, oil, grit, grease, etc.

B Factory painted equipment shall not be repainted unless damaged areas exist. These areas shall be touched up with a material suitable for the intended service. In no event shall nameplates be painted.

C At a scheduled meeting, the Contractor shall instruct the Owner or the Owner's representative in the operation and maintenance of all equipment installed under his Contract (in the presence of the Engineer).

3.07 MAINTENANCE AND OPERATING MANUAL

A The Contractor shall prepare an electronic submission of a manual describing the proper maintenance and system operation. This manual shall not consist of standard factory printed data intended for dimension or design purposes (although these may be included), but shall be prepared to describe this particular job. This manual shall include the following:

B Data on all equipment as listed on the fixture and equipment schedules on the plans. Also data on all fire alarm, data, security system, lighting control systems, generator, battery backup system, etc. that are applicable for the project.

C Warranties as required for each product.

D A check list for periodic maintenance of all equipment requiring maintenance. (i.e., fire alarm system, security system, generator, battery backup system, etc.)

E Maintenance and spare parts data for all equipment.

F As-Built wiring for equipment containing field wired systems. (i.e., fire alarm, security, data system, lighting control, generator, etc.)

G The manuals shall be dated and signed by the Contractor when completed.

H The operating and maintenance manuals shall be submitted to the Engineer for approval. When the manuals are considered complete by the Engineer, they will be turned over to the Owner for their permanent use.

END OF SECTION 26 01 00 26 01 00

SECTION 26 05 05
ELECTRICAL DEMOLITION

PART 1 GENERAL

1.01 SECTION INCLUDES

A Electrical demolition.

PART 2 PRODUCTS

2.01 MATERIALS AND EQUIPMENT

A Materials and equipment for patching and extending work.

PART 3 EXECUTION

3.01 EXAMINATION

A Verify field measurements and circuiting arrangements are as indicated.

B Demolition drawings are based on casual field observation and existing record documents.

C Report discrepancies to Owner before disturbing existing installation.

D Report discrepancies to Architect before disturbing existing installation.

3.02 PREPARATION

A Disconnect electrical systems in walls, floors, and ceilings to be removed.

B Coordinate utility service outages with utility company.

C Provide temporary wiring and connections to maintain existing systems in service during construction. When work must be performed on energized equipment or circuits, use personnel experienced in such operations.

D Existing Electrical Service: Maintain existing system in service until new system is complete and ready for service. Disable system only to make switchovers and connections. Minimize outage duration.

1. Obtain permission from Owner at least 48 hours before de-energizing system.

E Fire alarm system shall be maintained to all occupied portions of the building.

1. Notify Owner and Fire Marshall a least 48 hours before partially or completely disabling system.
2. If the Fire alarm system cannot be maintained in the occupied portion of the building contractor shall provide a fire watch in accordance with NFPA 72 and local authority requirements.

3.03 DEMOLITION AND EXTENSION OF EXISTING ELECTRICAL WORK

A Perform work for removal and disposal of equipment and materials containing toxic substances regulated under the Federal Toxic Substances Control Act (TSCA) in accordance with applicable federal, state, and local regulations. Lamps are to be disposed of in accordance with NC G.S. 130A - 310.60. Applicable equipment and materials include, but are not limited to:

1. PCB-containing electrical equipment, including transformers, capacitors, and switches.
2. PCB- and DEHP-containing lighting ballasts.
3. Mercury-containing lamps and tubes, including fluorescent lamps, high intensity discharge (HID), arc lamps, ultra-violet, high pressure sodium, mercury vapor, ignitron tubes, neon, and incandescent.

B Remove, relocate, and extend existing installations to accommodate new construction.

C Remove abandoned wiring to source of supply.

D Remove exposed abandoned conduit, including abandoned conduit above accessible ceiling finishes. Where conduit cannot be removed from floors or walls, cut conduit flush with walls and floors, and patch surfaces.

E Disconnect abandoned outlets and remove devices. Remove abandoned outlets if conduit servicing them is abandoned and removed. Provide blank cover for abandoned outlets that are not removed.

F Disconnect and remove all panelboards, and distribution equipment in main builing and selective demolition in the mechanical building.

G Disconnect and remove electrical devices and equipment serving utilization equipment that has been removed.

H Disconnect and remove luminaires. Remove brackets, stems, hangers, and other accessories.

I Repair adjacent construction and finishes damaged during demolition and extension work.

J Maintain access to existing electrical installations that remain active as app. Modify installation or provide access panel as appropriate.

K Remove all devices from walls or ceilings shown to be removed on the Architectural drawings wether shown on the electrical demolition plans or not.

L Where existing downstream devices are to remain, extend existing branch circuit conduit and conductors to maintain service.

3.04 CLEANING AND REPAIR

A Clean and repair existing materials and equipment that remain or that are to be reused.

END OF SECTION 26 05 05

SECTION 26 05 19
POWER CONDUCTORS AND CABLES

PART 1 GENERAL

1.01 SECTION INCLUDES

A Single conductor building wire.
B Underground feeder and branch-circuit cable.
C Wiring connectors.
D Electrical tape.
E Oxide inhibiting compound.
F Wire pulling lubricant.

1.02 REFERENCE STANDARDS

A ASTM B3 - Standard Specification for Soft or Annealed Copper Wire; 2013 (Reapproved 2018).
B ASTM B8 - Standard Specification for Concentric-Lay-Stranded Copper Conductors, Hard, Medium-Hard, or Soft; 2023.
C ASTM B33 - Standard Specification for Tin-Coated Soft or Annealed Copper Wire for Electrical Purposes; 2010, with Editorial Revision (2020).
D ASTM B787/B787M - Standard Specification for 19 Wire Combination Unilay-Stranded Copper Conductors for Subsequent Insulation; 2004 (Reapproved 2020).
E NFPA 70 - National Electrical Code; National Fire Protection Association, Including All Applicable Amendments and Supplements; 2020.

1.03 SUBMITTALS

A Product Data: Provide manufacturer's standard catalog pages and data sheets for conductors and cables, including detailed information on materials, construction, ratings, listings, and available sizes, configurations, and stranding.
B Field Quality Control Test Reports.
C Manufacturer's Installation Instructions: Indicate application conditions and limitations of use stipulated by product testing agency. Include instructions for storage, handling, protection, examination, preparation, and installation of product.
D Project Record Documents: Record actual installed circuiting arrangements. Record actual routing of exterior below grade conduit and associated hand holes or man holes..
E Maintenance Materials: Furnish the following for Owner's use in maintenance of project.

1.04 QUALITY ASSURANCE

A Comply with requirements of NFPA 70.
B Manufacturer Qualifications: Company specializing in manufacturing the products specified in this section with minimum five years documented experience.
C Product Listing Organization Qualifications: Third party agencies shall be amongst those accredited by the NCBCC (North Carolina Building Code Council) to label Electrical and Mechanical Equipment.

1.05 DELIVERY, STORAGE, AND HANDLING

A Receive, inspect, handle, and store conductors and cables in accordance with manufacturer's instructions.

1.06 FIELD CONDITIONS

A Do not install or otherwise handle thermoplastic-insulated conductors at temperatures lower than 14 degrees F, unless otherwise permitted by manufacturer's instructions. When installation below this temperature is unavoidable, notify Architect and obtain direction before proceeding with work.

PART 2 PRODUCTS

2.01 CONDUCTOR AND CABLE APPLICATIONS

A Do not use conductors and cables for applications other than as permitted by NFPA 70 and product listing.
B Provide single conductor building wire installed in suitable raceway unless otherwise indicated, permitted, or required.
C Nonmetallic-sheathed cable is not permitted.
D Service entrance cable is not permitted.

2.02 CONDUCTOR AND CABLE GENERAL REQUIREMENTS

A Provide products that comply with requirements of NFPA 70.

B Provide products listed, classified, and labeled as suitable for the purpose intended.

C All conductors shall be labeled two feet on centers indicating size, type, voltage, rating, and manufacturer's name.

D Provide new conductors and cables manufactured not more than one year prior to installation.

E Unless specifically indicated to be excluded, provide all required conduit, boxes, wiring, connectors, etc. as required for a complete operating system.

F Comply with NEMA WC 70.

G Conductor Material:

1. Provide copper conductors. Substitution of aluminum conductors for copper is not permitted.
2. Copper Conductors: Soft drawn annealed, 98 percent conductivity, uncoated copper conductors.

H Minimum Conductor Size:12 AWG.

I Maximum Conductor Size: 500 kcmil

J Conductors for branch circuits shall be sized to prevent a voltage drop exceeding three percent (3%) at the farthest outlet of power, heating and lighting loads, or any combination of such loads. The maximum total voltage drop on both feeders and branch circuits to the farthest outlet shall not exceed five percent (5%).

1. Where the branch circuit conductor length from the panel to the first outlet on a 277 volt circuit exceeds 125 feet, the branch circuit conductors from the panel to the first outlet shall not be smaller than #10 AWG. Increase the branch circuit conductor size an additional wire size for reach 125’ of additional length of the entire circuit. The ground conductor size shall be increased proportionately to the increase in the phase conductors per 2020 NEC 250.122(B).
2. Where the conductor length from the panel to the first outlet on a 120 volt circuit exceeds 50 feet, the branch circuit conductors from the panel to the first outlet shall not be smaller than #10 AWG. Increase the branch circuit conductor size an additional wire size for reach 100’ of additional length of the entire circuit. The ground conductor size shall be increased proportionately to the increase in the phase conductors per 2020 NEC 250.122(B).

K Conductor Color Coding:

1. Color code conductors as indicated unless otherwise required by the authority having jurisdiction. Maintain consistent color coding throughout project.
2. Color Coding Method:
   a. Conductors #10 AWG and smaller shall be factory color coded.
   b. Conductors #3 and larger shall be factory color coded on the entire length.
3. Color Code:
   a. 480Y/277 V, 3 Phase, 4 Wire System:
      1) Phase A: Brown.
      2) Phase B: Orange.
      3) Phase C: Yellow.
      4) Neutral/Grounded: Gray.
   b. 208Y/120 V, 3 Phase, 4 Wire System:
      1) Phase A: Black.
      2) Phase B: Red.
      3) Phase C: Blue.
      4) Neutral/Grounded: White.
   c. Equipment Ground, All Systems: Green.
   d. 0 - 10V Dimming conductors: Violet and Grey

2.03 BUILDING WIRE

A Approved Manufacturers as listed below or approved equal:

1. Copper or Aluminum Building Wire:
   a. Triangle
   b. Okonite

c. Houston Wire and Cable
d. or approved equal

B Description: Single conductor insulated wire.

C Conductor Stranding:
1. Feeders and Branch Circuits:
a. Size 10 AWG and Smaller: Solid.
b. Size 8 AWG and Larger: Class B Stranded.

D Insulation Voltage Rating: 600 V.

E Insulation:
1. Copper Building Wire: Type THHN/THWN or XHHW-2.
2. Conductors routed on roofs or other exterior surface where raceway is exposed to direct sunlight shall be type XHHW-2 insulation.

2.04 WIRING CONNECTORS

A Description: Wiring connectors appropriate for the application, suitable for use with the conductors to be connected, and listed as complying with UL 486A-486B or UL 486C as applicable.

B Connectors for Grounding and Bonding: Comply with Section 26 05 26.

C Wiring Connectors for Splices and Taps:
1. Splices or taps shall not be allowed for feeder conductors unless specifically noted on plans.
2. Where a splice or tap for feeder conductors is noted on the plans, connectors shall be Blackburn insulated multi-tap or approved equal.
3. Splices in branch circuit conductors shall be allowed in accessible junction boxes, troughs, or gutters.
a. Copper Conductors #10 AWG and smaller: Use twist-on insulated spring connectors.
b. Copper Conductors #8 AWG and larger: Use mechanical connectors with gum rubber tape or friction tape. Solderless mechanical connectors with UL listed insulating covers may be used at contractor's option.
4. Use of split bolts is not allowed.
5. "Sta-kon" or other permanent type crimp connectors shall not be used for branch circuit connections.

D Wiring Connectors for Terminations:
1. Provide terminal lugs for connecting conductors to equipment furnished with terminations designed for terminal lugs.
2. Provide compression adapters for connecting conductors to equipment furnished with mechanical lugs when only compression connectors are specified.
3. Where over-sized conductors are larger than the equipment terminations can accommodate, provide connectors suitable for reducing to appropriate size, but not less than required for the rating of the overcurrent protective device.

E Twist-on Insulated Spring Connectors: Rated 600 V, 221 degrees F for standard applications and 302 degrees F for high temperature applications; pre-filled with sealant and listed as complying with UL 486D for damp and wet locations.

2.05 ACCESSORIES

A Electrical Tape:
1. Vinyl Color Coding Electrical Tape: Integrally colored to match color code indicated; listed as complying with UL 510; minimum thickness of 7 mil; resistant to abrasion, corrosion, and sunlight; suitable for continuous temperature environment up to 221 degrees F.
a. Product: Okonite 2000 or approved equal.
2. Vinyl Insulating Electrical Tape: Complying with ASTM D3005 and listed as complying with UL 510; minimum thickness of 7 mil; resistant to abrasion, corrosion, and sunlight; conformable for application down to 0 degrees F and suitable for continuous temperature environment up to 221 degrees F.

B Wire Pulling Lubricant: Listed; suitable for use with the conductors or cables to be installed and suitable for use at the installation temperature.

PART 3 EXECUTION

3.01 EXAMINATION

A Verify that interior of building has been protected from weather.

B Verify that work likely to damage wire and cable has been completed.

C Verify that raceways, boxes, and equipment enclosures are installed and are properly sized to accommodate conductors and cables in accordance with NFPA 70.

D Verify that field measurements are as indicated.

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

3.02 PREPARATION

A Clean raceways thoroughly to remove foreign materials before installing conductors and cables.

3.03 INSTALLATION

A Circuiting Requirements:

1. Circuit routing indicated is diagrammatic.
2. Maintain separation of Class 1, Class 2, and Class 3 remote-control, signaling, and power-limited circuits in accordance with NFPA 70.
3. 0 - 10V lighting dimming conductors may not be routed in the same raceway with line voltage conductors.
4. Maintain separation of wiring for emergency systems in accordance with NFPA 70.
5. Common Neutrals: Unless otherwise indicated, sharing of neutral/grounded conductors among up to three single phase branch circuits of different phases installed in the same raceway is not permitted. Provide dedicated neutral/grounded conductor for each individual branch circuit.
6. A dedicated green equipment grounding conductor shall be provided for all raceways containing branch circuit or feeder conductors. Equipment ground conductor shall be sized in accordance with the NEC.

B Install products in accordance with manufacturer's instructions.

C Install conductors and cable in a neat and workmanlike manner. Neatly train and lace wiring inside boxes, equipment, and panelboards.

D Installation in Raceway:

1. Tape ends of conductors and cables to prevent infiltration of moisture and other contaminants.
2. Pull all conductors and cables together into raceway at same time.
3. Do not damage conductors and cables or exceed manufacturer's recommended maximum pulling tension and sidewall pressure.
4. Use suitable wire pulling lubricant for conductors #4 AWG or larger, except when lubricant is not recommended by the manufacturer.

E Paralleled Conductors: Install conductors of the same length and terminate in the same manner.

F Secure and support conductors and cables in accordance with NFPA 70 using suitable supports and methods approved by the authority having jurisdiction. Provide independent support from building structure. Do not provide support from raceways, piping, ductwork, or other systems.

G Install conductors with a minimum of 12 inches of slack at each outlet.

H Neatly train conductors inside boxes, wireways, panelboards and other equipment enclosures. Condcutors shall not be laced or bundled to avoid overheating.

I Group or otherwise identify neutral/grounded conductors with associated ungrounded conductors inside enclosures in accordance with NFPA 70.

J Make wiring connections using specified wiring connectors.

1. Remove appropriate amount of conductor insulation for making connections without cutting, nicking or damaging conductors.
2. Do not remove conductor strands to facilitate insertion into connector.
3. Clean contact surfaces on conductors and connectors to suitable remove corrosion, oxides, and other contaminates. Do not use wire brush on plated connector surfaces.

K Insulate ends of spare conductors using vinyl insulating electrical tape.

L Unless specifically indicated to be excluded, provide final connections to all equipment and devices, including those furnished by others, as required for a complete operating system.

3.04 FIELD QUALITY CONTROL

A All tests shall be completely documented indicating time of day, date, temperature and all pertinent test information. All required documentation shall be submitted to the Engineer prior to, and as a prerequisite for, final acceptance of the project. All test results shall be included in the Owner's operation and maintenance manual.

B Inspect and test in accordance with NETA ATS, Section 7.3.2.

1. Perform each of the following visual and electrical tests:
    a. Compare cable data with drawings and specifications to ensure compliance with contract documents.
    b. Inspect exposed sections of conductor and cable for physical damage and correct connection according to the single-line diagram.
    c. Test bolted connections for high resistance using one of the following:
        1) A low-resistance ohmmeter.
        2) Calibrated torque wrench.
    d. Inspect compression-applied connectors for correct cable match and indentation.
    e. Inspect for correct identification.
    f. Inspect cable jacket and condition.
    g. Continuity test on each conductor and cable.
    h. Uniform resistance of parallel conductors.

C Insulation resistance test is required for all feeder conductors prior to energizing feeders, sub-feeders, or service entrance conductors.

1. All current carrying feeder phase conductors and neutrals shall be tested as installed, and before connections are made, for insulation resistance and accidental grounds. This shall be done with a 500 volt insulation resistance tester. In the procedures listed below shall be followed:
    a. Minimum readings shall be one million (1,000,000) or more ohms for #6 AWG wire and smaller, 250,000 ohms or more for #4 AWG wire or larger, between conducts and between conductor and the grounding conductor.
    b. After all fixtures, devices and equipment are installed and all connections completed to each panel, the Contractor shall disconnect the neutral feeder conductor from the neutral bar and take a insulation resistance reading between the neutral bar and the grounded enclosure. If this reading is less than 250,000 ohms, the Contractor shall disconnect the branch circuit neutral wires from this neutral bar. He shall then test each one separately to the panel and until the low readings are found. The Contractor shall correct troubles, reconnect and retest until at 250,000 ohms from the neutral bar to the grounded panel can be achieved with only the neutral feeder disconnected.
    c. The Contractor shall send a letter to the Engineer certifying that the above has been done and tabulating the insulation resistance readings for each panel. This shall be done at least four (4) days prior to final inspection.
    d. At final inspection, The Contractor shall furnish a insulation resistance tester and show the Engineer’s representatives that the panels comply with the above requirements. He shall also furnish a hook-on type ammeter and voltmeter to take current and voltage readings as directed by the representatives.
    e. Results of the test shall be made available to the engineer at the required pre-energization walk through.
2. Disconnect surge protective devices (SPDs) prior to performing any high potential testing. Replace SPDs damaged by performing high potential testing with SPDs connected.

D Correct deficiencies and replace damaged or defective conductors and cables and re-test as indicated above. Contractor shall submit new test results to the Engineer to demonstrate the deficiency has been corrected.

END OF SECTION 26 05 19

SECTION 26 05 26
GROUNDING AND BONDING FOR ELECTRICAL SYSTEMS

PART 1 GENERAL

1.01 SECTION INCLUDES

A Grounding and bonding requirements.
B Conductors for grounding and bonding.
C Connectors for grounding and bonding.
D Ground bars.
E Ground rod electrodes.

1.02 REFERENCE STANDARDS

A IEEE 81 - IEEE Guide for Measuring Earth Resistivity, Ground Impedance, and Earth Surface Potentials of a Grounding System; 2012.
B NEMA GR 1 - Grounding Rod Electrodes and Grounding Rod Electrode Couplings; 2022.
C NETA ATS - Standard For Acceptance Testing Specifications For Electrical Power Equipment And Systems; 2021.
D NFPA 70 - National Electrical Code; National Fire Protection Association, Including All Applicable Amendments and Supplements; 2020.
E UL 467 - Grounding and Bonding Equipment; Current Edition, Including All Revisions.

1.03 ADMINISTRATIVE REQUIREMENTS

A Coordination:
1. Verify exact locations of underground metal water service pipe entrances to building.
2. Coordinate the work with other trades to provide steel reinforcement complying with specified requirements for concrete-encased electrode.
3. Notify Architect of any conflicts with or deviations from Contract Documents. Obtain direction before proceeding with work.

B Sequencing:
1. Do not install ground rod electrodes until final backfill and compaction is complete.

1.04 SUBMITTALS

A Product Data: Provide manufacturer's standard catalog pages and data sheets for grounding and bonding system components.
B Manufacturer's Instructions: Indicate application conditions and limitations of use stipulated by product testing agency. Include instructions for storage, handling, protection, examination, preparation, and installation of product.
C Field quality control test reports.
D Project Record Documents: Record actual locations of grounding electrode system components and connections.

1.05 QUALITY ASSURANCE

A Comply with requirements of NFPA 70.
B Manufacturer Qualifications: Company specializing in manufacturing the products specified in this section with minimum three years documented experience.
C Product Listing Organization Qualifications: Third party agencies shall be amongst those accredited by the NCBCC (North Carolina Building Code Council) to label Electrical and Mechanical Equipment.

1.06 DELIVERY, STORAGE, AND HANDLING

A Receive, inspect, handle, and store products in accordance with manufacturer's instructions.

PART 2 PRODUCTS

2.01 GROUNDING AND BONDING REQUIREMENTS

A Existing Work: Where existing grounding and bonding system components are indicated to be reused, they may be reused only where they are free from corrosion, integrity and continuity are verified, and where acceptable to the authority having jurisdiction.
B Do not use products for applications other than as permitted by NFPA 70 and product listing.

C Unless specifically indicated to be excluded, provide all required components, conductors, connectors, conduit, boxes, fittings, supports, accessories, etc. as necessary for a complete grounding and bonding system.

D Where conductor size is not indicated, size to comply with NFPA 70 but not less than applicable minimum size requirements specified.

E Grounding System Resistance:

1. Achieve specified grounding system resistance under normally dry conditions unless otherwise approved by Architect. Precipitation within the previous 48 hours does not constitute normally dry conditions.
2. Grounding Electrode System: Not greater than 5 ohms to ground, when tested according to IEEE 81 using "fall-of-potential" method.
3. Between Grounding Electrode System and Major Electrical Equipment Frames, System Neutral, and Derived Neutral Points: Not greater than 0.5 ohms, when tested using "point-to-point" methods.

F Grounding Electrode System:

1. Provide connection to required and supplemental grounding electrodes indicated to form grounding electrode system.
   a. Provide continuous grounding electrode conductors without splice or joint.
   b. Install grounding electrode conductors in raceway where exposed to physical damage. Bond grounding electrode conductor to metallic raceways at each end with bonding jumper.
2. Metal Underground Water Pipe(s):
   a. Provide connection to underground metal domestic and fire protection (where present) water service pipe(s) that are in direct contact with earth for at least 10 feet at an accessible location not more than 5 feet from the point of entrance to the building.
   b. Provide bonding jumper(s) around insulating joints/pipes as required to make pipe electrically continuous.
   c. Provide bonding jumper around water meter of sufficient length to permit removal of meter without disconnecting jumper.
3. Metal In-Ground Support Structure:
   a. Provide connection to metal in-ground support structure that is in direct contact with earth in accordance with NFPA 70.
4. Concrete-Encased Electrode:
   a. Where metallic structural components meet the definition of a concrete encased electrode as defined in NEC 250.52, the concrete encased electrode shall be bonded to the grounding electrode system per NEC 250.50. Coordinate with the structure prior to pouring concrete foundations.
   b. Provide connection to concrete-encased electrode consisting of not less than 20 feet of either steel reinforcing bars or bare copper conductor not smaller than 4 AWG embedded within concrete foundation or footing that is in direct contact with earth in accordance with NFPA 70.
5. Ground Rod Electrode(s):
   a. Space electrodes not less than 10 feet from each other and any other ground electrode until maximum allowed resistance to ground is achieved.
   b. Where location is not indicated, locate electrode(s) at least 5 feet outside building perimeter foundation as near as possible to electrical service entrance; where possible, locate in softscape (uncovered) area.
6. Provide additional ground electrode(s) as required to achieve specified grounding electrode system resistance.
7. Ground Bar: Provide ground bar in main electrical room, separate from service equipment enclosure, for common connection point of grounding electrode system bonding jumpers as permitted in NFPA 70. Connect grounding electrode conductor provided for service-supplied system grounding to this ground bar.
   a. Ground Bar Size: 1/4" x 2" x 18" unless otherwise indicated or required.

b. Where ground bar location is not indicated, locate in accessible location as near as possible to service disconnect enclosure.

8. unless otherwise noted. Location as identified on plans.
9. Ground Riser: Provide common grounding electrode conductor not less than 3/0 AWG for tap connections to multiple separately derived systems as permitted in NFPA 70.

G Service-Supplied System Grounding:

1. For each service disconnect, provide grounding electrode conductor to connect neutral (grounded) service conductor to grounding electrode system. Unless otherwise indicated, make connection at neutral (grounded) bus in service disconnect enclosure.
2. For each service disconnect, provide main bonding jumper to connect neutral (grounded) bus to equipment ground bus where not factory-installed. Do not make any other connections between neutral (grounded) conductors and ground on load side of service disconnect.

H Separately Derived System Grounding:

1. Separately derived systems include, but are not limited to:
   a. Transformers.
   b. Uninterruptible power supplies (UPS), when configured as separately derived systems.
   c. Generators, when neutral is switched in the transfer switch.
2. Provide grounding electrode conductor to connect derived system grounded conductor to nearest effectively grounded metal building frame. Unless otherwise indicated, make connection at neutral (grounded) bus in source enclosure.
3. Provide bonding jumper to connect derived system grounded conductor to nearest metal building frame and nearest metal water piping in the area served by the derived system, where not already used as a grounding electrode for the derived system. Make connection at same location as grounding electrode conductor connection.
4. Where common grounding electrode conductor ground riser is used for tap connections to multiple separately derived systems, provide bonding jumper to connect the metal building frame and metal water piping in the area served by the derived system to the common grounding electrode conductor.
5. Provide system bonding jumper to connect system grounded conductor to equipment ground bus. Make connection at same location as grounding electrode conductor connection. Do not make any other connections between neutral (grounded) conductors and ground on load side of separately derived system disconnect.

I Bonding and Equipment Grounding:

1. Provide bonding for equipment grounding conductors, equipment ground busses, metallic equipment enclosures, metallic raceways and boxes, device grounding terminals, and other normally non-current-carrying conductive materials enclosing electrical conductors/equipment or likely to become energized as indicated and in accordance with NFPA 70.
2. Provide insulated equipment grounding conductor in each feeder and branch circuit raceway. Do not use raceways as sole equipment grounding conductor.
3. Where circuit conductor sizes are increased for voltage drop, increase size of equipment grounding conductor proportionally in accordance with NFPA 70.
4. Unless otherwise indicated, connect wiring device grounding terminal to branch circuit equipment grounding conductor and to outlet box with bonding jumper.
5. Terminate branch circuit equipment grounding conductors on solidly bonded equipment ground bus only. Do not terminate on neutral (grounded) or isolated/insulated ground bus.
6. Provide bonding jumper across expansion or expansion/deflection fittings provided to accommodate conduit movement.
7. Provide bonding for interior metal piping systems in accordance with NFPA 70. This includes, but is not limited to:
   a. Metal water piping where not already effectively bonded to metal underground water pipe used as grounding electrode.

b. Metal gas piping.
c. Metal process piping.

J Communications Systems Grounding and Bonding:
1. Provide intersystem bonding termination at service equipment or metering equipment enclosure and at disconnecting means for any additional buildings or structures in accordance with NFPA 70.
2. Provide bonding jumper in raceway from intersystem bonding termination to each communications room or backboard and provide ground bar for termination.
a. Bonding Jumper Size: #3/0 AWG.
b. Raceway Size: 1" trade size unless otherwise indicated or required.
c. Ground Bar Size: 1/4" x 2" x 18" unless otherwise indicated or required.
d. Ground Bar Mounting Height: 18 inches above finished floor unless otherwise indicated.

2.02 GROUNDING AND BONDING COMPONENTS

A General Requirements:
1. Provide products listed, classified, and labeled as suitable for the purpose intended.
2. Provide products listed and labeled as complying with UL 467 where applicable.

B Conductors for Grounding and Bonding, in Addition to Requirements of Section 26 05 26:
1. Use insulated copper conductors unless otherwise indicated.
a. Exceptions:
1) Use bare copper conductors where installed underground in direct contact with earth.
2) Use bare copper conductors where directly encased in concrete (not in raceway).
2. Where insulated grounding conductors are used conductors shall be colored solid green.
3. Grounding electrode conductors #4 AWG and larger shall be installed in raceway.

C Connectors for Grounding and Bonding:
1. Description: Connectors appropriate for the application and suitable for the conductors and items to be connected; listed and labeled as complying with UL 467.
2. Unless otherwise indicated, use exothermic welded connections for underground, concealed and other inaccessible connections.
3. Unless otherwise indicated, use double crimp compression connectors or exothermic welded connections for accessible connections.

D Ground Bars:
1. Description: Copper rectangular ground bars with mounting brackets and insulators.
2. Size: As indicated elsewhere in this section.
3. Holes for Connections: All mechanical connectors shall be double hole double crimp compression connectors..

E Ground Rod Electrodes:
1. Comply with NEMA GR 1.
2. Material: Copper-bonded (copper-clad) steel.
3. Size: 3/4 inch diameter by 10 feet length, unless otherwise indicated.

PART 3 EXECUTION

3.01 EXAMINATION

A Verify that work likely to damage grounding and bonding system components has been completed.
B Verify that field measurements are as indicated.
C Verify that conditions are satisfactory for installation prior to starting work.

3.02 INSTALLATION

A Install products in accordance with manufacturer's instructions.
B Install grounding and bonding system components in a neat and workmanlike manner.
C Boxes with concentric, eccentric or oversized knockouts shall be provided with bonding bushings and jumpers. The jumper shall be sized per NEC table 250-122 and lugged to the box.
D Ground Rod Electrodes: Unless otherwise indicated, install ground rod electrodes vertically. Where encountered rock prohibits vertical installation, install at 45 degree angle.

1. Outdoor Installations: Unless otherwise indicated, install with top of rod 6 inches below finished grade.

E Make grounding and bonding connections using specified connectors.

1. Remove appropriate amount of conductor insulation for making connections without cutting, nicking or damaging conductors. Do not remove conductor strands to facilitate insertion into connector.
2. Remove nonconductive paint, enamel, or similar coating at threads, contact points, and contact surfaces.
3. Exothermic Welds: Make connections using molds and weld material suitable for the items to be connected in accordance with manufacturer's recommendations.
4. Compression Connectors: Secure connections using manufacturer's recommended tools and dies. Connectors must be UL listed for use with grounding electrode conductors.

F Identify grounding and bonding system components in accordance with Section 26 05 53.

3.03 FIELD QUALITY CONTROL

A Inspect and test in accordance with NETA ATS Section 7.13.

1. After installing grounding system but before permanent electrical circuits have been energized, test for compliance with requirements.
2. Verify that ground system was installed in accordance with the contract documents and NEC Article 250.
3. Inspect physical and mechanical condition. Verify tightness of accessible, bolted, electrical connections with a calibrated torque wrench according to manufacturer's written instructions.
   a. Perform resistance measurements through bolted connections with a low-resistance ohmmeter.
4. Test completed grounding system at each location where a maximum ground-resistance level is specified, at service disconnect enclosure grounding terminal at ground test wells and at individual ground rods. Make tests at ground rods before any conductors are connected.
   a. Measure ground resistance no fewer than two full days after last trace of precipitation and without soil being moistened by any means other than natural drainage or seepage and without chemical treatment or other artificial means of reducing natural ground resistance.
   b. Perform tests by fall-of-potential method according to IEEE 81.

B Perform ground electrode resistance tests under normally dry conditions. Precipitation within the previous 48 hours does not constitute normally dry conditions.

C Investigate and correct deficiencies where measured ground resistances do not comply with specified requirements.

D Submit detailed reports indicating inspection and testing results and corrective actions taken.

END OF SECTION 26 05 26

SECTION 26 05 29
HANGERS AND SUPPORTS FOR ELECTRICAL SYSTEMS

PART 1 GENERAL

1.01 SECTION INCLUDES

A Support and attachment requirements and components for equipment, conduit, cable, boxes, and other electrical work.

1.02 RELATED REQUIREMENTS

A Section 26 05 33.13 - Conduit for Electrical Systems: Additional support and attachment requirements for conduits.

B Section 26 05 33.16 - Boxes and Cabinets: Additional support and attachment requirements for boxes.

1.03 REFERENCE STANDARDS

A NFPA 70 - National Electrical Code; National Fire Protection Association, Including All Applicable Amendments and Supplements; 2020.

1.04 ADMINISTRATIVE REQUIREMENTS

A Coordination:

B Sequencing:

1.05 SUBMITTALS

A Product Data: Provide manufacturer's standard catalog pages and data sheets for channel (strut) framing systems, non-penetrating rooftop supports, and post-installed concrete and masonry anchors.

B Manufacturer's Instructions: Indicate application conditions and limitations of use stipulated by product testing agency. Include instructions for storage, handling, protection, examination, preparation, and installation of product.

1.06 QUALITY ASSURANCE

1.07 DELIVERY, STORAGE, AND HANDLING

A Receive, inspect, handle, and store products in accordance with manufacturer's instructions.

PART 2 PRODUCTS

2.01 SUPPORT AND ATTACHMENT COMPONENTS

A General Requirements:

1. Provide all required hangers, supports, anchors, fasteners, fittings, accessories, and hardware as necessary for the complete installation of electrical work.
2. Provide products listed, classified, and labeled as suitable for the purpose intended, where applicable.
3. Where support and attachment component types and sizes are not indicated, select in accordance with manufacturer's application criteria as required for the load to be supported. Include consideration for vibration, equipment operation, and shock loads where applicable.
4. Do not use products for applications other than as permitted by NFPA 70 and product listing.

B Conduit and Cable Supports: Straps, clamps, etc. suitable for the conduit or cable to be supported.

1. Conduit Straps: One-hole or two-hole type; steel or malleable iron.
2. Conduit Clamps: Bolted type unless otherwise indicated.

C Anchors and Fasteners:

1. Concrete: Use preset concrete inserts, expansion anchors, or screw anchors.
2. Solid or Grout-Filled Masonry: Use expansion anchors or screw anchors.
3. Hollow Masonry: Use toggle bolts.
4. Hollow Stud Walls: Use toggle bolts.
5. Steel: Use beam clamps, machine bolts, or welded threaded studs.
6. Sheet Metal: Use sheet metal screws, bolts, or bolts.
7. Wood: Use wood screws.
8. Plastic and lead anchors are not permitted.
9. Powder-actuated fasteners are not permitted.

PART 3 EXECUTION

3.01 EXAMINATION

A Verify that field measurements are as indicated.

B Verify that mounting surfaces are ready to receive support and attachment components.

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

3.02 INSTALLATION

A Install products in accordance with manufacturer's instructions.

B Perform work in accordance with NECA 1 (general workmanship).

C Provide independent support from building structure. Do not provide support from piping, ductwork, or other systems.

D Do not provide support from suspended ceiling support system or ceiling grid.

E Unless specifically indicated or approved by Architect, do not provide support from roof deck.

F Do not penetrate or otherwise notch or cut structural members without approval of Structural Engineer.

G Equipment Support and Attachment:

1. Securely fasten floor-mounted equipment. Do not install equipment such that it relies on its own weight for support.

H Conduits installed on the interior of exterior building walls shall be spaced off the wall surface a minimum of 1/4 inch using "clamp-backs" or strut.

I Remove temporary supports.

3.03 FIELD QUALITY CONTROL

A Inspect support and attachment components for damage and defects.

B Repair cuts and abrasions in galvanized finishes using zinc-rich paint recommended by manufacturer. Replace components that exhibit signs of corrosion.

C Correct deficiencies and replace damaged or defective support and attachment components.

END OF SECTION 26 05 29

SECTION 26 05 33.13
CONDUIT FOR ELECTRICAL SYSTEMS

PART 1 GENERAL

1.01 SECTION INCLUDES

A Galvanized steel rigid metal conduit (RMC).
B Flexible metal conduit (FMC).
C Liquidtight flexible metal conduit (LFMC).
D Electrical metallic tubing (EMT).
E Rigid polyvinyl chloride (PVC) conduit.
F Conduit fittings.
G Accessories.

1.02 REFERENCE STANDARDS

A ANSI C80.1 - American National Standard for Electrical Rigid Steel Conduit (ERSC); 2020.
B ANSI C80.3 - American National Standard for Electrical Metallic Tubing -- Steel (EMT-S); 2020.
C ASTM B633 - Standard Specification for Electrodeposited Coatings of Zinc on Iron and Steel; 2023.
D ASTM A153/A153M - Standard Specification for Zinc Coating (Hot-Dip) on Iron and Steel Hardware; 2023.
E ASTM A123/A123M - Standard Specification for Zinc (Hot-Dip Galvanized) Coatings on Iron and Steel Products; 2017.
F NECA 101 - Standard for Installing Steel Conduits (Rigid, IMC, EMT); 2020.
G NECA 111 - Standard for Installing Nonmetallic Raceways (RNC, ENT, LFNC); 2017.
H NFPA 70 - National Electrical Code; National Fire Protection Association, Including All Applicable Amendments and Supplements; 2020.

1.03 ADMINISTRATIVE REQUIREMENTS

A Coordination:
1. Coordinate minimum sizes of conduits with the actual conductors to be installed, including adjustments for conductor sizes increased for voltage drop.
2. Coordinate the arrangement of conduits with structural members, ductwork, piping, equipment and other potential conflicts installed under other sections or by others.
3. Verify exact conduit termination locations required for boxes, enclosures, and equipment installed under other sections or by others.
4. Coordinate the work with other trades to provide roof penetrations that preserve the integrity of the roofing system and do not void the roof warranty.
5. Notify Architect of any conflicts with or deviations from Contract Documents. Obtain direction before proceeding with work.

B Sequencing:
1. Do not begin installation of conductors and cables until installation of conduit is complete between outlet, junction and splicing points.

1.04 SUBMITTALS

A Product Data: Provide manufacturer's standard catalog pages and data sheets for conduits and fittings.
B Project Record Documents: Record actual routing for conduits installed underground exterior to the building envelope.

1.05 QUALITY ASSURANCE

A Conduit shall be delivered to the project site in bundles of full length pipes, each length marked with the trademark of the manufacturer and the Underwriters' Laboratories, Inc. stamp. Each conduit length shall be straight, true and free from scales, blisters, burrs and other imperfections.
1. Product Listing Organization Qualifications: Third party agencies shall be amongst those accredited by the NCBCC (North Carolina Building Code Council) to label Electrical and Mechanical Equipment.

1.06 DELIVERY, STORAGE, AND HANDLING

A Receive, inspect, handle, and store conduit and fittings in accordance with manufacturer's instructions.

PART 2 PRODUCTS

2.01 CONDUIT APPLICATIONS

A Do not use conduit and associated fittings for applications other than as permitted by NFPA 70 and product listing.

B Unless otherwise indicated and where not otherwise restricted, use the conduit types indicated for the specified applications.

C Embedded Within Concrete:
1. Within Slab on Grade: Not permitted.
2. Within Slab Above Ground: Not permitted.
3. Within Poured Concrete Walls Above Ground: Use galvanized steel rigid metal conduit, intermediate metal conduit (IMC), PVC-coated galvanized steel rigid metal conduit, rigid PVC conduit, or reinforced thermosetting resin conduit (RTRC).

D Outdoors: Apply raceways as indicated below unless otherwise noted
1. Above ground conduit: Rigid galvanized steel conduit with 90o rigid elbow below grade transition to PVC.
2. Roof: Rigid galvanized steel conduit supported on rubber blocks and unistrut frame. Conduit must be at least 3-1/2" above roof surface.
3. Feeders: PVC Type DB concrete encased
4. Branch circuits: Schedule 40 PVC direct buried
5. Telecommunications: Schedule 40 PVC concrete encased
6. Connections to vibrating equipment including transformers, generators, and other motor driven equipment: Liquid tight flexible metal conduit.
7. Boxes and enclosures above ground Nema Type 4
8. Where rigid polyvinyl (PVC) conduit is used for feeder conductors, transition to galvanized steel rigid metal conduit a minimum of three feet horizontally prior to emerging from underground.
9. Where rigid polyvinyl (PVC) conduitis used for branch circuits, use galvanized steel rigid metal conduit elbows for bends.

E Indoors: Finished spaces (not subject to physical damage)
1. Raceway shall be routed concealed in interior portions of furred spaces, ceilings, and cavities, unless other than concrete or solid plaster where possible.
2. Raceways 2 inch or less shall be allowed to be EMT conduit.
3. All raceways concealed in exterior walls shall be rigid galvanized steel conduit.
4. All raceways larger than 2 inch shall be rigid galvanized conduit.
5. Where surface mounted conduit is required in finished spaces, contractor shall utilize surface metal raceway wire mold.
6. Where there is a transition between RGS in a wall to EMT above ceiling, it shall be made at a junction box above accessible ceiling.
7. Interior, Damp or Wet Locations: Use galvanized steel rigid metal conduit.

F Stub Ups
1. All feeder stub ups shall transition below grade from PVC to rigid a minimum of 3 feet horizontally from stub up location.
2. All branch circuit stub ups, where exposed or in non-CMU walls, shall transition to rigid galvanized steel at 90 degree elbow.
3. Schedule 40 rigid polyvinyl (PVC) stub ups are only allowed where conduits come up in CMU walls or the bottom of floor mounted equipment.

G Unfinished spaces subject to damage (Electrical, Mechanical etc.)
1. All conduit in unfinished spaces shall rigid galvanized steel. Conduit is not considered subject to damage when installed at least 10 feet above finished floor or tight to structure.
2. Conduits are not required to transition to transition to rigid galvanized steel where they are routed down into panelboards or other wall mounted equipment.

H Exposed, Interior finished spaces: Use surface metal raceway as identified on the drawings.

1. Surface metal raceway shall be manufactured by Wiremold or approved equal.
2. A separate equipment ground conductor shall be run in the surface metal raceway.

I Connection to vibrating equipment shall be made with flexible metal conduit or liquid tight flexible metal conduit depending on the environment installed.

J Connections to Luminaires Above Accessible Ceilings: Use flexible metal conduit shall be allowed.
1. Maximum Length: 6 feet.

K Connections to Vibrating Equipment:
1. Dry Locations: Use flexible metal conduit.
2. Damp, Wet, or Corrosive Locations: Use liquidtight flexible metal conduit.
3. Maximum Length: 6 feet unless otherwise indicated.
4. Vibrating equipment includes, but is not limited to:
   a. Transformers.
   b. Motors.
   c. Generators.

2.02 CONDUIT REQUIREMENTS

A Existing Work: Where existing conduits are indicated to be reused, they may be reused only where they comply with specified requirements, are free from corrosion, and integrity is verified by pulling a mandrel through them.

B Provide all conduit, fittings, supports, and accessories required for a complete raceway system.

C Provide products listed, classified, and labeled as suitable for the purpose intended.

D Minimum Conduit Size, Unless Otherwise Indicated:
1. Interior: 3/4 inch (21 mm) trade size.
2. Flexible Connections to Luminaires: 1/2 inch (13 mm) trade size.
3. Exterior: 1 inch (27 mm) trade size.

2.03 GALVANIZED STEEL RIGID METAL CONDUIT (RMC)

A Manufacturers:
1. Allied Tube & Conduit.
2. Republic Conduit.
3. Wheatland Tube Company.
4. or approved equal.

B Description: NFPA 70, Type RMC standard weight mild steel, hot dipped galvanized, sherardised or zinc-coated rigid metal conduit complying with ANSI C80.1 and listed and labeled as complying with UL 6.

C Fittings:
1. Manufacturers:
   a. Thomas & Betts Corporation.
   b. Rayco.
   c. Appleton.
   d. or approved equal.
2. Connectors and Couplings: Use steel compression fittings with insulated throats.

2.04 FLEXIBLE METAL CONDUIT AND LIQUIDTIGHT FLEXIBLE METAL CONDUIT (FMC LFMC)

A Manufacturers:
1. Allied Tube & Conduit.
2. Republic Conduit.
3. Wheatland Tube Company.
4. or approved equal.

B Description: NFPA 70, Type FMC standard wall steel flexible metal conduit listed and labeled as complying with UL 1, and listed for use in classified firestop systems to be used.

C Description: NFPA 70, Type LFMC polyvinyl chloride (PVC) jacketed steel flexible metal conduit listed and labeled as complying with UL 360.

D Spiral strip construction shall allow the conduit to bend up to four times its internal radius.

E Fittings shall be compression type with insulated throats and listed for use with conduit specified.

2.05 ELECTRICAL METALLIC TUBING (EMT)

A Manufacturers:
1. Allied Tube & Conduit.
2. Republic Conduit.
3. Wheatland Tube Company.
4. or approved equal.

B Description: NFPA 70, Type EMT cold-rolled steel electrical metallic tubing with zinc coating on the inside and protected on the inside by a zinc, enamel or equivalent corrosion-resistant coating complying with ANSI C80.3 and listed and labeled as complying with UL 797.

C Fittings:
1. Description: Fittings complying with NEMA FB 1 and listed and labeled as complying with UL 514B.
2. Material: Use steel or malleable iron.
3. Connectors and Couplings: Use hexagonal compression (gland) type.
   a. Do not use indenter type connectors and couplings.
   b. Do not use set-screw type connectors and couplings.

2.06 RIGID POLYVINYL CHLORIDE (PVC) CONDUIT

A Manufacturers:
1. Allied Tube & Conduit.
2. Republic Conduit.
3. Wheatland Tube Company.
4. or approved equal.

B Description: NFPA 70, Type PVC rigid polyvinyl chloride conduit complying with NEMA TC 2 and listed and labeled as complying with UL 651; Schedule 40 or Schedule 80 as indicated; rated for use with conductors rated 90 degrees C.

C Fittings:
1. Manufacturer: Same as manufacturer of conduit to be connected.
2. Description: Fittings complying with NEMA TC 3 and listed and labeled as complying with UL 651; material to match conduit.

2.07 ACCESSORIES

A Corrosion Protection Tape: PVC-based, minimum thickness of 20 mil.

B Conduit Joint Compound: Corrosion-resistant, electrically conductive; suitable for use with the conduit to be installed.

C Solvent Cement for PVC Conduit and Fittings: As recommended by manufacturer of conduit and fittings to be installed.

D Pull Strings: Use nylon cord with average breaking strength of not less than 200 pound-force.

PART 3 EXECUTION

3.01 EXAMINATION

A Verify that field measurements are as indicated.

B Verify that mounting surfaces are ready to receive conduits.

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

3.02 INSTALLATION

A Install products in accordance with manufacturer's instructions.

B Install conduit in a neat and workmanlike manner tight against walls, columns or ceilings.

C The conduit shall bend cold 90 degrees about a radius equal to ten (10) times its own diameter without signs of flaw or fracture in either pipe or protective coverings. All bends and offsets shall be made on a forming tool to prevent the conduit or its coating from being damaged in the bending.

D Install galvanized steel rigid metal conduit (RMC) in accordance with NECA 101.

E Install rigid polyvinyl chloride (PVC) conduit in accordance with NECA 111.

F Conduit Routing:
1. Unless dimensioned, conduit routing indicated is diagrammatic.
2. Conceal all conduits unless specifically indicated to be exposed.

3. Conduits in the following areas may be exposed, unless otherwise indicated:
   a. Electrical rooms.
   b. Mechanical equipment rooms.
4. Arrange conduit to maintain maximum headroom, clearances, and access.
5. Arrange conduit to provide no more than the equivalent of four 90 degree bends between pull points.
6. Arrange conduit to provide no more than 100 feet between pull points.
7. In every instance, conduit shall be installed in such a manner that the conductors may readily and easily be drawn or pulled in without strain or damage to the insulation; and, also, so that defective conductors may be readily and easily withdrawn and replaced by new conductors. Long radius bends and a sufficient number of approved pull and junction boxes shall be approved for this purpose, and as may be directed by the Engineer. All conduit shall be securely supported and grounded.
8. Arrange conduit to prevent moisture traps. Provide drain fittings at low points and at sealing fittings where moisture may collect.
9. Where conduits join any couplings or threaded fittings, the ends shall be made watertight.
10. Maintain minimum clearance of 12 inches between conduits and hot surfaces. This includes, but is not limited to:

G Conduit Support:

1. Provide all required hangers, supports, anchors, fasteners, fittings, accessories, and hardware as necessary for the complete installation of electrical work.
2. Secure and support conduits in accordance with NFPA 70 and Section 26 05 29 using suitable supports and methods approved by the authority having jurisdiction.
3. Provide independent support from building structure. Do not provide support from piping, ductwork, or other systems.
4. Installation Above Suspended Ceilings: Do not provide support from ceiling support system. Do not provide support from ceiling grid or allow conduits to lay on ceiling tiles.
5. Use conduit strap to support single surface-mounted conduit.
   a. Use clamp back spacer with conduit strap for damp and wet locations to provide space between conduit and mounting surface.
6. Use metal channel (strut) with accessory conduit clamps to support multiple parallel surface-mounted conduits.
7. Use conduit clamp to support single conduit from beam clamp or threaded rod.
8. Use trapeze hangers assembled from threaded rods and metal channel (strut) with accessory conduit clamps to support multiple parallel suspended conduits.
9. Steel Components: Use corrosion resistant materials suitable for the environment where installed.
   a. Indoor Dry Locations: Use zinc-plated steel or approved equivalent unless otherwise indicated.
   b. Outdoor and Damp or Wet Indoor Locations: Use galvanized steel, stainless steel, or approved equivalent unless otherwise indicated.
   c. Zinc-Plated Steel: Electroplated in accordance with ASTM B633.
   d. Galvanized Steel: Hot-dip galvanized after fabrication in accordance with ASTM A123/A123M or ASTM A153/A153M.
10. Metal Channel (Strut) Framing Systems: Factory-fabricated continuous-slot metal channel (strut) and associated fittings, accessories, and hardware required for field-assembly of supports.
    a. Minimum Channel Thickness: Steel sheet, 12 gage, 0.1046 inch.
    b. Minimum Channel Dimensions: 1-5/8 inch width by 13/16 inch height.

H Connections and Terminations:

1. Use approved zinc-rich paint or conduit joint compound on field-cut threads of galvanized steel conduits prior to making connections.
2. Where two threaded conduits must be joined and neither can be rotated, use three-piece couplings or split couplings. Do not use running threads.
3. Use suitable adapters where required to transition from one type of conduit to another.

4. Terminate threaded conduits in boxes and enclosures using threaded hubs or double lock nuts for dry locations and raintight hubs for wet locations.
5. Provide insulating bushings or insulated throats at all conduit terminations to protect conductors.
6. Secure joints and connections to provide maximum mechanical strength and electrical continuity.
7. Condulet fittings shall not be used in lieu of pull boxes.

I Penetrations:
1. Do not penetrate or otherwise notch or cut structural members, including footings and grade beams.
2. Make penetrations perpendicular to surfaces unless otherwise indicated.
3. Where conduits penetrate waterproof membrane, seal as required to maintain integrity of membrane.
   a. All raceway penetrating exterior walls or other water proof membranes shall slope away from the building with a minimum slope of 4" over 100 feet.
4. Make penetrations for roof-mounted equipment within associated equipment openings and curbs where possible to minimize roofing system penetrations. Where penetrations are necessary, seal as required to preserve integrity of roofing system and maintain roof warranty.
5. Install firestopping to preserve fire resistance rating of partitions and other elements. Refer to penetration details on plans.
6. Where conduits cross building expansion joints or pass between areas with a temperature difference of 14 degrees C, provide expansion fittings on all raceway.

J Underground Installation:
1. Minimum Cover, Unless Otherwise Indicated or Required:
   a. Underground, Exterior: 24 inches.
2. Provide underground warning tape six to eight inches below finished grade directly above raceway. Tape shall be six inches wide with a minimum thickness of seven mil, non-distorting, colorfast, no-stretch, 600 pound tensile strength per six inch width, ultraviolet light fast. Message must repeat within a maximum of 40 inches. Painted legend shall be indicative of the type of underground line.

K Concrete Encasement: Where conduits not otherwise embedded within concrete are indicated to be concrete-encased, provide concrete in accordance with Section 03 30 00 with minimum concrete cover of 3 inches on all sides unless otherwise indicated.

L Ductbanks containing conductors of 600 volts or more shall be concrete encased with red dyed concrete.

M Conduit Movement Provisions: Where conduits are subject to movement, provide expansion and expansion/deflection fittings to prevent damage to enclosed conductors or connected equipment. This includes, but is not limited to:
1. Where conduits cross structural joints intended for expansion, contraction, or deflection.
2. Where calculated in accordance with NFPA 70 for rigid polyvinyl chloride (PVC) conduit installed above ground to compensate for thermal expansion and contraction.
3. Where conduits are subject to earth movement by settlement or frost.

N Condensation Prevention: Where conduits cross barriers between areas of potential substantial temperature differential, provide sealing fitting or approved sealing compound at an accessible point near the penetration to prevent condensation. This includes, but is not limited to:
1. Where conduits pass from outdoors into conditioned interior spaces.
2. Where conduits pass from unconditioned interior spaces into conditioned interior spaces.
3. Where conduits penetrate coolers or freezers.

O Provide 200 pound tensile strength pull string in all empty conduits and in conduits where conductors and cables are to be installed by others. Leave minimum slack of 12 inches at each end. All empty conduits shall terminate in a junction box.

P All ducts shall be sealed at terminations, using sealing compound and plugs, as required to withstand 15 psi minimum hydrostatic pressure.

3.03 FIELD QUALITY CONTROL

A Repair cuts and abrasions in galvanized finishes using zinc-rich paint recommended by manufacturer. Replace components that exhibit signs of corrosion.

B Where coating of PVC-coated galvanized steel rigid metal conduit (RMC) contains cuts or abrasions, repair in accordance with manufacturer's instructions.

C Correct deficiencies and replace damaged or defective conduits.

3.04 CLEANING

A Clean interior of conduits to remove moisture and foreign matter.

3.05 PROTECTION

A Immediately after installation of conduit, use suitable manufactured plugs to provide protection from entry of moisture and foreign material and do not remove until ready for installation of conductors.

END OF SECTION 26 05 33.13

SECTION 26 05 33.16
BOXES AND CABINETS

PART 1 GENERAL

1.01 SECTION INCLUDES

A Outlet and device boxes up to 100 cubic inches, including those used as junction and pull boxes.

B Cabinets and enclosures, including junction and pull boxes larger than 100 cubic inches.

C Floor boxes.

D Underground boxes/enclosures.

1.02 REFERENCE STANDARDS

A NEMA 250 - Enclosures for Electrical Equipment (1000 Volts Maximum); 2020.

B NFPA 70 - National Electrical Code; National Fire Protection Association, Including All Applicable Amendments and Supplements; 2020.

C SCTE 77 - Specifications for Underground Enclosure Integrity; 2023.

1.03 ADMINISTRATIVE REQUIREMENTS

A Coordination:

1. Coordinate the work with other trades to avoid placement of ductwork, piping, equipment, or other potential obstructions within the dedicated equipment spaces and working clearances for electrical equipment required by NFPA 70.
2. Coordinate arrangement of electrical equipment with the dimensions and clearance requirements of the actual equipment to be installed.
3. Coordinate minimum sizes of boxes with the actual installed arrangement of conductors, clamps, support fittings, and devices, calculated according to NFPA 70.
4. Coordinate minimum sizes of pull boxes with the actual installed arrangement of connected conduits, calculated according to NFPA 70.
5. Coordinate the placement of boxes with millwork, furniture, devices, equipment, etc. installed under other sections or by others.
6. Coordinate the work with other trades to preserve insulation integrity.
7. Coordinate the work with other trades to provide walls suitable for installation of flush-mounted boxes where indicated.
8. Notify Architect of any conflicts with or deviations from Contract Documents. Obtain direction before proceeding with work.

1.04 SUBMITTALS

A Product Data: Provide manufacturer's standard catalog pages and data sheets for outlet and device boxes, junction and pull boxes, cabinets and enclosures, and floor boxes.

B Project Record Documents: Record actual locations for outlet and device boxes, cabinets and enclosures, and floor boxes.

1.05 QUALITY ASSURANCE

A Product Listing Organization Qualifications: Third party agencies shall be amongst those accredited by the NCBCC (North Carolina Building Code Council) to label Electrical and Mechanical Equipment.

1.06 DELIVERY, STORAGE, AND HANDLING

A Receive, inspect, handle, and store products in accordance with manufacturer's instructions.

PART 2 PRODUCTS

2.01 BOXES

A General Requirements:

1. The Electrical Contractor shall provide junction boxes, pull boxes, cable, support boxes, and wiring troughs as required by NEC and as otherwise indicated in the Drawings.
2. Do not use boxes and associated accessories for applications other than as permitted by NFPA 70 and product listing.
3. Provide all boxes, fittings, supports, and accessories required for a complete raceway system and to accommodate devices and equipment to be installed.
4. Provide products listed, classified, and labeled as suitable for the purpose intended.

5. Where box size is not indicated, size to comply with NFPA 70 but not less than applicable minimum size requirements specified.
6. Provide grounding terminals within boxes where equipment grounding conductors terminate.
7. Each outlet designated on the plans shall be provided with an outlet box.
8. In general, outlets shall be installed at the heights indicated. The Contractor shall examine the plans of and coordinate with all other trades to assure mounting heights are correct for the intended purpose. Assure that all mounting heights comply with the latest version of ADA. Outlets installed at incorrect heights shall be relocated to the correct elevation at the Contractor's expense.

B Outlet and Device Boxes Up to 100 cubic inches, Including Those Used as Junction and Pull Boxes:

1. Use sheet-steel boxes for dry locations unless otherwise indicated or required.
2. Use cast iron boxes or cast aluminum boxes for damp or wet locations unless otherwise indicated or required; furnish with compatible weatherproof gasketed covers.
3. Outlet boxes shall be 4" square, 2 1/8" deep unless otherwise noted.
4. Use suitable concrete type boxes where flush-mounted in concrete.
5. Use suitable masonry type boxes where flush-mounted in masonry walls.
6. Do not use "through-wall" boxes designed for access from both sides of wall.
7. Sheet-Steel Boxes: Comply with NEMA OS 1, and list and label as complying with UL 514A.
8. Cast Metal Boxes: Comply with NEMA FB 1, and list and label as complying with UL 514A; furnish with threaded hubs.
9. Junction boxes larger than 4" square shall be galvanized and without pre-formed knockouts.
10. Boxes for Supporting Luminaires and Ceiling Fans: Listed as suitable for the type and weight of load to be supported; furnished with fixture stud to accommodate mounting of luminaire where required.
11. Boxes for Ganged Devices: Use multigang boxes of single-piece construction. Do not use field-connected gangable boxes.
12. Manufacturers Recessed:
    a. Steel City Electric Company
    b. Metropolitan
    c. B & C
    d. or approved equal.
13. Manufacturers Surface:
    a. Crouse-Hinds
    b. Appleton
    c. Rayco
    d. or approved equal.

C Cabinets and Enclosures, Including Junction and Pull Boxes Larger Than 100 cubic inches:

1. Comply with NEMA 250, and list and label as complying with UL 50 and UL 50E, or UL 508A.
2. NEMA 250 Environment Type, Unless Otherwise Indicated:
3. Junction and Pull Boxes Larger Than 100 cubic inches:
    a. Provide screw-cover or hinged-cover enclosures unless otherwise indicated.
    b. Boxes 12" square and Larger: Provide hinged-cover enclosures with quick access latches.
4. Cabinets and Hinged-Cover Enclosures, Other Than Junction and Pull Boxes:
    a. Provide lockable hinged covers, all locks keyed alike unless otherwise indicated.
5. Manufacturers Surface:
    a. Cooper.
    b. Hoffman.
    c. Hubbell Incorporated.
    d. or approved equal..

D Floor Boxes:

1. Description: Floor boxes compatible with floor box service fittings provided; with partitions to separate multiple services; furnished with all components, adapters, covers, faceplates, and trims required for complete installation. Number of gangs as identified on plans.

2. Cover and finish options shall be selected by architect prior to ordering.
3. Use cast iron floor boxes within slab on grade.
    a. Protect moisture barrier during floor box installation.
4. Use sheet-steel floor boxes or fire rated poke throughs within slab above grade.
5. Metallic Floor Boxes: Fully adjustable (with integral means for leveling adjustment prior to and after concrete pour).
6. Manufacturer:
    a. Legrand Wiremold
    b. Thomas & Betts Corporation
    c. or approved equal.

E Underground Boxes/Enclosures:

1. Description: In-ground, solid bottom boxes furnished with flush, non-skid covers with legend indicating type of service and stainless steel tamper resistant cover bolts.
2. Size: As indicated on drawings.
3. Depth: As required to extend below frost line to prevent frost upheaval, but not less than 12 inches.
4. Applications:
    a. Parking Lots, in Areas Subject Only To Occasional Nondeliberate Vehicular Traffic: Use polymer concrete enclosures, with minimum SCTE 77 Tier 22 load rating.
    b. Do not use polymer concrete enclosures in areas subject to deliberate vehicular traffic.
5. Polymer Concrete Underground Boxes/Enclosures: Comply with SCTE 77.
    a. Combination fiberglass/polymer concrete boxes/enclosures are not acceptable. Use all-polymer concrete boxes/enclosures.

PART 3 EXECUTION

3.01 EXAMINATION

A Verify that field measurements are as indicated.

B Verify that mounting surfaces are ready to receive boxes.

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

3.02 INSTALLATION

A Install products in accordance with manufacturer's instructions.

B Perform work in a neat and workmanlike manner.

C Arrange equipment to provide maximum clearances.

D Unless otherwise indicated, provide separate boxes for line voltage and low voltage systems.

E Flush-mount boxes in finished areas unless specifically indicated to be surface-mounted.

F Box Locations:

1. Locate boxes in accessible locations.
2. Locate boxes so that wall plates do not span different building finishes.
3. Locate boxes so that wall plates do not cross masonry joints.
4. Unless otherwise indicated, where multiple outlet boxes are installed at the same location at different mounting heights, install along a common vertical center line.
5. Do not install flush-mounted boxes on opposite sides of walls back-to-back. Provide minimum 6 inches horizontal separation unless otherwise indicated.
6. Fire Resistance Rated Walls: Install flush-mounted boxes such that the required fire resistance will not be reduced.
7. Locate junction and pull boxes as indicated, as required to facilitate installation of conductors, and to limit conduit length and/or number of bends between pulling points in accordance with Section 26 05 33.13.

G Box Supports:

1. Secure and support boxes in accordance with NFPA 70 and Section 26 05 29 using suitable supports and methods approved by the authority having jurisdiction.

H Install boxes plumb and level.

I Flush-Mounted Boxes:

1. Install boxes in noncombustible materials such as concrete, tile, gypsum, plaster, etc. so that front edge of box or associated raised cover is not set back from finished surface more than 1/4 inch or does not project beyond finished surface.
2. Install boxes in combustible materials such as wood so that front edge of box or associated raised cover is flush with finished surface.
3. Repair rough openings around boxes in noncombustible materials such as concrete, tile, gypsum, plaster, etc. so that there are no gaps or open spaces greater than 1/8 inch at the edge of the box.

J Install boxes as required to preserve insulation integrity.

K Metallic Floor Boxes: Install box level at the proper elevation to be flush with finished floor.

L Boxes in damp or wet locations shall be provided with gaskets and covers.

M Underground Boxes/Enclosures:

1. Install enclosure on gravel base, minimum 6 inches deep.
2. Install additional bracing inside enclosures in accordance with manufacturer's instructions to minimize box sidewall deflections during backfilling. Backfill with cover bolted in place.

N Install permanent barrier between ganged wiring devices when voltage difference between adjacent devices exceeds 300 V.

O Close unused box openings.

P Install blank wall plates on junction boxes and on outlet boxes with no devices or equipment installed or designated for future use.

3.03 CLEANING

A Clean interior of boxes to remove dirt, debris, plaster and other foreign material.

3.04 PROTECTION

A Immediately after installation, protect boxes from entry of moisture and foreign material until ready for installation of conductors.

END OF SECTION 26 05 33.16

SECTION 26 05 53
IDENTIFICATION FOR ELECTRICAL SYSTEMS

PART 1 GENERAL

1.01 SECTION INCLUDES

A Electrical identification requirements.
B Identification nameplates and labels.
C Wire and cable markers.
D Underground warning tape.
E Warning signs and labels.

1.02 ADMINISTRATIVE REQUIREMENTS

A Coordination:
1. Verify final designations for equipment, systems, and components to be identified prior to fabrication of identification products.

B Sequencing:
1. Do not conceal items to be identified, in locations such as above suspended ceilings, until identification products have been installed.
2. Do not install identification products until final surface finishes and painting are complete.

1.03 SUBMITTALS

A Product Data: Provide manufacturer's standard catalog pages and data sheets for each product.
B Shop Drawings: Provide schedule of items to be identified indicating proposed designations, materials, legends, and formats.

1.04 FIELD CONDITIONS

A Do not install adhesive products when ambient temperature is lower than recommended by manufacturer.

PART 2 PRODUCTS

2.01 IDENTIFICATION REQUIREMENTS

A Identification for Equipment:
1. Use identification nameplate to identify each piece of electrical distribution and control equipment and associated sections, compartments, and components.
   a. Panelboards:
      1) Identify ampere rating.
      2) Identify voltage and phase.
      3) Identify power source and circuit number. Include location.
      4) Use typewritten circuit directory to identify load(s) served.
   b. Transformers:
      1) Identify kVA rating.
      2) Identify voltage and phase for primary and secondary.
      3) Identify power source and circuit number. Include location.
      4) Identify load(s) served. Include location.
   c. Enclosed switches, circuit breakers, and motor controllers:
      1) Identify voltage and phase.
      2) Identify power source and circuit number. Include location.
      3) Identify load(s) served. Include location.
   d. Enclosed Contactors:
      1) Identify ampere rating.
      2) Identify voltage and phase.
      3) Identify coil voltage.
      4) Identify load(s) and associated circuits controlled. Include location.
   e. Centralized Emergency Lighting Inverters:
      1) Identify input and output voltage and phase.
      2) Identify power source and circuit number for normal power source. Include location when not within sight of equipment.

3) Identify load(s) served. Include location.

f. Transfer Switches:

1) Identify voltage and phase.

2) Identify power source and circuit number for both normal power source and standby power source. Include location.

3) Identify load(s) served. Include location.

4) Identify short circuit current rating based on the specific overcurrent protective device type and settings protecting the transfer switch.

2. Service Equipment:

a. For buildings or structures supplied by more than one service, or any combination of branch circuits, feeders, and services, use identification nameplate at each service disconnecting means to identify all other services, feeders, and branch circuits supplying that building or structure. Verify format and descriptions with authority having jurisdiction.

3. Emergency System Equipment:

a. Use identification nameplate or voltage marker to identify emergency system equipment in accordance with NFPA 70.

4. Use identification nameplate to identify disconnect location for equipment with remote disconnecting means.

5. Available Fault Current Documentation: Use identification label to identify the available fault current and date calculations were performed at locations requiring documentation by NFPA 70 including but not limited to the following.

a. Service equipment.

6. Arc Flash Hazard Warning Labels: Comply with Section 26 05 73.

B Identification for Conductors and Cables:

1. Color Coding for Power Conductors 600 V and Less: Comply with Section 26 05 19.
2. Identification for Communications Conductors and Cables: Comply with Section 27 10 00.
3. Use underground warning tape to identify power and communication feeders and branch circuits exterior to the building.

C Identification for Boxes:

1. Use color coded boxes to identify specified systems.

a. Color-Coded Boxes: Field-painted per the same color coding as identified in this section for the system contained within.

b. Fire alarm junction boxes shall be painted on all sides including the box cover.

2. For boxes concealed above accessible ceilings or exposed in mechanical or electrical rooms use neatly handwritten text using indelible marker to identify circuits enclosed.
3. For exposed boxes in public areas, use only type written labels.

D Identification for Devices:

1. Wiring Device and Wallplate Finishes: Comply with Section 26 27 26.
2. Use identification label to identify fire alarm system devices.
3. For devices concealed above suspended ceilings, provide additional identification on ceiling tile below device location.
4. Use identification label to identify receptacles protected by upstream GFI protection, where permitted.

E Color Coding

1. Phenolic Nameplates and associated conduit and boxes shall be identified with the following color scheme. Note: For existing buildings the contractor shall field verify the existing building standard and revise the color scheme to match the existing field conditions. Failure to match existing conditions will result in the contractor correcting the mislabeled equipment at his expense.

a. Blue surface white core - 120/208V equipment.

b. Black surface white core - 277/480V equipment.

c. Bright red surface white core - fire alarm equipment.

d. Dark red (burgundy) surface white core - security equipment.

e. Green surface white core - emergency systems.
f. Brown surface white core - data systems.
g. Purple surface white core - TV systems.

2.02 IDENTIFICATION NAMEPLATES AND LABELS

A Identification Nameplates:
1. Materials:
a. Indoor Clean, Dry Locations: Use plastic nameplates.
b. Outdoor Locations: Use plastic nameplates suitable for exterior use.
2. Plastic Nameplates: Two-layer or three-layer laminated electrically non-conductive phenolic with beveled edges; minimum thickness of 1/16 inch; engraved text.
3. Mounting Holes for Mechanical Fasteners: Two, centered on sides for sizes up to 1 inch high; Four, located at corners for larger sizes.
4. Nameplates shall be secured with self tapping stainless steel screws; if screws have sharp ends they shall be protected, otherwise rivets shall be used.

B Identification Labels:
1. Materials: Use self-adhesive laminated plastic labels; UV, chemical, water, heat, and abrasion resistant.
a. Use only for indoor locations.
2. Text: Use factory pre-printed or machine-printed text. Do not use handwritten text.

C Format for Equipment Identification:
1. Minimum Size: 1 inch by 2.5 inches.
2. Text: All capitalized unless otherwise indicated.
3. Minimum Text Height:
a. Equipment Designation: 1/2 inch.
b. Exception: Provide minimum text height of 1 inch for equipment located more than 10 feet above floor or working platform.

D Wiring device circuit labels.
1. All wiring devices (receptacles and switches) shall be labeled with the circuit serving the device. Label shall be a typed adhesive label affixed to the front of the wiring device face plate. Label shall have black text on clear background.

2.03 UNDERGROUND WARNING TAPE

A Foil-backed Detectable Type Tape: 3 inches wide, with minimum thickness of 7 mil, unless otherwise required for proper detection.

B Legend: Type of service, continuously repeated over full length of tape.

C Color:
1. Tape for Buried Power Lines: Black text on red background.
2. Tape for Buried Communication, Alarm, and Signal Lines: Black text on orange background.

2.04 WARNING SIGNS AND LABELS

A Comply with ANSI Z535.2 or ANSI Z535.4 as applicable.

B Warning Signs:
1. Materials:
a. Indoor Dry, Clean Locations: Use factory pre-printed rigid plastic or self-adhesive vinyl signs.
b. Outdoor Locations: Use factory pre-printed rigid aluminum signs.
2. Rigid Signs: Provide four mounting holes at corners for mechanical fasteners.

C Warning Labels:
1. Materials: Use factory pre-printed or machine-printed self-adhesive polyester or self-adhesive vinyl labels; UV, chemical, water, heat, and abrasion resistant; produced using materials recognized to UL 969.
2. Machine-Printed Labels: Use thermal transfer process printing machines and accessories recommended by label manufacturer.

PART 3 EXECUTION

3.01 PREPARATION

A Clean surfaces to receive adhesive products according to manufacturer's instructions.

3.02 INSTALLATION

A Install products in accordance with manufacturer's instructions.

B Install identification products to be plainly visible for examination, adjustment, servicing, and maintenance.

C Install identification products centered, level, and parallel with lines of item being identified.

D Secure nameplates to exterior surfaces of enclosures using stainless steel screws.

E Install self-adhesive labels and markers to achieve maximum adhesion, with no bubbles or wrinkles and edges properly sealed.

F Install underground warning tape above buried lines with one tape per trench at six to eight inches below finished grade.

G Secure rigid signs using stainless steel screws.

H Mark all handwritten text, where permitted, to be neat and legible.

3.03 FIELD QUALITY CONTROL

A Replace self-adhesive labels and markers that exhibit bubbles, wrinkles, curling or other signs of improper adhesion.

END OF SECTION 26 05 53

SECTION 26 05 70
ELECTRICAL COORDINATION DRAWINGS

1.01 SECTION INCLUDES

A The Electrical Contractor shall be responsible for providing 1/4 scale drawings to the Mechanical Contractor, in REVIT, for the entire project.

B The drawings shall cover above ceiling spaces, mechanical rooms, electrical rooms, and service yards.

PART 2 PRODUCT - NOT USED

PART 3 EXECUTION

3.01 COORDINATION (REVIT)

A The Electrical contractor shall obtain architectural base plans from the architect. The drawings will be Revit **2018** or higher.

B The drawing files shall be forwarded to the mechanical contractor for incorporation into the overall coordination drawings.

C The Electrical contractor shall be responsible for coordinating any conflicts with the mechanical contractor and fire protection contractor. In addition, the electrical contractor is responsible for attending any required coordination meetings at the job site.

D The final overall coordination drawings must be completed prior to any fire protection, mechanical and electrical work starting on the job.

E The Electrical Contractor is responsible for purchasing his final overall coordination drawings from the printer.

END OF SECTION 26 05 70 26 05 70

SECTION 26 05 73
POWER SYSTEM STUDIES

PART 1 GENERAL

1.01 SECTION INCLUDES

A Short-circuit study.

B Protective device coordination study.

C Arc flash and shock risk assessment.

1. Includes arc flash hazard warning labels.

D Criteria for the selection and adjustment of equipment and associated protective devices not specified in this section, as determined by studies to be performed.

1.02 REFERENCE STANDARDS

A IEEE 1584 - IEEE Guide for Performing Arc-Flash Hazard Calculations; 2018, with Errata (2019).

B NFPA 70 - National Electrical Code; National Fire Protection Association, Including All Applicable Amendments and Supplements; 2020.

C NFPA 70E - Standard for Electrical Safety in the Workplace; 2024.

1.03 ADMINISTRATIVE REQUIREMENTS

A Coordination:

1. Coordinate the work to provide equipment and associated protective devices complying with criteria for selection and adjustment, as determined by studies to be performed.
2. Notify Architect of any conflicts with or deviations from the contract documents. Obtain direction before proceeding with work.

B Sequencing:

1. Submit study reports prior to or concurrent with product submittals.
2. Contractor shall be responsible for making any and all changes to the purchased equipment as recommended in the study results. Changes to the electrical distribution equipment, generator, transfer switches, and breakers due to study recommendations and to comply with the requirements of this section shall not incur an additional cost to the project. This includes but is not limited to changes in equipment or breakers to meet required maximum fault current levels, changes in breaker models, types or frame sizes to achieve selective coordination where required, changes in breaker models or types to achieve the required minimum AIC rating for transfer switches.
3. Do not order equipment until matching study reports and product submittals have both been evaluated by Architect.
4. Verify naming convention for equipment identification prior to creation of final drawings, reports, and arc flash hazard warning labels to match equipment name plates.
5. Study shall be updated prior to project completion. All changes throughout construction shall be incorporated in the update.
6. After study has been updated with construction changes, print and apply labels.
7. Final study shall be included in the O&M manuals.

1.04 SUBMITTALS

A Study preparer's qualifications.

B Study reports, stamped or sealed and signed by study preparer.

C Product Data:

1. Include characteristic time-current trip curves for protective devices.
2. Clearly indicate short circuit current ratings for all equipment. Series rating is not allowed.

D All submittals transmitted to the engineer for approval shall have a digital copy of the report and model files included on a USB drive.

E Arc Flash Hazard Warning Label Samples: One of each type required. All labels shall be rated to withstand the environment where installed.

F Certification that field adjustable protective devices have been set in accordance with requirements of studies.

G Project Record Documents: Revise studies as required to reflect as-built conditions.

1. Include hard copies with operation and maintenance data submittals.
2. Include computer software files used to prepare studies with file name(s) cross-referenced to specific pieces of equipment and systems.

1.05 POWER SYSTEM STUDIES

A Scope of Studies:
1. Perform analysis of new electrical distribution system as indicated on drawings.
2. Except where study descriptions below indicate exclusions, analyze system at each bus from primary protective devices of utility source down to each piece of equipment involved, including parts of system affecting calculations being performed (e.g. fault current contribution from motors).
3. Include in analysis alternate sources and operating modes (including known future configurations) to determine worst case conditions.
    a. Known Operating Modes:
        1) Utility as source.
        2) Generator as source.

B General Study Requirements:
1. Perform studies utilizing computer software complying with specified requirements; manual calculations are not permitted.

C Data Collection:
1. Compile information on project-specific characteristics of actual installed equipment, protective devices, feeders, etc. as necessary to develop single-line diagram of electrical distribution system and associated input data for use in system modeling.
    a. Utility Source Data: Include primary voltage, maximum and minimum three-phase and line-to-ground fault currents, impedance, X/R ratio, and primary protective device information.
        1) Obtain up-to-date information from Utility Company.
        2) Include in the report documentation the following information
            (a) Utility Company: Contractor to Determine.
                (1) Point of Contact: Contractor to Determine.
                (2) Address: Contractor to Determine.
                (3) Phone: Contractor to Determine.
                (4) Email: Contractor to Determine.
                (5) Utility Company Project Reference Number: Contractor to Determine.
                (6) Date Fault Current was obtained from power company.
    b. Generators: Include manufacturer/model, kW and voltage ratings, and impedance.
    c. Motors 25HP and greater: Include manufacturer/model, type (e.g. induction, synchronous), horsepower rating, voltage rating, and full load amps.
    d. Branch circuit and overcurrent protective device information associated with all industrial control panels, including HVAC control panels.
    e. Transformers: Include primary and secondary voltage ratings, kVA rating, winding configuration, percent impedance, and X/R ratio.
    f. Protective Devices:
        1) Circuit Breakers: Include manufacturer/model, type (e.g. thermal magnetic, electronic trip), frame size, trip rating, voltage rating, interrupting rating, available field-adjustable trip response settings, and features (e.g. zone selective interlocking).
        2) Fuses: Include manufacturer/model, type/class (e.g. Class J), size/rating, and speed (e.g. time delay, fast acting).
    g. Conductors: Include feeder size, material (e.g. copper, aluminum), insulation type, voltage rating, number per phase, raceway type, and actual length.
    h. Contractor shall maintain a log of all conductor sizes and lengths to be used in the power systems study.

D Short-Circuit Study:

1. For purposes of determining equipment short circuit current ratings, consider conditions that may result in maximum available fault current, including but not limited to:
    a. Maximum utility fault currents.
    b. Maximum motor contribution.
2. For each bus location, calculate the maximum available three-phase bolted symmetrical and asymmetrical fault currents. For grounded systems, also calculate the maximum available line-to-ground bolted fault currents.
3. Calculate the short circuit current at the following additional locations:
    a. Industrial Control Panels, including HVAC control panels.

E Protective Device Coordination Study:

1. Analyze alternate scenarios considering known operating modes (e.g. utility as source, generator as source).
2. Analyze protective devices on the normal power system and associated settings for suitable margins between time-current curves to achieve best possible coordination while providing adequate protection for equipment and conductors.
3. For emergency systems analyze protective devices and associated settings so that full selective coordination is achieved per NEC 700.27

F Arc Flash and Shock Risk Assessment:

1. Comply with NFPA 70E.
2. Perform incident energy and arc flash boundary calculations in accordance with IEEE 1584 (as referenced in NFPA 70E Annex D), where applicable.
3. Analyze alternate scenarios considering conditions that may result in maximum incident energy, including but not limited to:
    a. Maximum and minimum utility fault currents.
    b. Maximum and minimum motor contribution.
    c. Known operating modes (e.g. utility as source, generator as source).

G Study Reports:

1. General Requirements:
    a. Identify date of study and study preparer.
    b. Identify study methodology and software product(s) used.
    c. Identify scope of studies, assumptions made, implications of possible alternate scenarios, and any exclusions from studies.
    d. Include single-line diagram and associated input data used for studies; identify buses on single-line diagram as referenced in reports, and indicate bus voltage.
    e. Include conclusions and recommendations.
2. Short-Circuit Study:
    a. For each scenario, identify at each bus location:
        1) Calculated maximum available symmetrical and asymmetrical fault currents (both three-phase and line-to-ground where applicable).
        2) Fault point X/R ratio.
        3) Associated equipment short circuit current ratings.
    b. Identify locations where the available fault current exceeds the equipment short circuit current rating, along with recommendations.
3. Protective Device Coordination Study:
    a. For each scenario, include time-current coordination curves plotted on log-log scale graphs.
    b. For each graph include (where applicable):
        1) Partial single-line diagram identifying the portion of the system illustrated.
        2) Protective Devices: Time-current curves with applicable tolerance bands for each protective device in series back to the source, plotted up to the maximum available fault current at the associated bus.
        3) Transformers: Inrush points and damage curves.

4) Generators: Full load current, overload curves, decrement curves, and short circuit withstand points.
5) Motors: Full load current, starting curves, and damage curves.

c. For each protective device, identify fixed and adjustable characteristics with available ranges and recommended settings.
1) Circuit Breakers: Include long time pickup and delay, short time pickup and delay, and instantaneous pickup.
2) Include ground fault pickup and delay.
3) Include fuse ratings.

d. Identify cases where either full selective coordination or adequate protection is not achieved, along with recommendations.

4. Arc Flash and Shock Risk Assessment:
a. For the worst case for each scenario, identify at each bus location:
1) Calculated incident energy and associated working distance.
2) Calculated arc flash boundary.
3) Bolted fault current.
4) Arcing fault current.
5) Clearing time.
6) Arc gap distance.

b. For purposes of producing arc flash hazard warning labels, summarize the maximum incident energy and associated data reflecting the worst case condition of all scenarios at each bus location.

c. Include recommendations for reducing the incident energy at locations where the calculated maximum incident energy exceeds 8 calories per sq cm.

5. For Oneline diagram indicate the following:
a. At each Bus:
1) Equipment ID.
2) Voltage.
3) 3 Phase Fault Current.
4) 1 Phase Fault Current.
5) X/R ratio.

b. At each breaker:
1) Equipment ID.
2) Device Amperage.
3) Voltage Rating.
4) Interrupting Rating.
5) Breaker Settings (If applicable).

c. At each source:
1) Device ID.
2) Voltage.
3) 3 Phase Fault Current.
4) 1 Phase Fault Current.
5) X/R Rating.

d. At each Generator:
1) Equipment ID.
2) Rated kW.
3) Rated kVA.
4) Voltage.

e. At each Transformer:
1) Equipment ID.
2) Rated kVA.

3) Primary Voltage.
4) Secondary Voltage.
5) Percent Impedance.

f. At each Motor:
1) Equipment ID.
2) Rated Horse Power.

1.06 QUALITY ASSURANCE

A Study Preparer Qualifications: Professional electrical engineer licensed in the State in which the Project is located and with minimum three years experience in the preparation of studies of similar type and complexity using specified computer software.
1. Study preparer may be employed by the manufacturer of the electrical distribution equipment.

B Computer Software for Study Preparation: Use the latest edition of commercially available software utilizing specified methodologies.
1. Acceptable Software Products:
a. SKM Systems Analysis, Inc: www.skm.com/#sle.

PART 2 PRODUCTS

2.01 ARC FLASH HAZARD WARNING LABELS

A Provide warning labels complying with ANSI Z535.4 to identify arc flash hazards for each work location analyzed by the arc flash and shock risk assessment.
1. Materials: Label shall be vinyl adhesive with moisture and UV resistance. Paper adhesive labels will not be accepted.
2. Label Information shall comply with 2015 NFPA 70E.
3. Legend: Provide custom legend in accordance with NFPA 70E based on equipment-specific data as determined by arc flash and shock risk assessment.
a. Include at least the following information:
1) Arc flash boundary.
2) Available incident energy and corresponding working distance.
3) Site-specific PPE (personnel protective equipment) requirements.
4) Nominal system voltage.
5) Limited approach boundary.
6) Restricted approach boundary.
7) Equipment identification.
8) Date calculations were performed.

PART 3 EXECUTION

3.01 INSTALLATION

A Labels shall be cut with straight and perpendicular lines.

B Labels shall be installed neatly and consistently from one piece of equipment to another.

C Clean surface of equipment so that it is free of dirt, dust, or other foreign substance prior to applying labels.

3.02 FIELD QUALITY CONTROL

A Adjust equipment and protective devices for compliance with studies and recommended settings.

END OF SECTION 26 05 73

SECTION 26 08 00
COMMISSIONING OF ELECTRICAL SYSTEMS

PART 1 - GENERAL

1.01 DESCRIPTION

A Commissioning is the process for ensuring that the Electrical System is installed and performs interactively according to the design intent and meets the building operational performance expectations as defined in the sequences of operations. The process also provides adequate documentation of installation, start-up and functional testing and ensures that the Owner's maintenance personnel are adequately trained. It provides for discovery of system operational performance deficiencies prior to substantial completion while the responsible contractors can provide a timely response. It establishes testing and communication protocols in an effort to advance the Electrical System from installation to complete dynamic operation and optimization.

B The commissioning process involves all the parties involved in the design and construction process as well as the Owner and the Commissioning Agent (CxA). Primary elements of Commissioning during the construction, acceptance and warranty phases of the project include:

1. Verify applicable equipment and systems are installed in accordance with manufacturers' instructions and contract documents and receive adequate operational start-up checkout by installing contractors.
2. Demonstrate functional operational performance of equipment and systems in the commissioning program.
3. Verify O&M documentation submitted is complete. Provide required documentation and information to allow compilation of Building Systems Manuals in accordance with Section 01 7823.
4. Verify Owner's maintenance personnel are adequately trained in accordance with specified training plan requirements.
5. Verify systems are interacting and performing optimally in accordance with the system sequence of operations.
6. The commissioning process requires Division 26 participation, as necessary, in support of the mechanical system commissioning for the Division 23 systems. This may include participation in system installation and start-up activities (e.g. full load amp readings on motors) and monitoring electrical systems during function performance testing. Section 01 9113 specifies the systems included in the commissioning program.
7. Furnish labor and material to accomplish electrical system commissioning and systems' testing as specified herein and other related sections.
8. RELATED SECTIONS
    a. Section 01 7823 – Operation and Maintenance Data
    b. Section 01 9113 - General Commissioning Requirements
    c. Section 01 7513 – Pre-Functional Checklists
    d. Section 01 9114 – Functional Testing Requirements
    e. Section 01 7900 – Demonstration and Training
    f. Section 23 0800 – Commissioning of HVAC Systems.
    g. Section 23 0801 – Commissioning of Building Controls System
    h. Division 26 Sections pertaining to the electrical systems included in the commissioning program.
9. SUBMITTALS
    a. Refer to Section 01 9113 for commissioning submittal requirements. Provide copies of commissioning submittal requirements to the Commissioning Agent, in addition to the copies required by the Owner and Design Professional.
10. COORDINATION
    a. The installation schedule for the electrical systems included in the commissioning program shall be such that the commissioning requirements can be met without impacting the construction schedule. Commissioning Functional Performance Testing is a requirement for Substantial Completion. The functional performance testing is scheduled to occur the two months prior to substantial completion.

PART 2 - PRODUCTS

2.01 TEST EQUIPMENT

A Provide industry standard test equipment to verify readings and test system and equipment performance. This test equipment will also be made available to the CxA. Generally, no equipment will be required beyond that required to perform Contractors work under these Contract Documents. The standards and accuracy requirements for test equipment are defined in Section 01 9113.

PART 3 - EXECUTION

3.01 COMMISSIONING

A General Requirements. For additional information regarding general commissioning requirements refer to Section 01 9113.

B Installation sub-contractors shall be responsible for executing and documenting equipment installation, start-up and check out for systems and equipment prior to the Commissioning Agent scheduling the functional performance test. Contractor shall also be responsible for providing training for the Owner's maintenance personnel in accordance with project requirements.

C Installation verification and start-up checklists for each type of equipment and system shall be provided to the installation contractors by the Commissioning Agent for use by the contractor in documenting the installation and start-up of equipment in the commissioning program. Refer to Section 01 7513 – Pre-Functional Checklists.

D For equipment and system components requiring a manufacturer's representative for installation verification and start-up, manufacturer documentation of these activities shall be attached to the checklists provided by the Commissioning Agent.

E Completed Start-up checklists for all pieces of equipment shall be submitted by Contractor to the Commissioning Agent prior to verification and performance testing.

1. TRAINING
    a. Refer to Section 01 7900 - Demonstration and Training for training requirements.
    b. Contractor responsible for the installation of the system shall coordinate the participation of other sub-contractors and manufacturer's representatives in the training program.
2. GENERAL SYSTEM TESTING CRITERIA
    a. Functional Performance Testing
        1) Refer to Sections 01 9113 - General Commissioning Requirements and 01 9114 - Functional Testing Requirements. Installation contractor shall be responsible for providing qualified manufacturer's representatives to demonstrate the operational capabilities of the electrical systems.

END OF SECTION 260800 26 08 00

SECTION 26 09 23
LIGHTING CONTROL DEVICES

PART 1 GENERAL

1.01 SECTION INCLUDES

A Occupancy sensors.

1.02 REFERENCE STANDARDS

A NFPA 70 - National Electrical Code; National Fire Protection Association, Including All Applicable Amendments and Supplements; 2020.

1.03 ADMINISTRATIVE REQUIREMENTS

A Coordination:
1. Coordinate the placement of wall switch occupancy sensors with actual installed door swings.
2. Coordinate the placement of occupancy sensors with millwork, furniture, equipment or other potential obstructions to motion detection coverage installed under other sections or by others.
3. Notify Architect of any conflicts or deviations from Contract Documents to obtain direction prior to proceeding with work.

B Sequencing:
1. Do not install lighting control devices until final surface finishes and painting are complete.

1.04 SUBMITTALS

A Product Data: Include ratings, configurations, standard wiring diagrams, dimensions, colors, service condition requirements, and installed features.
1. Occupancy Sensors: Include detailed motion detection coverage range diagrams.

B Shop Drawings:
1. Occupancy Sensors: Provide lighting plan indicating location, model number, and orientation of each occupancy sensor and associated system component.

C Field Quality Control Reports.

D Manufacturer's Installation Instructions: Include application conditions and limitations of use stipulated by product testing agency. Include instructions for storage, handling, protection, examination, preparation, and installation of product.

E Operation and Maintenance Data: Include detailed information on device programming and setup.

F Maintenance Materials: Furnish the following for Owner's use in maintenance of project.

G Project Record Documents: Record actual installed locations and settings for lighting control devices.

1.05 QUALITY ASSURANCE

A Comply with requirements of NFPA 70.

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

C Product Listing Organization Qualifications: Third party agencies shall be amongst those accredited by the NCBCC (North Carolina Building Code Council) to label Electrical and Mechanical Equipment.

1.06 DELIVERY, STORAGE, AND PROTECTION

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

1.07 FIELD CONDITIONS

A Maintain field conditions within manufacturer's required service conditions during and after installation.

1.08 WARRANTY

A Provide five year manufacturer warranty for all occupancy sensors.

PART 2 PRODUCTS

2.01 LIGHTING CONTROL DEVICES - GENERAL REQUIREMENTS

A Provide products listed, classified, and labeled as suitable for the purpose intended.

B Unless specifically indicated to be excluded, provide all required conduit, wiring, connectors, hardware, components, accessories, etc. as required for a complete operating system.

2.02 OCCUPANCY SENSORS

A Manufacturers:
1. Hubbell Incorporated: www.hubbell.com/#sle.

2. Sensor Switch Inc.
3. WattStopper.
4. Approved Equal.
5. Source Limitations: Furnish products produced by a single manufacturer and obtained from a single supplier.

B All Occupancy Sensors:

1. Description: Factory-assembled commercial specification grade devices for indoor use capable of sensing both major motion, such as walking, and minor motion, such as small desktop level movements, according to published coverage areas, for automatic control of load indicated.
2. Sensor Technology:
   a. Passive Infrared (PIR) Occupancy Sensors: Designed to detect occupancy by sensing movement of thermal energy between zones.
   b. Ultrasonic Occupancy Sensors: Designed to detect occupancy by sensing frequency shifts in emitted and reflected inaudible sound waves.
   c. Passive Infrared/Ultrasonic Dual Technology Occupancy Sensors: Designed to detect occupancy using a combination of both passive infrared and ultrasonic technologies.
3. Provide LED to visually indicate motion detection.
4. Operation: Unless otherwise indicated, occupancy sensor to turn load on when occupant presence is detected and to turn load off when no occupant presence is detected during an adjustable turn-off delay time interval.
5. Dual Technology Occupancy Sensors: Field configurable turn-on and hold-on activation with settings for activation by either or both sensing technologies.
6. Passive Infrared Lens Field of View: Field customizable by addition of factory masking material, adjustment of integral blinders, or similar means to block motion detection in selected areas.
7. Turn-Off Delay: Field adjustable, with time delay settings up to 30 minutes.
8. Sensitivity: Field adjustable.
9. Adaptive Technology: Field selectable; capable of self-adjusting sensitivity and time delay according to conditions.
10. Isolated Relay for Low Voltage Occupancy Sensors: SPDT dry contacts, for interface with HVAC systems.

C Wall Switch Occupancy Sensors:

1. All Wall Switch Occupancy Sensors:
   a. Description: Occupancy sensors designed for installation in standard wall box at standard wall switch mounting height with a field of view of 180 degrees, integrated manual control capability, and no leakage current to load in off mode.
   b. Unless otherwise indicated or required to control the load indicated on drawings, provide line voltage units with self-contained relay.
   c. Where indicated, provide two-circuit units for control of two separate lighting loads, with separate manual controls and separately programmable operation for each load.
   d. Finish: Match finishes specified for wiring devices in Section 26 27 26, unless otherwise indicated.
2. Dual Technology wall switch occupancy sensors: Capable of detecting motion within an area of 35 x 30 foot area for major motion and a 20 x 15 foot area for minor motion.
   a. Products:
      1) Single Button: Wattstopper DW-100.
      2) Two Button: Wattstopper DW-200.
      3) or approved equal.

D Ceiling Mounted Occupancy Sensors:

1. All Ceiling Mounted Occupancy Sensors:
   a. Description: Low profile occupancy sensors designed for ceiling installation.

b. Unless otherwise indicated or required to control the load indicated on drawings, provide low voltage units, for use with separate compatible accessory power packs.
c. Provide field selectable setting for disabling LED motion detector visual indicator.
d. Occupancy sensor to be field selectable as either manual-on/automatic-off or automatic on/off.
e. Finish: White unless otherwise indicated.

2. Passive Infrared/Ultrasonic Dual Technology Ceiling Mounted Occupancy Sensors:
   a. Extended Range Sensors: Capable of detecting motion within an area of 1,000 square feet coverage 9 feet, with a field of view of 360 degrees.
      1) Products:
         (a) Wattstopper DT-300.

E Directional Occupancy Sensors:
1. All Directional Occupancy Sensors: Designed for wall or ceiling mounting, with integral swivel for field adjustment of motion detection coverage.
   a. Unless otherwise indicated or required to control the load indicated on drawings, provide low voltage units, for use with separate compatible accessory power packs.
   b. Provide field selectable setting for disabling LED motion detector visual indicator.
   c. Finish: White unless otherwise indicated.
2. Passive Infrared (PIR) Directional Occupancy Sensors:
3. Passive Infrared/Ultrasonic Dual Technology Directional Occupancy Sensors: Capable of detecting motion within a distance of 40 feet at a mounting height of 10 feet.
   a. Products:
      1) Wattstopper CX-100.
      2) Wattstopper DT-200.
      3) or approved equal.

F Power Packs for Low Voltage Occupancy Sensors:
1. Description: Plenum rated, self-contained low voltage class 2 transformer and relay compatible with specified low voltage occupancy sensors for switching of line voltage loads.
2. Provide quantity and configuration of power and slave packs with all associated wiring and accessories as required to control the load indicated on drawings.
3. Input Supply Voltage: Dual rated for 120/277 V ac.
4. Power packs shall be capable of fitting in a standard 4" square junction box.
5. Load Rating: As required to control the load indicated on drawings.
6. Provide isolated relay for interface with HVAC units.

2.03 LIGHTING OVERRIDE SWITCHES AND BAS PROGRAMMING

A Coordinate all override lighting controls, contactors, and programming with the BAS controls contractor.

B BAS controls contractor shall provide single button override switches with all associated wiring back to BAS panel. Electrical contractor shall provide device box, and 3/4" conduit, with pull string, to above nearest accessible ceiling.

C BAS system will have all required outputs to control the lighting contactors identified on the drawings.

D Override switches shall be programmed by BAS controls contractor as follows:
1. Time of day schedule shall be coordinated with owner.
2. During scheduled on period: button press has no effect.
3. Impending off event: Fifteen minutes prior to a scheduled off event BAS shall blink the lights on and off three times in three second intervals to warn occupants.
4. If button is pressed during an impending off event the normal schedule shall be overridden to be on for two hours from the time the button is pressed.
5. 15 minutes prior to the 2 hour override is expired if the normal schedule is still off another impending off blink warning will be initiated.
6. Pressing the button at any time during a normally scheduled off period will initiate a 2 hour on override.

E Exterior Lighting Controls Programming.

1. Exterior lighting schedule shall be confirmed with owner prior to programming.
2. On/Off schedule shall be adjustable based on daylight sensor input to turn exterior lighting on/off based on exterior lighting levels.
3. In general exterior lighting shall turn on 15 minutes prior to sunset, off at 12:00am, and on again at 5:00 am until sunrise. Coordinate final sequence with owner.

F Upon activation of fire alarm system the BAS shall automatically override any schedule off period or event. Normal programmed schedule to resume once fire alarm system is no longer in alarm.

PART 3 EXECUTION

3.01 EXAMINATION

A Verify that field measurements are as indicated.

B Verify that outlet boxes are installed in proper locations and at proper mounting heights and are properly sized to accommodate devices and conductors in accordance with NFPA 70.

C Verify that openings for outlet boxes are neatly cut and will be completely covered by devices or wall plates.

D Verify that final surface finishes are complete, including painting.

E Verify that branch circuit wiring installation is completed, tested, and ready for connection to lighting control devices.

F Verify that the service voltage and ratings of lighting control devices are appropriate for the service voltage and load requirements at the location to be installed.

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

3.02 PREPARATION

A Provide extension rings to bring outlet boxes flush with finished surface.

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

3.03 INSTALLATION

A Perform work in a neat and workmanlike manner in accordance.

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

1. Mounting Heights: Unless otherwise indicated, as follows:
   a. Wall Switch Occupancy Sensors: 48 inches above finished floor.
2. Orient outlet boxes for vertical installation of lighting control devices unless otherwise indicated.

C Install lighting control devices in accordance with manufacturer's instructions.

D Unless otherwise indicated, connect lighting control device grounding terminal or conductor to branch circuit equipment grounding conductor and to outlet box with bonding jumper.

E Install lighting control devices plumb and level, and held securely in place.

F Where required and not furnished with lighting control device, provide wall plate in accordance with Section 26 27 26.

G Provide required supports in accordance with Section 26 05 29.

H Where applicable, install lighting control devices and associated wall plates to fit completely flush to mounting surface with no gaps and rough opening completely covered without strain on wall plate. Repair or reinstall improperly installed outlet boxes or improperly sized rough openings.

I Occupancy Sensor Locations:

1. Location Adjustments: Locations indicated are diagrammatic and only intended to indicate which rooms or areas require devices. Provide quantity and locations as required for complete coverage of respective room or area based on manufacturer's recommendations for installed devices.
2. Locate ultrasonic and dual technology passive infrared/ultrasonic occupancy sensors a minimum of 6 feet from air supply ducts or other sources of heavy air flow and as per manufacturer's recommendations, in order to minimize false triggers.

J Unless otherwise indicated, install power packs for lighting control devices above accessible ceiling near the sensor location.

K Unless otherwise indicated, install switches on load side of power packs so that switch does not turn off power pack.

3.04 FIELD QUALITY CONTROL

A Provide System Commissioning in accordance with 2018 NCECC Section C408.

B Inspect each lighting control device for damage and defects.

C Test occupancy sensors to verify proper operation, including time delays and ambient light thresholds where applicable. Verify optimal coverage for entire room or area.

D Correct wiring deficiencies and replace damaged or defective lighting control devices.

3.05 ADJUSTING

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

B Adjust occupancy sensor settings to minimize undesired activations while optimizing energy savings, and to achieve desired function as indicated or as directed by Architect.

C Adjust position of directional occupancy sensors and outdoor motion sensors to achieve optimal coverage as required.

D Where indicated or as directed by Architect or owner, install factory masking material or adjust integral blinders on passive infrared (PIR) and dual technology occupancy sensor lenses to block undesired motion detection.

E Adjust time switch settings to achieve desired operation schedule as indicated or as directed by Architect.

3.06 CLEANING

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

3.07 CLOSEOUT ACTIVITIES

A Demonstration: Demonstrate proper operation of lighting control devices to Architect, and correct deficiencies or make adjustments as directed.

B Training: Train Owner's personnel on operation, adjustment, programming, and maintenance of lighting control devices.

1. Use operation and maintenance manual as training reference, supplemented with additional training materials as required.
2. Provide minimum of two hours of training.
3. Instructor: Qualified contractor familiar with the project and with sufficient knowledge of the installed lighting control devices.
4. Location: At project site.

END OF SECTION 26 09 23

SECTION 26 22 00
DRY TYPE TRANSFORMERS

PART 1 GENERAL

1.01 SECTION INCLUDES

A General purpose transformers.

1.02 REFERENCE STANDARDS

A UL 1561 - Standard for Dry-Type General Purpose and Power Transformers; Current Edition, Including All Revisions.

B NFPA 70 - National Electrical Code; National Fire Protection Association, Including All Applicable Amendments and Supplements; 2020.

1.03 SUBMITTALS

A Product Data: Include voltage, kVA, impedance, tap configurations, insulation system class and rated temperature rise, efficiency, sound level, enclosure ratings, outline and support point dimensions, weight, required clearances, service condition requirements, and installed features.

1. Vibration Isolators: Include attachment method and rated load and deflection.

B Shop Drawings: Provide dimensioned plan and elevation views of transformers and adjacent equipment with all required clearances indicated.

C Field Quality Control Test Reports.

D Manufacturer's Installation Instructions: Indicate application conditions and limitations of use stipulated by product testing agency. Include instructions for storage, handling, protection, examination, preparation, and installation of product.

E Maintenance Data: Include recommended maintenance procedures and intervals.

F Project Record Documents: Record actual locations of transformers.

1.04 QUALITY ASSURANCE

A Comply with requirements of NFPA 70.

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

C Product Listing Organization Qualifications: Third party agencies shall be amongst those accredited by the NCBCC (North Carolina Building Code Council) to label Electrical and Mechanical Equipment.

1.05 DELIVERY, STORAGE, AND HANDLING

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

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

1.06 FIELD CONDITIONS

A Ambient Temperature: Do not exceed the following maximum temperatures during and after installation of transformers.

1. 104 degrees F maximum.

PART 2 PRODUCTS

2.01 MANUFACTURERS

A ABB/GE: www.geindustrial.com/#sle.

B Eaton Corporation.

C Schneider Electric; Square D Products.

D Approved Equal.

E Source Limitations: Furnish transformers produced by the same manufacturer as the other electrical distribution equipment used for this project and obtained from a single supplier.

2.02 TRANSFORMERS - GENERAL REQUIREMENTS

A Description: Factory-assembled, dry type transformers for 60 Hz operation designed and manufactured in accordance with NEMA ST 20 and listed, classified, and labeled as suitable for the purpose intended.

B Unless noted otherwise, transformer ratings indicated are for continuous loading according to IEEE C57.96 under the following service conditions:

1. Altitude: Less than 3,300 feet.

2. Ambient Temperature:
    a. Not exceeding 104 degrees F.

C Core: High grade, non-aging silicon steel with high magnetic permeability and low hysteresis and eddy current losses. Keep magnetic flux densities substantially below saturation point, even at 10 percent primary overvoltage. Tightly clamp core laminations to prevent plate movement and maintain consistent pressure throughout core length.

D Impregnate core and coil assembly with non-hydroscopic thermo-setting varnish to effectively seal out moisture and other contaminants.

E Basic Impulse Level: 10 kV.

F Ground core and coil assembly to enclosure by means of a visible flexible copper grounding strap.

G Isolate core and coil from enclosure using vibration-absorbing mounts.

H Nameplate: Include transformer connection data, ratings, wiring diagrams, and overload capacity based on rated winding temperature rise.

2.03 GENERAL PURPOSE TRANSFORMERS

A Description: Self-cooled, two winding transformers listed and labeled as complying with UL 506 or UL 1561; ratings as indicated on the drawings.

B Insulation System and Allowable Average Winding Temperature Rise:
1. 15 kVA and Larger: Class 220 degrees C insulation system with 115 degrees C average winding temperature rise.

C Coil Conductors: Continuous copper windings with terminations brazed or welded.

D Winding Taps:
1. 15 kVA through 300 kVA: Two 2.5 percent full capacity primary taps above and four 2.5 percent full capacity primary taps below rated voltage.
2. 500 kVA and Larger: Two 2.5 percent full capacity primary taps above and two 2.5 percent full capacity primary taps below rated voltage.

E Energy Efficiency: Comply with DOE 2016.

F Sound Levels: Standard sound levels complying with NEMA ST 20

G Mounting Provisions:
1. 15 kVA through 75 kVA: Suitable for wall, floor, or trapeze mounting.
2. Larger than 75 kVA: Suitable for floor mounting.

H Transformer Enclosure: Comply with NEMA ST 20.
1. Environment Type per NEMA 250: As indicated on the drawings.
2. Construction: Steel.
    a. 15 kVA and Larger: Ventilated.
3. Finish: Manufacturer's standard grey, suitable for outdoor installations.
4. Provide lifting eyes or brackets.

I Accessories:
1. Lug Kits: Sized as required for termination of conductors as indicated on the drawings.

PART 3 EXECUTION

3.01 EXAMINATION

A Verify that field measurements are as indicated.

B Verify that suitable support frames and anchors are installed where required and that mounting surfaces are ready to receive transformers.

C Perform pre-installation tests and inspections on transformers per manufacturer's instructions and as specified in NECA 409. Correct deficiencies prior to installation.

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

3.02 INSTALLATION

A Perform work in a neat and workmanlike manner.

B Install products in accordance with manufacturer's instructions.

C Use flexible conduit, under the provisions of Section 26 05 33.13, 2 feet minimum length, for connections to transformer case. Make conduit connections to side panel of enclosure.

D Arrange equipment to provide minimum clearances as specified on transformer nameplate and in accordance with manufacturer's instructions and NFPA 70.

E Install transformers plumb and level.

F Transformer Support:

1. Provide required support and attachment in accordance with Section 26 05 29, where not furnished by transformer manufacturer.
2. Use integral transformer flanges, accessory brackets furnished by manufacturer, or field-fabricated supports to support wall-mounted transformers.
3. Unless otherwise indicated, mount floor-mounted transformers on properly sized 4 inch high concrete pad constructed in accordance with Section 03 30 00.
4. Use trapeze hangers assembled from threaded rods and metal channel (strut) to support suspended transformers. Provide independent support from building structure. Do not provide support from piping, ductwork, or other systems.

G Provide grounding and bonding in accordance with Section 26 05 26.

H Remove shipping braces and adjust bolts that attach the core and coil mounting bracket to the enclosure according to manufacturer's recommendations in order to reduce audible noise transmission.

I Where not factory-installed, install lugs sized as required for termination of conductors as indicated.

3.03 FIELD QUALITY CONTROL

A Perform inspections and tests listed in NETA ATS Sections 7.2.1.1 and 7.2.1.2. Tests and inspections listed as optional are not required.

1. Visual and Mechanical Inspection.
   a. Verify equipment name plate is in accordance with contract documents.
   b. Inspect physical and mechanical condition.
   c. Inspect anchorage, alignment, and grounding.
   d. Verify that resilient mounts are free and that any shipping brackets have been removed.
   e. Verify the unit is clean.
   f. Verify that as-left tap connections are as specified.
2. 167 kVA single phase, 500 kVA three phase and smaller:
   a. Electrical Tests:
      1) Measure resistance at each winding, tap, and bolted connection.
      2) Perform insulation-resistance tests winding-to-winding and each winding-to-ground. Apply voltage according to manufacturer's published data. In the absence of manufacturer's published data, comply with NETA ATS, Table 100.5. Calculate polarization index: the value of the index shall not be less than 1.0.
      3) Perform turns-ratio tests at all tap positions. Test results shall not deviate by more than one-half percent from either the adjacent coils or the calculated ratio. If test fails, replace the transformer.
      4) Verify correct secondary voltage, phase-to-phase and phase-to-neutral, after energization and prior to loading.
3. Larger than 167 kVA single phase and 500 kVA three phase:
   a. Electrical Tests
      1) Measure resistance at each winding, tap, and bolted connection.
      2) Perform insulation-resistance tests winding-to-winding and each winding-to-ground. Apply voltage according to manufacturer's published data. In the absence of manufacturer's published data, comply with NETA ATS, Table 100.5. Calculate polarization index: the value of the index shall not be less than 1.0.
      3) Perform power-factor or dissipation-factor tests on all windings.
      4) Perform turns-ratio tests at all tap positions. Test results shall not deviate by more than one-half percent from either the adjacent coils or the calculated ratio. If test fails, replace the transformer.
      5) Perform an excitation-current test on each phase.

6) Perform an applied voltage test on all high- and low-voltage windings to ground. See IEEE C57.12.91, Sections 10.2 and 10.9.
7) Verify correct secondary voltage, phase-to-phase and phase-to-neutral, after energization and prior to loading.

3.04 ADJUSTING

A Measure primary and secondary voltages and make appropriate tap adjustments.
B Adjust tightness of mechanical and electrical connections to manufacturer's recommended torque settings.

3.05 CLEANING

A Clean dirt and debris from transformer components according to manufacturer's instructions.
B Repair scratched or marred exterior surfaces to match original factory finish.

END OF SECTION 26 22 00

SECTION 26 24 16
PANELBOARDS

PART 1 GENERAL

1.01 SECTION INCLUDES

A Power distribution panelboards.

B Lighting and appliance panelboards.

C Overcurrent protective devices for panelboards.

1.02 REFERENCE STANDARDS

A UL 67 - Panelboards; Current Edition, Including All Revisions.

B UL 489 - Molded-Case Circuit Breakers, Molded-Case Switches and Circuit Breaker Enclosures; Current Edition, Including All Revisions.

C NFPA 70 - National Electrical Code; National Fire Protection Association, Including All Applicable Amendments and Supplements; 2020.

1.03 ADMINISTRATIVE REQUIREMENTS

A Coordination:

1. Coordinate the work with other trades to avoid placement of ductwork, piping, equipment, or other potential obstructions within the dedicated equipment spaces and working clearances for electrical equipment required by NFPA 70.
2. Coordinate arrangement of electrical equipment with the dimensions and clearance requirements of the actual equipment to be installed.
3. Coordinate the work with other trades to provide walls suitable for installation of flush-mounted panelboards where indicated.
4. Verify with manufacturer that conductor terminations are suitable for use with the conductors to be installed.
5. Notify Architect of any conflicts with or deviations from Contract Documents. Obtain direction before proceeding with work.

1.04 SUBMITTALS

A Product Data: Provide manufacturer's standard catalog pages and data sheets for panelboards, enclosures, overcurrent protective devices, and other installed components and accessories.

1. Contractor shall confirm that all lug sizes and quantities submitted are compatible with the conductors specified on the contract documents. Changes required to lug sizes and quantities due to lack of coordination between the contractor and the supplier are to be made at the contractor's expense.

B Shop Drawings: Indicate outline and support point dimensions, voltage, main bus ampacity, overcurrent protective device arrangement and sizes, short circuit current ratings, conduit entry locations, conductor terminal information, and installed features and accessories.

1. It is the contractor's responsibility to ensure that the equipment submitted to comply with the requirements of this section are in compliance with the requirements and recommendations of the power system studies. Any changes recommended by the power system study shall be incorporated at no expense to the project.

C Field Quality Control Test Reports.

D Manufacturer's Installation Instructions: Indicate application conditions and limitations of use stipulated by product testing agency. Include instructions for storage, handling, protection, examination, preparation, and installation of product.

E Project Record Documents: Record actual installed locations of panelboards and actual installed circuiting arrangements.

F Maintenance Data: Include information on replacement parts and recommended maintenance procedures and intervals.

1.05 QUALITY ASSURANCE

A Comply with requirements of NFPA 70.

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

C Product Listing Organization Qualifications: Third party agencies shall be amongst those accredited by the NCBCC (North Carolina Building Code Council) to label Electrical and Mechanical Equipment.

D Contractor shall schedule a pre-energization site visit with the Engineer. Meeting shall be scheduled at least 7 days in advance. The results of the megger test and service ground resistance test shall be made available to the Engineer prior to scheduling the pre-energization site visit.

1.06 DELIVERY, STORAGE, AND HANDLING

A Receive, inspect, handle, and store panelboards in accordance with manufacturer's instructions.

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

C Handle carefully in accordance with manufacturer's written instructions to avoid damage to panelboard internal components, enclosure, and finish.

1.07 FIELD CONDITIONS

A Maintain ambient temperature within the following limits during and after installation of panelboards:

1. Panelboards Containing Circuit Breakers: Between 23 degrees F and 104 degrees F.

PART 2 PRODUCTS

2.01 MANUFACTURERS

A ABB/GE: www.geindustrial.com/#sle.

B Eaton Corporation.

C Schneider Electric; Square D Products.

D Source Limitations: Furnish panelboards and associated components produced by the same manufacturer as the other electrical distribution equipment used for this project and obtained from a single supplier.

2.02 PANELBOARDS - GENERAL REQUIREMENTS

A Provide products listed, classified, and labeled as suitable for the purpose intended.

B Unless otherwise indicated, provide products suitable for continuous operation under the following service conditions:

1. Altitude: Less than 6,600 feet.
2. Ambient Temperature:
   a. Panelboards Containing Circuit Breakers: Between 23 degrees F and 104 degrees F.

C Short Circuit Current Rating:

1. Provide panelboards with listed short circuit current rating not less than the available fault current at the installed location as indicated on the drawings.
2. When a power system study is included in the contract short circuit current ratings shall be verified with the study prior to submitting equipment for approval. Any changes required to meet the maximum available fault current shall be made in the submittal.
3. Series rating is not allowed.

D Panelboards Used for Service Entrance: Listed and labeled as suitable for use as service equipment according to UL 869A.

E Mains: Configure for top or bottom incoming feed as indicated or as required for the installation.

F Branch Overcurrent Protective Devices: Replaceable without disturbing adjacent devices.

G Bussing: Sized in accordance with UL 67 temperature rise requirements.

1. Provide fully rated neutral bus unless otherwise indicated, with a suitable lug for each feeder or branch circuit requiring a neutral connection.
2. Provide solidly bonded equipment ground bus in each panelboard, with a suitable lug for each feeder and branch circuit equipment grounding conductor.

H Conductor Terminations: Suitable for use with the conductors to be installed.

I Enclosures: Comply with NEMA 250, and list and label as complying with UL 50 and UL 50E.

1. Environment Type per NEMA 250: As indicated on the drawings.
2. Boxes: Galvanized steel unless otherwise indicated.
3. Fronts:
   a. Fronts for Surface-Mounted Enclosures: Same dimensions as boxes.
   b. Fronts for Flush-Mounted Enclosures: Overlap boxes on all sides to conceal rough opening.

c. All covers shall be door in door type where one door can be opened to access the breakers and and dead front and the second door opens to the wire bending space adjacent to the dead front.
d. Door in door covers shall feature a full length piano hinge.

4. Lockable Doors: All locks keyed alike unless otherwise indicated.

J Future Provisions: Prepare all unused spaces for future installation of devices including bussing, connectors, mounting hardware and all other required provisions.

K Selectivity: Where the requirement for selectivity is indicated, furnish products as required to achieve selective coordination.

L Load centers are not acceptable.

2.03 POWER DISTRIBUTION PANELBOARDS

A Description: Panelboards complying with NEMA PB 1, power and feeder distribution type, circuit breaker type, and listed and labeled as complying with UL 67; ratings, configurations and features as indicated on the drawings.

B Conductor Terminations:
1. Main and Neutral Lug Material: Copper, suitable for terminating copper conductors only.
2. Main and Neutral Lug Type: Compression.

C Bussing:
1. Phase and Neutral Bus Material: Copper.
2. Ground Bus Material: Copper.

D Circuit Breakers:
1. Provide bolt-on type.
2. Provide thermal magnetic circuit breakers for circuit breaker frame sizes less than 250 amperes.
3. Provide electronic trip circuit breakers for circuit breaker frame sizes 250 amperes and above.
4. Panelboards used for service shall have 100% fully rated main breaker.

E Enclosures:
1. Fronts: Provide door-in-door trim with hinged cover for access to load terminals and wiring gutters, and separate lockable hinged door with concealed hinges for access to overcurrent protective device handles without exposing live parts.
2. Provide clear plastic circuit directory holder mounted on inside of door.

2.04 LIGHTING AND APPLIANCE PANELBOARDS

A Description: Panelboards complying with NEMA PB 1, lighting and appliance branch circuit type, circuit breaker type, and listed and labeled as complying with UL 67; ratings, configurations and features as indicated on the drawings.

B Conductor Terminations:
1. Main and Neutral Lug Material: Copper, suitable for terminating copper conductors only.
2. Main and Neutral Lug Type: Compression.

C Bussing:
1. Phase Bus Connections: Arranged for sequential phasing of overcurrent protective devices.
2. Phase and Neutral Bus Material: Copper.
3. Ground Bus Material: Copper.

D Circuit Breakers: Thermal magnetic bolt-on type unless otherwise indicated.

E Provide electronic trip circuit breakers for circuit breaker frame sizes [250] amperes and above.

F Panelboards used as service entrance shall have 100% fully rated main breaker.

G Enclosures:
1. Fronts: Provide door-in-door trim with hinged cover for access to load terminals and wiring gutters, and separate lockable hinged door with concealed hinges for access to overcurrent protective device handles without exposing live parts.
2. Provide clear plastic circuit directory holder mounted on inside of door.

2.05 OVERCURRENT PROTECTIVE DEVICES

A Molded Case Circuit Breakers:

1. Description: Quick-make, quick-break, over center toggle, trip-free, trip-indicating circuit breakers listed and labeled as complying with UL 489, and complying with FS W-C-375 where applicable; ratings, configurations, and features as indicated on the drawings.
2. Main Breakers in Service Entrance Panels shall be 100% fully rated.
3. Interrupting Capacity:
    a. Provide circuit breakers with interrupting capacity as required to provide the short circuit current rating indicated.
    b. Fully Rated Systems: Provide circuit breakers with interrupting capacity not less than the short circuit current rating indicated.
4. Conductor Terminations:
    a. Provide compression lugs.
    b. Lug Material: Copper, suitable for terminating copper conductors only.
5. Thermal Magnetic Circuit Breakers: For each pole, furnish thermal inverse time tripping element for overload protection and magnetic instantaneous tripping element for short circuit protection.
    a. Provide field-adjustable magnetic instantaneous trip setting for circuit breaker frame sizes 100 amperes and larger.
6. Electronic Trip Circuit Breakers: Furnish solid state, microprocessor-based, true rms sensing trip units.
7. Provide electronic trip circuit breakers for circuit breaker frame sizes larger than 250 amperes.
    a. Provide the following individually field-adjustable trip response settings:
        1) Long time pickup, adjustable by setting dial.
        2) Long time delay.
        3) Short time pickup and delay.
        4) Instantaneous pickup.
        5) Ground fault pickup and delay where ground fault protection is indicated.
8. Do not use handle ties in lieu of multi-pole circuit breakers.
9. Provide multi-pole circuit breakers for multi-wire branch circuits as required by NFPA 70.
10. Provide the following features and accessories where indicated or where required to complete installation:
    a. Shunt Trip: Provide coil voltage as required for connection to indicated trip actuator.
    b. Handle Pad-Lock Provision: For locking circuit breaker handle in OFF position.
        1) Provide handle locks for all breakers serving fire alarm equipment or elevator emergency communication systems. Handle locks shall be Space Age Electronics ELOCK series or approved equal.

PART 3 EXECUTION

3.01 EXAMINATION

A Verify that field measurements are as indicated.

B Verify that the ratings and configurations of the panelboards and associated components are consistent with the indicated requirements.

C Verify that mounting surfaces are ready to receive panelboards.

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

3.02 INSTALLATION

A Perform work in accordance with NECA 1 (general workmanship).

B Install products in accordance with manufacturer's instructions.

C Install panelboards securely, in a neat and workmanlike manner.

D Arrange equipment to provide at least clearances in accordance with manufacturer's instructions and NFPA 70.

E Provide required support and attachment in accordance with Section 26 05 29.

F Install panelboards plumb.

G Mount panelboards such that the highest position of any operating handle for circuit breakers or switches does not exceed 79 inches above the floor or working platform.

H Provide grounding and bonding in accordance with Section 26 05 26.

I Install all field-installed branch devices, components, and accessories.

J Set field-adjustable circuit breaker tripping function settings as directed. If a power system study is included in the contract, set breakers according to the recommendations made in the study.

K Provide filler plates to cover unused spaces in panelboards.

L Provide circuit breaker lock-on devices to prevent unauthorized personnel from de-energizing essential loads where indicated. Also provide for the following:

1. Emergency and night lighting circuits.
2. Fire detection and alarm circuits.

M Identify panelboards in accordance with Section 26 05 53.

3.03 FIELD QUALITY CONTROL

A Molded Case Circuit Breakers: Perform inspections and tests listed in NETA ATS, Section 7.6.1.1 for all main circuit breakers and circuit breakers larger than 600 amperes. Tests listed as optional are not required.

1. Verify equipment nameplate is in accorance with contract documents.
2. Inspect physical and mechanical condition.
3. Inspect anchorage and anlignment.
4. Verify unit is clean.
5. Operate breaker to enusre smooth operation.
6. Perform breaker adjustamants in accorance with the power system study.
7. Perform resistance measurements through bolted connectionswith a low-resistance ohmmeter.
8. Perform insulation-resistance test for one minute on each pole, phase-to-phase and phase-to-ground with circuit breaker closed.
9. Perform contact/pole resistance test.
10. Determine long-time and short time pickup and delay settings by primary current injection.
11. Determine ground fault pickup and time delay by primary current injection.

B Ground Fault Protection Systems: Test in accordance with manufacturer's instructions as required by NFPA 70.

C Test GFCI circuit breakers to verify proper operation.

D Test AFCI circuit breakers to verify proper operation.

E Test shunt trips to verify proper operation.

F Correct deficiencies and replace damaged or defective panelboards or associated components.

G For Services and feeders 1000 amperes and larger, and any installation utilizing selective coordination, the following test should be performed on the circuit breakers. Testing shall be performed by a qualified manufacturer's factory technician at the job site. All readings shall be tabulated.

1. Phase Tripping tolerance (within 20% of UL requirements).
2. Trip time (per phase) in seconds.
3. Instantaneous trip (amps) per phase.
4. Insulation resistance (in megohms) at 1000-volts DC (phase to phase, and line to load).

3.04 ADJUSTING

A Adjust tightness of mechanical and electrical connections to manufacturer's recommended torque settings.

B Adjust alignment of panelboard fronts.

C Load Balancing: For each panelboard, rearrange circuits such that the difference between each measured steady state phase load does not exceed 20 percent and adjust circuit directories accordingly. Maintain proper phasing for multi-wire branch circuits.

3.05 CLEANING

A Clean dirt and debris from panelboard enclosures and components according to manufacturer's instructions.

B Repair scratched or marred exterior surfaces to match original factory finish.

END OF SECTION 26 24 16

SECTION 26 27 26
WIRING DEVICES

PART 1 GENERAL

1.01 SECTION INCLUDES

A Wall switches.
B Wall dimmers.
C Receptacles.
D Wall plates.
E Floor box service fittings.

1.02 REFERENCE STANDARDS

A UL 20 - General-Use Snap Switches; Current Edition, Including All Revisions.
B UL 498 - Attachment Plugs and Receptacles; Current Edition, Including All Revisions.
C UL 514D - Cover Plates for Flush-Mounted Wiring Devices; Current Edition, Including All Revisions.
D UL 1472 - Solid-State Dimming Controls; Current Edition, Including All Revisions.
E NFPA 70 - National Electrical Code; National Fire Protection Association, Including All Applicable Amendments and Supplements; 2020.

1.03 ADMINISTRATIVE REQUIREMENTS

A Coordination:
1. Coordinate the placement of outlet boxes with millwork, furniture, equipment, etc. installed under other sections or by others.
2. Coordinate wiring device ratings and configurations with the electrical requirements of actual equipment to be installed.
3. Coordinate the placement of outlet boxes for wall switches with actual installed door swings.
4. Coordinate the installation and preparation of uneven surfaces, such as split face block, to provide suitable surface for installation of wiring devices.
5. Coordinate the core drilling of holes for poke-through assemblies with the work covered under other sections.
6. Notify Architect of any conflicts or deviations from Contract Documents to obtain direction prior to proceeding with work.

B Sequencing:
1. Do not install wiring devices until final surface finishes and painting are complete.

1.04 SUBMITTALS

A Product Data: Provide manufacturer's catalog information showing dimensions, colors, and configurations.
1. Wall Dimmers: Include derating information for ganged multiple devices.

B Field Quality Control Test Reports.
C Manufacturer's Installation Instructions: Indicate application conditions and limitations of use stipulated by product testing agency. Include instructions for storage, handling, protection, examination, preparation, and installation of product.
D Operation and Maintenance Data:
1. Wall Dimmers: Include information on operation and setting of presets.
2. GFCI Receptacles: Include information on status indicators.

E Project Record Documents: Record actual installed locations of wiring devices.
F Maintenance Materials: Furnish the following for Owner's use in maintenance of project.
1. Screwdrivers for Tamper-Resistant Screws: Two for each type of screw.
2. Extra Keys for Locking Switches: Two of each type.
3. Extra Wall Plates: Two of each style, size, and finish.

1.05 QUALITY ASSURANCE

A Comply with requirements of NFPA 70.
B Maintain at the project site a copy of each referenced document that prescribes execution requirements.
C Products: Listed, classified, and labeled as suitable for the purpose intended.

D Product Listing Organization Qualifications: Third party agencies shall be amongst those accredited by the NCBCC (North Carolina Building Code Council) to label Electrical and Mechanical Equipment.

1.06 DELIVERY, STORAGE, AND PROTECTION

A Store in a clean, dry space in original manufacturer's packaging until ready for installation.

PART 2 PRODUCTS

2.01 WIRING DEVICE APPLICATIONS

A Provide wiring devices suitable for intended use and with ratings adequate for load served.

B For single receptacles installed on an individual branch circuit, provide receptacle with ampere rating not less than that of the branch circuit.

C Provide weather resistant GFCI receptacles with specified weatherproof covers for receptacles installed outdoors or in damp or wet locations.

D Provide GFCI protection for receptacles installed within 6 feet of sinks.

E Provide GFCI protection for receptacles installed in kitchens.

F Provide GFCI protection for receptacles serving electric drinking fountains.

G Unless noted otherwise, do not use combination switch/receptacle devices.

H For flush floor service fittings, use carpet flanges for installations in carpeted floors.

2.02 WIRING DEVICE FINISHES

A Provide wiring device finishes as described below unless otherwise indicated.

B Wiring Devices, Unless Otherwise Indicated: White with stainless steel wall plate.

C Wiring Devices Installed in Finished Spaces: White with stainless steel wall plate.

D Wiring Devices Installed in Unfinished Spaces: White with galvanized steel wall plate.

2.03 WALL SWITCHES

A Manufacturers:

1. Hubbell Incorporated: www.hubbell.com/#sle.
2. Leviton Manufacturing Company, Inc.
3. Pass & Seymour, a brand of Legrand North America, Inc
4. Approved Equal.

B Wall Switches - General Requirements: AC only, quiet operating, general-use snap switches with silver alloy contacts, complying with NEMA WD 1 and NEMA WD 6, and listed as complying with UL 20; types as indicated on the drawings.

1. Wiring Provisions: Terminal screws for side wiring and screw actuated binding clamp for back wiring with separate ground terminal screw.

C Standard Wall Switches: Industrial heavy duty grade, 20 A, 120/277 V with standard toggle type switch actuator and maintained contacts; single pole single throw, three way, or four way as indicated on the drawings.

2.04 WALL DIMMERS

A Manufacturers:

1. Leviton Manufacturing Company, Inc.
2. Lutron Electronics Company, Inc.
3. Pass & Seymour, a brand of Legrand North America, Inc
4. Or approved equal.

B Wall Dimmers - General Requirements: Solid-state with continuous full-range even control following square law dimming curve, integral radio frequency interference filtering, power failure preset memory, air gap switch accessible without removing wall plate, complying with NEMA WD 1 and NEMA WD 6, and listed as complying with UL 1472; types and ratings suitable for load controlled as indicated on the drawings.

C Provide accessory wall switches to match dimmer appearance when installed adjacent to each other.

D Contractor shall ensure dimmer switch compatibility with luminaire controlled prior to ordering.

2.05 RECEPTACLES

A Manufacturers:

1. Hubbell Incorporated: www.hubbell.com/#sle.

2. Leviton Manufacturing Company, Inc.
3. Pass & Seymour, a brand of Legrand North America, Inc.
4. Approved equal.
5. Source Limitations: Where wall controls are furnished as part of lighting control system, provide accessory matching receptacles and wallplates by the same manufacturer in locations indicated.

B Receptacles - General Requirements: Self-grounding, complying with NEMA WD 1 and NEMA WD 6, and listed as complying with UL 498and where applicable FS W-C-596; types as indicated on the drawings.
1. Wiring Provisions: Terminal screws for side wiring or screw actuated binding clamp for back wiring with separate ground terminal screw.
2. NEMA configurations specified are according to NEMA WD 6.

C Convenience Receptacles:
1. Standard Convenience Receptacles: Industrial Heavy Duty Grade, 20A, 125V, NEMA 5-20R; single or duplex as indicated on the drawings.
2. Tamper Resistant Convenience Receptacles: Industrial specification grade, 20A, 125V, NEMA 5-20R, listed and labeled as tamper resistant type; single or duplex as indicated on the drawings.
3. Tamper Resistant and Weather Resistant Convenience Receptacles: Industrial specification grade, 20A, 125V, NEMA 5-20R, listed and labeled as tamper resistant type and as weather resistant type complying with UL 498 Supplement SE suitable for installation in damp or wet locations; single or duplex as indicated on the drawings.

D GFCI Receptacles:
1. GFCI Receptacles - General Requirements: Self-testing, with feed-through protection and light to indicate ground fault tripped condition and loss of protection; listed as complying with UL 943, class A.
   a. Provide test and reset buttons of same color as device.
2. Standard GFCI Receptacles: Extra Heavy Duty Grade, duplex, 20A, 125V, NEMA 5-20R, rectangular decorator style.
3. Tamper Resistant GFCI Receptacles: Industrial specification grade, duplex, 20A, 125V, NEMA 5-20R, rectangular decorator style, listed and labeled as tamper resistant type.
4. Tamper Resistant and Weather Resistant GFCI Receptacles: Industrial specification grade, duplex, 20A, 125V, NEMA 5-20R, rectangular decorator style, listed and labeled as tamper resistant type and as weather resistant type complying with UL 498 Supplement SE suitable for installation in damp or wet locations.

2.06 WALL PLATES

A Manufacturers:
1. Hubbell Incorporated.
2. Leviton Manufacturing Company, Inc.
3. Pass & Seymour, a brand of Legrand North America, Inc.
4. Source Limitations: Where wall controls are furnished as part of lighting control system, provide accessory matching receptacles and wallplates by the same manufacturer in locations indicated.

B Wall Plates: Comply with UL 514D.
1. Configuration: One piece cover as required for quantity and types of corresponding wiring devices.
2. Size: Semi-Jumbo; Midi Size.
3. Screws: Metal with slotted heads finished to match wall plate finish.

C Stainless Steel Wall Plates: Brushed satin finish, Type 302 stainless steel.

D Galvanized Steel Wall Plates: Rounded corners and edges, with corrosion resistant screws.

E Weatherproof Covers for Wet and Damp Locations: Gasketed, thermoplastic, with self-closing hinged cover and corrosion-resistant screws; listed as suitable for use in wet locations with cover closed. Covers must be weatherproof while in use.

2.07 FLOOR BOX SERVICE FITTINGS

A Manufacturers:
1. Hubbell Incorporated: www.hubbell.com/#sle.

2. Thomas & Betts Corporation.
3. Wiremold, a brand of Legrand North America, Inc.
4. Or approved equal.

B Description: Service fittings compatible with floor boxes provided under Section 26 05 33.16 with components, adapters, and trims required for complete installation.

C Flush Floor Service Fittings:

1. Dual Service Flush Combination Outlets:
   a. Cover: Round - Finish to be selected by Architect.
   b. Configuration:
      1) Power: Two standard convenience duplex receptacles.
      2) Communications: As indicated on drawings.
      3) Voice and Data Jacks: As indicated on the drawings.
2. Accessories:
   a. Tile Rings: Finish to match covers; configuration as required to accommodate specified covers.
   b. Carpet Flanges: Finish to match covers; configuration as required to accommodate specified covers.

PART 3 EXECUTION

3.01 EXAMINATION

A Verify that field measurements are as indicated.

B Verify that outlet boxes are installed in proper locations and at proper mounting heights and are properly sized to accommodate devices and conductors in accordance with NFPA 70.

C Verify that wall openings are neatly cut and will be completely covered by wall plates.

D Verify that final surface finishes are complete, including painting.

E Verify that floor boxes are adjusted properly.

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

G Verify that core drilled holes for poke-through assemblies are in proper locations.

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

3.02 PREPARATION

A Provide extension rings to bring outlet boxes flush with finished surface.

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

3.03 INSTALLATION

A Perform work in a neat and workmanlike manner.

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

1. Orient outlet boxes for vertical installation of wiring devices unless otherwise indicated.
2. Where multiple receptacles, wall switches, or wall dimmers are installed at the same location and at the same mounting height, gang devices together under a common wall plate.
3. Locate receptacles for electric drinking fountains concealed behind drinking fountain according to manufacturer's instructions.

C Install wiring devices in accordance with manufacturer's instructions.

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

E Where required, connect wiring devices using pigtails not less than 6 inches long. Do not connect more than one conductor to wiring device terminals.

F Connect wiring devices by wrapping conductor clockwise 3/4 turn around screw terminal and tightening to proper torque specified by the manufacturer. Where present, do not use push-in pressure terminals that do not rely on screw-actuated binding.

G Unless otherwise indicated, connect wiring device grounding terminal to branch circuit equipment grounding conductor and to outlet box with bonding jumper.

H Provide tamper resistant GFCI receptacles with integral GFCI protection at each location indicated. Do not use feed-through wiring to protect downstream devices.

I Install wiring devices plumb and level with mounting yoke held rigidly in place.

J Install wall switches with OFF position down.

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

L Do not share neutral conductor on branch circuits utilizing wall dimmers.

M Install vertically mounted receptacles with grounding pole on top and horizontally mounted receptacles with grounding pole on left.

N Where receptacles are indicated to be mounted above counters they shall be mounted horizontally.

O Install wall plates to fit completely flush to wall with no gaps and rough opening completely covered without strain on wall plate. Repair or reinstall improperly installed outlet boxes or improperly sized rough openings.

P Install blank wall plates on junction boxes and on outlet boxes with no wiring devices installed or designated for future use.

3.04 FIELD QUALITY CONTROL

A Inspect each wiring device for damage and defects.

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

C Test each receptacle to verify operation and proper polarity.

D Test each GFCI receptacle for proper tripping operation according to manufacturer's instructions.

E Correct wiring deficiencies and replace damaged or defective wiring devices.

3.05 ADJUSTING

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

B Adjust presets for wall dimmers according to manufacturer's instructions as directed by Architect.

3.06 CLEANING

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

END OF SECTION 26 27 26

SECTION 26 28 13
FUSES

PART 1 GENERAL

1.01 SECTION INCLUDES

A Fuses.

B Spare fuse cabinet.

1.02 REFERENCE STANDARDS

A NFPA 70 - National Electrical Code; National Fire Protection Association, Including All Applicable Amendments and Supplements; 2020.

B UL 248-4 - Low-Voltage Fuses - Part 4: Class CC Fuses; Current Edition, Including All Revisions.

C UL 248-8 - Low-Voltage Fuses - Part 8: Class J Fuses; Current Edition, Including All Revisions.

D UL 248-10 - Low-Voltage Fuses - Part 10: Class L Fuses; Current Edition, Including All Revisions.

E UL 248-12 - Low-Voltage Fuses - Part 12: Class R Fuses; Current Edition, Including All Revisions.

F UL 248-15 - Low-Voltage Fuses - Part 15: Class T Fuses; Current Edition, Including All Revisions.

1.03 ADMINISTRATIVE REQUIREMENTS

A Coordination:

1. Coordinate fuse clips furnished in equipment provided under other sections for compatibility with indicated fuses.
2. Coordinate fuse requirements according to manufacturer's recommendations and nameplate data for actual equipment to be installed.
3. Notify Architect of any conflicts with or deviations from Contract Documents. Obtain direction before proceeding with work.

1.04 SUBMITTALS

A Product Data: Provide manufacturer's standard data sheets including voltage and current ratings, interrupting ratings, time-current curves, and current limitation curves.

1. Spare Fuse Cabinet: Include dimensions.

B Maintenance Materials: Furnish the following for Owner's use in maintenance of project.

1. See Section 01 60 00 - Product Requirements, for additional provisions.
2. Extra Fuses: One set(s) of three for each type and size installed.
3. Fuse Pullers: One set(s) compatible with each type and size installed.
4. Spare Fuse Cabinet Keys: Two.

1.05 QUALITY ASSURANCE

A Comply with requirements of NFPA 70.

B Product Listing Organization Qualifications: Third party agencies shall be amongst those accredited by the NCBCC (North Carolina Building Code Council) to label Electrical and Mechanical Equipment.

PART 2 PRODUCTS

2.01 MANUFACTURERS

A Bussmann, a division of Eaton Corporation.

B Littelfuse, Inc.

C Mersen.

D Approved equal.

2.02 FUSES

A Provide products listed, classified, and labeled as suitable for the purpose intended.

B Unless specifically indicated to be excluded, provide fuses for all fusible equipment as required for a complete operating system.

C Provide fuses of the same type, rating, and manufacturer within the same switch.

D Comply with UL 248-1.

E Unless otherwise indicated, provide cartridge type fuses complying with NEMA FU 1, Class and ratings as indicated.

F Voltage Rating: Suitable for circuit voltage.

G Selectivity: Where the requirement for selectivity is indicated, furnish products as required to achieve selective coordination.

H Provide the following accessories where indicated or where required to complete installation:

1. Fuseholders: Compatible with indicated fuses.

2.03 SPARE FUSE CABINET

A Description: Wall-mounted sheet metal cabinet with shelves and hinged door with cylinder lock, suitably sized to store spare fuses and fuse pullers specified.

B Cabinet shall be located in the main electrical room unless otherwise indicated by owner.

C Finish: Manufacturer's standard, factory applied grey finish unless otherwise indicated.

PART 3 EXECUTION

3.01 EXAMINATION

A Verify that fuse ratings are consistent with circuit voltage and manufacturer's recommendations and nameplate data for equipment.

B Verify that mounting surfaces are ready to receive spare fuse cabinet.

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

3.02 INSTALLATION

A Do not install fuses until circuits are ready to be energized.

B Install fuses with label oriented such that manufacturer, type, and size are easily read.

C Install spare fuse cabinet where indicated.

D Identify spare fuse cabinet in accordance with Section 26 05 53.

END OF SECTION 26 28 13

SECTION 26 28 16.16
ENCLOSED SWITCHES AND CIRCUIT BREAKERS

PART 1 GENERAL

1.01 SECTION INCLUDES

A Enclosed safety switches.

B Enclosed circuit breakers.

1.02 REFERENCE STANDARDS

A UL 489 - Molded-Case Circuit Breakers, Molded-Case Switches and Circuit Breaker Enclosures; Current Edition, Including All Revisions.

B NFPA 70 - National Electrical Code; National Fire Protection Association, Including All Applicable Amendments and Supplements; 2020.

1.03 ADMINISTRATIVE REQUIREMENTS

A Coordination:

1. Coordinate the work with other trades. Avoid placement of ductwork, piping, equipment, or other potential obstructions within the dedicated equipment spaces and within working clearances for electrical equipment required by NFPA 70.
2. Coordinate arrangement of electrical equipment with the dimensions and clearance requirements of the actual equipment to be installed.
3. Verify with manufacturer that conductor terminations are suitable for use with the conductors to be installed.
4. Notify Architect of any conflicts with or deviations from Contract Documents. Obtain direction before proceeding with work.

1.04 SUBMITTALS

A Product Data: Provide manufacturer's standard catalog pages and data sheets for enclosed switches and other installed components and accessories.

B Shop Drawings: Indicate outline and support point dimensions, voltage and current ratings, short circuit current ratings, conduit entry locations, conductor terminal information, and installed features and accessories.

1. Include wiring diagrams showing all factory and field connections.
2. Contractor shall confirm that all lug sizes and quantities submitted are compatible with the conductors specified on the contract documents. Changes required to lug sizes and quantities due to lack of coordination between the contractor and the supplier are to be made at the contractor's expense.
3. It is the contractor's responsibility to ensure that the equipment submitted to comply with the requirements of this section are in compliance with the requirements and recommendations of the power system studies. Any changes recommended by the power system study shall be incorporated at no expense to the project.

C Field Quality Control Test Reports.

D Manufacturer's Installation Instructions: Indicate application conditions and limitations of use stipulated by product testing agency. Include instructions for storage, handling, protection, examination, preparation, installation, and starting of product.

E Project Record Documents: Record actual locations of enclosed switches or circuit breakers.

F Maintenance Data: Include information on replacement parts and recommended maintenance procedures and intervals.

1.05 QUALITY ASSURANCE

A Comply with requirements of NFPA 70.

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

C Product Listing Organization Qualifications: Third party agencies shall be amongst those accredited by the NCBCC (North Carolina Building Code Council) to label Electrical and Mechanical Equipment.

1.06 DELIVERY, STORAGE, AND HANDLING

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

B Handle carefully in accordance with manufacturer's written instructions to avoid damage to enclosed switch internal components, enclosure, and finish.

1.07 FIELD CONDITIONS

A Maintain ambient temperature between 23 degrees F and 104 degrees F during and after installation of enclosed circuit breakers.

PART 2 PRODUCTS

2.01 MANUFACTURERS

A ABB/GE: www.geindustrial.com/#sle.

B Eaton Corporation.

C Schneider Electric; Square D Products.

D Source Limitations: Furnish enclosed switches and associated components produced by the same manufacturer as the other electrical distribution equipment used for this project and obtained from a single supplier.

2.02 ENCLOSED SAFETY SWITCHES

A Description: Quick-make, quick-break enclosed safety switches listed and labeled as complying with UL 98; heavy duty; ratings, configurations, and features as indicated on the drawings.

B Provide products listed, classified, and labeled as suitable for the purpose intended.

C All switches shall be heavy duty type.

D Unless otherwise indicated, provide products suitable for continuous operation under the following service conditions:

1. Altitude: Less than 6,600 feet.
2. Ambient Temperature: Between -22 degrees F and 104 degrees F.

E Horsepower Rating: Suitable for connected load.

F Voltage Rating: Suitable for circuit voltage.

G Auxilary Contacts: Suitable for 120v rated control circuit. Contractor is to provide auxilary contacts in any disconnecting means that is downstream from a frequency drive. aux contacts shall be mechanically tied to switching mechanisims and shall provide both a N.O. and N.C. contacts. verify with DIV 23 prior to ordering equipment.

H Short Circuit Current Rating:

1. Provide enclosed safety switches, when protected by the fuses or supply side overcurrent protective devices to be installed, with listed short circuit current rating not less than the available fault current at the installed location as indicated on the drawings.
2. When a power system study is included in the contract, confirm the short circuit current rating of all devices with the results of the study prior to submitting for approval.

I Enclosed Safety Switches Used for Service Entrance: Listed and labeled as suitable for use as service equipment according to UL 869A.

J Provide with switch blade contact position that is visible when the cover is open.

K Fuse Clips for Fusible Switches: As required to accept fuses indicated.

1. Where NEMA Class R fuses are installed, provide rejection feature to prevent installation of fuses other than Class R.

L Conductor Terminations: Suitable for use with the conductors to be installed.

M Provide insulated, groundable fully rated solid neutral assembly where a neutral connection is required, with a suitable lug for terminating each neutral conductor.

N Provide solidly bonded equipment ground bus in each enclosed safety switch, with a suitable lug for terminating each equipment grounding conductor.

O Enclosures: Comply with NEMA 250, and list and label as complying with UL 50 and UL 50E.

1. Environment Type per NEMA 250: As indicated on the drawings.
2. Finish for Painted Steel Enclosures: Manufacturer's standard, factory applied grey unless otherwise indicated.

P Provide safety interlock to prevent opening the cover with the switch in the ON position with capability of overriding interlock for testing purposes.

Q Heavy Duty Switches:
1. Comply with NEMA KS 1.
2. Conductor Terminations:
   a. Provide mechanical lugs for switch ratings less than 400 amperes.
   b. Provide compression lugs for switch ratings 400 amperes and above.
   c. Lug Material: Copper, suitable for terminating copper conductors only.
3. Provide externally operable handle with means for locking in the OFF position, capable of accepting three padlocks.

2.03 ENCLOSED CIRCUIT BREAKERS

A Description: Units consisting of molded case circuit breakers individually mounted in enclosures.

B Provide products listed, classified, and labeled as suitable for the purpose intended.

C Unless otherwise indicated, provide products suitable for continuous operation under the following service conditions:
1. Altitude: Less than 6,600 feet.
2. Ambient Temperature: Between 23 degrees F and 104 degrees F.

D Short Circuit Current Rating:
1. Provide enclosed circuit breakers with listed short circuit current rating not less than the available fault current at the installed location indicated on the drawings.

E Enclosed Circuit Breakers Used for Service Entrance: Listed and labeled as suitable for use as service equipment according to UL 869A.

F Auxilary Contacts: Suitable for 120v rated control circuit. Contractor is to provide auxilary contacts in any disconnecting means that is downstream from a frequency drive. aux contacts shall be mechanically tied to switching mechanisims and shall provide both a N.O. and N.C. contacts. verify with DIV 23 prior to ordering equipment.

G Conductor Terminations: Suitable for use with the conductors to be installed.

H Provide thermal magnetic circuit breakers for circuit breaker frame sizes less than 250 amperes.

I Provide electronic trip circuit breakers for circuit breaker frame sizes 250 amperes and above.

J Provide insulated, groundable fully rated solid neutral assembly where a neutral connection is required, with a suitable lug for terminating each neutral conductor.

K Provide solidly bonded equipment ground bus in each enclosed circuit breaker, with a suitable lug for terminating each equipment grounding conductor.

L Enclosures: Comply with NEMA 250, and list and label as complying with UL 50 and UL 50E.
1. Environment Type per NEMA 250: As indicated on the drawings.
2. Finish for Painted Steel Enclosures: Manufacturer's standard, factory applied grey unless otherwise indicated.
3. Provide surface-mounted enclosures unless otherwise indicated.

M Provide externally operable handle with means for locking in the OFF position.

N Ground Fault Protection: Where ground-fault protection is indicated, provide system listed and labeled as complying with UL 1053.
1. Where electronic circuit breakers equipped with integral ground fault protection are used, provide separate neutral current sensor where applicable.

O Selectivity: Where the requirement for selectivity is indicated, furnish products as required to achieve selective coordination.

P MOLDED CASE CIRCUIT BREAKERS
1. Description: Quick-make, quick-break, over center toggle, trip-free, trip-indicating circuit breakers listed and labeled as complying with UL 489, and complying with FS W-C-375 where applicable; ratings, configurations, and features as indicated on the drawings.
2. Interrupting Capacity:
   a. Provide circuit breakers with interrupting capacity as required to provide the short circuit current rating indicated.

b. Fully Rated Systems: Provide circuit breakers with interrupting capacity not less than the short circuit current rating indicated. Series rating is not allowed.

3. Conductor Terminations:
   a. Provide mechanical lugs for circuit breaker frame sizes less than 400 amperes.
   b. Provide compression lugs for circuit breaker frame sizes 400 amperes and above.
   c. Lug Material: Copper, suitable for terminating copper conductors only.
4. Thermal Magnetic Circuit Breakers: For each pole, furnish thermal inverse time tripping element for overload protection and magnetic instantaneous tripping element for short circuit protection.
   a. Provide field-adjustable magnetic instantaneous trip setting for circuit breaker frame sizes 100 amperes and larger.
5. Electronic Trip Circuit Breakers: Furnish solid state, microprocessor-based, true rms sensing trip units.
   a. Provide the following individually field-adjustable trip response settings:
      1) Long time pickup, adjustable by setting dial.
      2) Long time delay.
      3) Short time pickup and delay.
      4) Instantaneous pickup.
      5) Ground fault pickup and delay where ground fault protection is indicated.
6. Multi-Pole Circuit Breakers: Furnish with common trip for all poles.

PART 3 EXECUTION

3.01 EXAMINATION

A Verify that field measurements are as indicated.

B Verify that the ratings of the enclosed switches are consistent with the indicated requirements.

C Verify that mounting surfaces are ready to receive enclosed safety switches.

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

3.02 INSTALLATION

A Install products in accordance with manufacturer's instructions.

B Install enclosed switches securely, in a neat and workmanlike manner.

C Arrange equipment to provide minimum clearances in accordance with manufacturer's instructions and NFPA 70.

D Provide required support and attachment in accordance with Section 26 05 29.

E Install enclosed switches and breakers plumb.

F Except where indicated to be mounted adjacent to the equipment they supply, mount enclosed switches such that the highest position of the operating handle does not exceed 79 inches above the floor or working platform.

G Provide grounding and bonding in accordance with Section 26 05 26.

H Provide fuses complying with Section 26 28 13 for fusible switches as indicated or as required by equipment manufacturer's recommendations.

I Set field-adjustable circuit breaker tripping function settings as directed.

J Where accessories are not self-powered, provide control power source as indicated or as required to complete installation.

K Identify enclosed switches and breakers in accordance with Section 26 05 53.

3.03 FIELD QUALITY CONTROL

A Perform inspections and tests listed in NETA ATS, Section 7.5.1.1 for breakers larger than 600A.
   1. Verify equipment nameplate is in accorance with contract documents.
   2. Inspect physical and mechanical condition.
   3. Inspect anchorage and anlignment.
   4. Verify unit is clean.
   5. Operate breaker to enusre smooth operation.
   6. Perform breaker adjustments in accorance with the power system study.
   7. Perform resistance measurements through bolted connectionswith a low-resistance ohmmeter.

8. Perform insulation-resistance test for one minute on each pole, phase-to-phase and phase-to-ground with circuit breaker closed.
9. Perform contact/pole resistance test.
10. Determine long-time and short time pickup and delay settings by primary current injection.
11. Determine ground fault pickup and time delay by primary current injection.

B Correct deficiencies and replace damaged or defective enclosed safety switches or associated components.

3.04 ADJUSTING

A Adjust tightness of mechanical and electrical connections to manufacturer's recommended torque settings.

3.05 CLEANING

A Clean dirt and debris from switch enclosures and components according to manufacturer's instructions.

B Repair scratched or marred exterior surfaces to match original factory finish.

END OF SECTION 26 28 16.16

SECTION 26 32 13
ENGINE GENERATORS

PART 1 GENERAL (SEE ARCHITECTS LIST OF BUILDING ALTERNATES - (ALTERNATE 2)

1.01 SECTION INCLUDES

A Packaged engine generator system and associated components and accessories:
1. Engine and engine accessory equipment.
2. Alternator (generator).
3. Generator set control system.
4. Generator set enclosure.

1.02 REFERENCE STANDARDS

A NFPA 110 - Standard for Emergency and Standby Power Systems; 2025.

B UL 142 - Steel Aboveground Tanks for Flammable and Combustible Liquids; Current Edition, Including All Revisions.

C UL 2200 - Stationary Engine Generator Assemblies; Current Edition, Including All Revisions.

D NFPA 70 - National Electrical Code; National Fire Protection Association, Including All Applicable Amendments and Supplements; 2020.

1.03 ADMINISTRATIVE REQUIREMENTS

A Coordination:
1. Coordinate compatibility of generator sets to be installed with work provided under other sections or by others.
   a. Transfer Switches: See Section 26 36 00.
2. Coordinate the work with other trades to avoid placement of ductwork, piping, equipment or other potential obstructions within the spaces dedicated for engine generator system.
3. Coordinate arrangement of equipment with the dimensions and clearance requirements of the actual equipment to be installed.
4. Coordinate the work to provide electrical circuits suitable for the power requirements of the actual auxiliary equipment and accessories to be installed.
5. Notify Architect of any conflicts with or deviations from Contract Documents. Obtain direction before proceeding with work.

1.04 SUBMITTALS

A Product Data: Provide manufacturer's standard catalog pages and data sheets for each product, including ratings, configurations, dimensions, finishes, weights, service condition requirements, and installed features. Include alternator starting capabilities, engine fuel consumption rates, and cooling, combustion air, and exhaust requirements.
1. Include generator set sound level test data.
2. Include characteristic trip curves for overcurrent protective devices.
3. Include alternator thermal damage curve.

B Shop Drawings: Include dimensioned plan views and sections indicating locations of system components, required clearances, and field connection locations. Include system interconnection schematic diagrams showing all factory and field connections.
1. It is the contractor's responsibility to ensure that the equipment submitted to comply with the requirements of this section are in compliance with the requirements and recommendations of the power system studies. Any changes recommended by the power system study shall be incorporated at no expense to the project.

C Derating Calculations: Indicate ratings adjusted for applicable service conditions.

D Specimen Warranty: Submit sample of manufacturer's warranty.

E Evidence of qualifications for installer.

F Evidence of qualifications for maintenance contractor (if different entity from installer).

G Manufacturer's Installation Instructions: Indicate application conditions and limitations of use stipulated by product testing agency. Include instructions for storage, handling, protection, examination, preparation, installation, and operation of product.

H Manufacturer's factory emissions certification.

I Manufacturer's certification that products meet or exceed specified requirements.

J Source quality control test reports.

K Provide NFPA 110 required documentation from manufacturer, including but not limited to:

1. Certified prototype tests.
2. Torsional vibration compatibility certification.
3. NFPA 110 compliance certification.
4. Certified rated load test at rated power factor.

L Manufacturer’s detailed field testing procedures.

M Field quality control test reports.

N Operation and Maintenance Data: Include detailed information on system operation, equipment programming and setup, replacement parts, and recommended maintenance procedures and intervals.

1. Include contact information for entity that will be providing contract maintenance and trouble call-back service.

O Executed Warranty: Submit documentation of final executed warranty completed in Owner's name and registered with manufacturer.

P Maintenance contracts.

Q Project Record Documents: Record actual locations of system components, installed circuiting arrangements and routing, and final equipment settings.

R Maintenance Materials: Furnish the following for Owner's use in maintenance of project.

1. Extra Fuses: One of each type and size.
2. Extra Filter Elements: One of each type, including fuel, oil and air.
3. Extra generator enclosure keys: Two of each type required.

1.05 QUALITY ASSURANCE

A Comply with the following:

1. NFPA 70 (National Electrical Code).
2. NFPA 110 (Standard for Emergency and Standby Power Systems); meet requirements for Level 1 system.
3. NFPA 37 (Standard for the Installation and Use of Stationary Combustion Engines and Gas Turbines).
4. NFPA 30 (Flammable and Combustible Liquids Code).

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

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

1. Authorized service facilities located within 200 miles of project site.

D Installer Qualifications: Company specializing in performing the work of this section with minimum three years documented experience with engine generator systems of similar size, type, and complexity; manufacturer's authorized installer.

E Maintenance Contractor Qualifications: Same entity as installer or different entity with specified qualifications.

1. Contract maintenance office located within 200 miles of project site.

F Product Listing Organization Qualifications: Third party agencies shall be amongst those accredited by the NCBCC (North Carolina Building Code Council) to label Electrical and Mechanical Equipment.

1.06 DELIVERY, STORAGE, AND HANDLING

A Receive, inspect, handle, and store generator sets in accordance with manufacturer's instructions.

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

C Handle carefully in accordance with manufacturer's instructions to avoid damage to generator set components, enclosure, and finish.

1.07 FIELD CONDITIONS

A Maintain field conditions within manufacturer's required service conditions during and after installation.

1.08 WARRANTY

A Provide minimum five year manufacturer warranty covering repair or replacement due to defective materials or workmanship.

PART 2 PRODUCTS

2.01 MANUFACTURERS

A Packaged Engine Generator Set - Basis of Design: Kohler KG125.

B Packaged Engine Generator Set - Other Acceptable Manufacturers:

1. Caterpillar Inc.
2. Generac Power Systems: www.generac.com/industrial/#sle.Generac Power Systems: www.generac.com/industrial/#sle.Generac Power Systems: www.generac.com/industrial/#sle.
3. Kohler Co.
4. Pre-Approved equal.

C Source Limitations: Furnish engine generator sets and associated components and accessories produced by a single manufacturer and obtained from a single supplier.

2.02 PACKAGED ENGINE GENERATOR SYSTEM

A Provide new engine generator system consisting of all required equipment, sensors, conduit, boxes, wiring, piping, supports, accessories, system programming, etc. as necessary for a complete operating system that provides the functional intent indicated.

B Provide products listed, classified, and labeled as suitable for the purpose intended.

C System Description:

1. Application: Emergency/standby.
2. Configuration: Single packaged engine generator set operated independently (not in parallel).

D Packaged Engine Generator Set:

1. Type: Diesel (compression ignition).
2. Power Rating: 125KW/156KVA, standby.
3. Voltage: As indicated on drawings.
4. Main Line Circuit Breaker:
   a. Type: 100% rated with Electronic trip with long time and short time delay and instantaneous pickup.
   b. Trip Rating: As indicated on drawings.
   c. Features:
      1) Auxiliary contacts.

E Generator Set General Requirements:

1. Prototype tested in accordance with NFPA 110 for Level 1 systems.
2. Factory-assembled, with components mounted on suitable base.
3. List and label engine generator assembly as complying with UL 2200.
4. Power Factor: Unless otherwise indicated, specified power ratings are at 0.8 power factor for three phase voltages and 1.0 power factor for single phase voltages.
5. Provide suitable guards to protect personnel from accidental contact with rotating parts, hot piping, and other potential sources of injury.
6. Main Line Circuit Breaker: Provide factory-installed line side connections with suitable lugs for load side connections.

F Service Conditions: Provide engine generator system and associated components suitable for operation under the service conditions at the installed location.

1. Altitude: 300 feet.
2. Ambient Temperature: Between 0 and 104 degrees F.

G Starting and Load Acceptance Requirements:

1. Cranking Method: Cycle cranking complying with NFPA 110 (15 second crank period, followed by 15 second rest period, with cranking limiter time-out after 3 cycles), unless otherwise required.
2. Cranking Limiter Time-Out: If generator set fails to start after specified cranking period, indicate overcrank alarm condition and lock-out generator set from further cranking until manually reset.

3. Start Time: Capable of starting and achieving conditions necessary for load acceptance within 10 seconds (NFPA 110, Type 10).
4. Maximum Load Step: Supports 100 percent of rated load in one step.
   a. Maximum Voltage Deviation with Load Step: 20 percent.
   b. Maximum Frequency Deviation with Load Step: 20 percent.
5. Motor Starting Capability: Supports starting of motor load indicated with a maximum voltage dip of 20 percent.

H Exhaust Emissions Requirements:
1. Comply with federal (EPA), state, and local regulations applicable at the time of commissioning; include factory emissions certification with submittals.
2. Do not make modifications affecting generator set factory emissions certification without approval of manufacturer and Engineer. Where such modifications are made, provide field emissions testing as necessary for certification.

I Sound Level Requirements:
1. Do not exceed 75 dBA when measured at 23 feet from generator set in free field (no sound barriers) while operating at full load; include manufacturer's sound data with submittals.

2.03 ENGINE AND ENGINE ACCESSORY EQUIPMENT

A Provide engine with adequate horsepower to achieve specified power output at rated speed, accounting for alternator efficiency and parasitic loads.

B Engine Fuel System - Gaseous (Spark Ignition):
1. Fuel Source: Natural gas.
2. Engine Fuel Connections: Provide suitable, approved flexible fuel lines for coupling engine to fuel source.
3. Provide components/features indicated and as necessary for operation and/or required by applicable codes, including but not limited to:
   a. Carburetor.
   b. Gas pressure regulators.
   c. Fuel shutoff control valves.
   d. Low gas pressure switches.

C Engine Starting System:
1. System Type: Electric, with DC solenoid-activated starting motor(s).
2. Battery(s):
   a. Battery Type: Lead-acid.
   b. Battery Capacity: Size according to manufacturer's recommendations for achieving starting and load acceptance requirements under worst case ambient temperature; capable of providing cranking through two complete periods of cranking limiter time-outs without recharging.
   c. Provide battery rack, cables, and connectors suitable for the supplied battery(s); size battery cables according to manufacturer's recommendations for cable length to be installed.
3. Battery-Charging Alternator: Engine-driven, with integral solid-state voltage regulation.
4. Battery Charger:
   a. Provide dual rate battery charger with automatic float and equalize charging modes and minimum rating of 10 amps; suitable for maintaining the supplied battery(s) at full charge without manual intervention.
   b. Capable of returning supplied battery(s) from fully discharged to fully charged condition within 24 hours, as required by NFPA 110 for Level 1 applications while carrying normal loads.
   c. Recognized as complying with UL 1236.
   d. Furnished with integral overcurrent protection; current limited to protect charger during engine cranking; reverse polarity protection.
   e. Provide integral DC output ammeter and voltmeter with five percent accuracy.
   f. Provide alarm output contacts as necessary for alarm indications.

5. Battery Heater: Provide thermostatically controlled battery heater to improve starting under cold ambient conditions.

D Engine Speed Control System (Governor):
1. Single Engine Generator Sets (Not Operated in Parallel): Provide electronic isochronous governor for controlling engine speed/alternator frequency.
2. Frequency Regulation, Electronic Isochronous Governors: No change in frequency from no load to full load; plus/minus 0.25 percent at steady state.

E Engine Lubrication System:
1. System Type: Full pressure, with engine-driven, positive displacement lubrication oil pump, replaceable full-flow oil filter(s), and dip-stick for oil level indication. Provide oil cooler where recommended by manufacturer.
2. Oil Heater: Provide thermostatically controlled oil heater to improve starting under cold ambient conditions.

F Engine Cooling System:
1. System Type: Closed-loop, liquid-cooled, with unit-mounted radiator/fan and engine-driven coolant pump; suitable for providing adequate cooling while operating at full load under worst case ambient temperature.
2. Fan Guard: Provide suitable guard to protect personnel from accidental contact with fan.

G Engine Air Intake and Exhaust System:
1. Air Intake Filtration: Provide engine-mounted, replaceable, dry element filter.
2. Engine Exhaust Connection: Provide suitable, approved flexible connector for coupling engine to exhaust system.
3. Exhaust Silencer: Provide critical grade or better exhaust silencer with sound attenuation not less than basis of design; select according to manufacturer's recommendations to meet sound performance requirements, where specified.

2.04 ALTERNATOR (GENERATOR)

A Alternator: 4-pole, 1800 rpm (60 Hz output) revolving field, synchronous generator complying with NEMA MG 1; connected to engine with flexible coupling; voltage output configuration as indicated, with reconnectable leads for 3 phase alternators.

B Exciter:
1. Exciter Type: Brushless; provide permanent magnet generator (PMG) excitation system; self-excited (shunt) systems are not permitted.
2. PMG Excitation Short-Circuit Current Support: Capable of sustaining 300 percent of rated output current for 10 seconds.
3. Voltage Regulation (with PMG excitation): Plus/minus 0.5 percent for any constant load from no load to full load.

C Temperature Rise: maximum 130 degrees Farenheit.

D Insulation System: NEMA MG 1, Class H; suitable for alternator temperature rise.

E Enclosure: NEMA MG 1, drip-proof.

F Total Harmonic Distortion: Not greater than five percent.

2.05 GENERATOR SET CONTROL SYSTEM

A Provide microprocessor-based control system for automatic control, monitoring, and protection of generator set. Include sensors, wiring, and connections necessary for functions/indications specified.

B Control Panel:
1. Control Panel Mounting: Unit-mounted unless otherwise indicated; vibration isolated.
2. Generator Set Control Functions:
   a. Automatic Mode: Initiates generator set start/shutdown upon receiving corresponding signal from remote device (e.g. automatic transfer switch).
   b. Manual Mode: Initiates generator set start/shutdown upon direction from operator.
   c. Reset Mode: Clears all faults, allowing generator set restart after a shutdown.

d. Emergency Stop: Immediately shuts down generator set (without time delay) and prevents automatic restarting until manually reset.
e. Cycle Cranking: Programmable crank time, rest time, and number of cycles.
f. Time Delay: Programmable for shutdown (engine cooldown) and start (engine warmup).
g. Voltage Adjustment: Adjustable through range of plus/minus 5 percent.

3. Generator Set Status Indications:
   a. Voltage (Volts AC): Line-to-line, line-to-neutral for each phase.
   b. Current (Amps): For each phase.
   c. Frequency (Hz).
   d. Real power (W/kW).
   e. Reactive power (VAR/kVAR).
   f. Apparent power (VA/kVA).
   g. Power factor.
   h. Duty Level: Actual load as percentage of rated power.
   i. Engine speed (RPM).
   j. Battery voltage (Volts DC).
   k. Engine oil pressure.
   l. Engine coolant temperature.
   m. Engine run time.
   n. Generator powering load (position signal from transfer switch).
4. Generator Set Protection and Warning/Shutdown Indications:
   a. Comply with NFPA 110; configurable for NFPA 110 Level 1 or Level 2, or NFPA 99 systems including but not limited to the following protections/indications:
      1) Overcrank (shutdown).
      2) Low coolant temperature (warning).
      3) High coolant temperature (warning).
      4) High coolant temperature (shutdown).
      5) Low oil pressure (warning).
      6) Low oil pressure (shutdown).
      7) Overspeed (shutdown).
      8) Low fuel level (warning).
      9) Low coolant level (warning/shutdown).
      10) Generator control not in automatic mode (warning).
      11) High battery voltage (warning).
      12) Low cranking voltage (warning).
      13) Low battery voltage (warning).
      14) Battery charger failure (warning).
   b. In addition to NFPA 110 requirements, provide the following protections/indications:
      1) High AC voltage (shutdown).
      2) Low AC voltage (shutdown).
      3) High frequency (shutdown).
      4) Low frequency (shutdown).
      5) Overcurrent (shutdown).
      6) Fuel tank leak (warning), where applicable.
   c. Provide contacts for local and remote common alarm.
   d. Provide lamp test function that illuminates all indicator lamps.
5. Other Control Panel Features:
   a. Event log.
   b. Remote monitoring capabilityvia BAS system.

C Remote Annunciator:

1. Remote Annunciator Mounting: Wall-mounted; Provide flush-mounted annunciator for finished areas and surface-mounted annunciator for non-finished areas unless otherwise indicated (Locate at Building Main Lobbby) Coordinate final placement with architect/owner.
2. Generator Set Status Indications:
   a. Generator powering load (via position signal from transfer switch).
3. Generator Set Warning/Shutdown Indications:
   a. Comply with NFPA 110; configurable for NFPA 110 Level 1 or Level 2, or NFPA 99 systems including but not limited to the following indications:
      1) Overcrank (shutdown).
      2) Low coolant temperature (warning).
      3) High coolant temperature (warning).
      4) High coolant temperature (shutdown).
      5) Low oil pressure (warning).
      6) Low oil pressure (shutdown).
      7) Overspeed (shutdown).
      8) Low fuel level (warning).
      9) Low coolant level (warning/shutdown).
      10) Generator control not in automatic mode (warning).
      11) High battery voltage (warning).
      12) Low cranking voltage (warning).
      13) Low battery voltage (warning).
      14) Battery charger failure (warning).
   b. Provide audible alarm with silence function.
   c. Provide lamp test function that illuminates all indicator lamps.

2.06 GENERATOR SET ENCLOSURE

A Enclosure Type: Sound attenuating, weather protective.

B Enclosure Material: Aluminum. Hurricane Rated and Wind load rated to 150MPH

C Hardware Material: Stainless steel.

D Color: Manufacturer's standard.

E Access Doors: Lockable, with all locks keyed alike.

F Openings: Designed to prevent bird/rodent entry.

G External Drains: Extend oil and coolant drain lines to exterior of enclosure for maintenance service.

H Sound Attenuating Enclosures: Line enclosure with non-hydroscopic, self-extinguishing sound-attenuating material.

I Exhaust Silencers: Where exhaust silencers are mounted within enclosure in main engine compartment, insulate silencer to minimize heat dissipation as necessary for operation at rated load under worst case ambient temperature.

J Enclosure Space Heater: Provide thermostatically controlled enclosure space heater to prevent condensation and improve starting under cold ambient conditions; size according to manufacturer's recommendations for achieving starting and load acceptance requirements under worst case ambient temperature.

2.07 SOURCE QUALITY CONTROL

A Perform production tests on generator sets at factory to verify operation and performance characteristics prior to shipment. Include certified test report with submittals.

B Generator Set production testing to include, at a minimum:
   1. Operation at rated load and rated power factor.
   2. Single step load pick-up.
   3. Transient and steady state voltage and frequency performance.
   4. Operation of safety shutdowns.

C Diesel Fuel Storage Tanks: Perform pressurized leak test prior to shipment.

PART 3 EXECUTION

3.01 EXAMINATION

A Verify that field measurements are as indicated.

B Verify that the ratings and configurations of generator sets and auxiliary equipment are consistent with the indicated requirements.

C Verify that rough-ins for field connections are in the proper locations.

D Verify that mounting surfaces are ready to receive equipment.

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

3.02 INSTALLATION

A Perform work in a neat and workmanlike manner.

B Install products in accordance with manufacturer's instructions.

C Install generator sets and associated accessories in accordance with NECA/EGSA 404.

D Arrange equipment to provide minimum clearances and required maintenance access.

E Unless otherwise indicated, mount generator set on properly sized 6 inch high concrete pad. Provide suitable vibration isolators, where not factory installed.

F Provide required support and attachment in accordance with Section 26 05 29.

G Use manufacturer's recommended oil and coolant, suitable for the worst case ambient temperatures.

H Provide natural gas piping in accordance with Section 23 11 23.

I Provide engine exhaust piping, where not factory installed.

1. Include piping expansion joints, piping insulation, thimble, condensation trap/drain, rain cap, hangers/supports, etc. as indicated or as required.
2. Do not exceed manufacturer's maximum back pressure requirements.

J Install exhaust silencer, where not factory installed.

K Provide grounding and bonding in accordance with Section 26 05 26.

L Identify system wiring and components in accordance with Section 26 05 53.

3.03 FIELD QUALITY CONTROL

A Provide services of a manufacturer's authorized representative to prepare and start systems and perform inspection and testing. Include manufacturer's detailed testing procedures and field reports with submittals.

B Notify Owner and Architect at least two weeks prior to scheduled inspections and tests.

C Notify authorities having jurisdiction and comply with their requirements for scheduling inspections and tests and for observation by their personnel.

D Provide all equipment, tools, and supplies required to accomplish inspection and testing, including load bank and fuel.

E Preliminary inspection and testing to include, at a minimum:

1. Inspect each system component for damage and defects.
2. Verify tightness of mechanical and electrical connections are according to manufacturer's recommended torque settings.
3. Check for proper oil and coolant levels.

F Prepare and start system in accordance with manufacturer's instructions.

G Perform acceptance test in accordance with NFPA 110.

H Inspection and testing to include, at a minimum:

1. Verify equipment nameplate is in accordance with the contract documents.
2. Inspact physical and mechanical condition.
3. Inspect anchorage, alignment and grounding.
4. Verify unit is clean.
5. Verify compliance with starting and load acceptance requirements.
6. Verify voltage and frequency; make required adjustments as necessary.
7. Verify phase sequence.
8. Verify control system operation, including safety shutdowns.
9. Verify operation of auxiliary equipment and accessories (e.g. battery charger, heaters, etc.).
10. Perform load tests using load bank at 100 percent full load for minimum of 2 hours.

I Provide field emissions testing where necessary for certification.

J Correct defective work, adjust for proper operation, and retest until entire system complies with Contract Documents.

K Submit detailed reports indicating inspection and testing results and corrective actions taken.

3.04 CLEANING

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

3.05 CLOSEOUT ACTIVITIES

A Demonstration: Demonstrate proper operation of system to Owner, and correct deficiencies or make adjustments as directed.

B Training: Train Owner's personnel on operation, adjustment, and maintenance of system.

1. Use operation and maintenance manual as training reference, supplemented with additional training materials as required.
2. Provide minimum of four hours of training.
3. Instructor: Manufacturer's authorized representative.
4. Location: At project site.

C After successful acceptance test and just prior to Project Acceptance, replace air, oil, and fuel filters.

3.06 PROTECTION

A Protect installed engine generator system from subsequent construction operations.

3.07 MAINTENANCE

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

END OF SECTION 26 32 13

SECTION 26 36 00
TRANSFER SWITCHES

PART 1 GENERAL

1.01 SECTION INCLUDES

A Transfer switches for low-voltage (600 V and less) applications and associated accessories:
1. Automatic transfer switches. (Alternate #2)
2. Manual Transfer Switch with temporary generator hook-up cam lock connections (Base Bid)

1.02 REFERENCE STANDARDS

A NFPA 110 - Standard for Emergency and Standby Power Systems; 2025.

B UL 1008 - Transfer Switch Equipment; Current Edition, Including All Revisions.

C NFPA 70 - National Electrical Code; National Fire Protection Association, Including All Applicable Amendments and Supplements; 2020.

1.03 ADMINISTRATIVE REQUIREMENTS

A Coordination:
1. Coordinate compatibility of transfer switches to be installed with work provided under other sections or by others.
   a. Engine Generators: See Section 26 32 13.
2. Coordinate the work with other trades to avoid placement of ductwork, piping, equipment, or other potential obstructions within the dedicated equipment spaces and working clearances required by NFPA 70.
3. Coordinate arrangement of equipment with the dimensions and clearance requirements of the actual equipment to be installed.
4. Coordinate the work with placement of supports, anchors, etc. required for mounting.
5. Notify Architect of any conflicts with or deviations from Contract Documents. Obtain direction before proceeding with work.

B Where work of this section involves interruption of existing electrical service, arrange service interruption with Owner.

1.04 SUBMITTALS

A Product Data: Provide manufacturer's standard catalog pages and data sheets for each product, including ratings, configurations, dimensions, finishes, weights, service condition requirements, and installed features.

B Shop Drawings: Include dimensioned plan views and sections indicating locations of system components, required clearances, and field connection locations. Include system interconnection schematic diagrams showing all factory and field connections.
1. It is the contractor's responsibility to ensure that the equipment submitted to comply with the requirements of this section are in compliance with the requirements and recommendations of the power system studies. Any changes recommended by the power system study shall be incorporated at no expense to the project.

C Specimen Warranty: Submit sample of manufacturer's warranty.

D Evidence of qualifications for installer.

E Evidence of qualifications for maintenance contractor (if different entity from installer).

F Manufacturer's Installation Instructions: Indicate application conditions and limitations of use stipulated by product testing agency. Include instructions for storage, handling, protection, examination, preparation, installation, and operation of product.

G Manufacturer's certification that products meet or exceed specified requirements.

H Source quality control test reports.

I Manufacturer’s detailed field testing procedures.

J Field quality control test reports.

K Operation and Maintenance Data: Include detailed information on system operation, equipment programming and setup, replacement parts, and recommended maintenance procedures and intervals.
1. Include contact information for entity that will be providing contract maintenance and trouble call-back service.

L Executed Warranty: Submit documentation of final executed warranty completed in Owner's name and registered with manufacturer.

M Maintenance contracts.

N Project Record Documents: Record actual locations of system components, installed circuiting arrangements and routing, and final equipment settings.

1.05 QUALITY ASSURANCE

A Comply with the following:

1. NFPA 70 (National Electrical Code).
2. NFPA 110 (Standard for Emergency and Standby Power Systems); meet requirements for system Level specified in Section 26 32 13.

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

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

1. Authorized service facilities located within 200 miles of project site.

D Installer Qualifications: Company specializing in performing the work of this section with minimum three years documented experience with power transfer systems of similar size, type, and complexity; manufacturer's authorized installer.

E Maintenance Contractor Qualifications: Same entity as installer or different entity with specified qualifications.

1. Contract maintenance office located within 200 miles of project site.

F Product Listing Organization Qualifications: Third party agencies shall be amongst those accredited by the NCBCC (North Carolina Building Code Council) to label Electrical and Mechanical Equipment.

1.06 DELIVERY, STORAGE, AND HANDLING

A Receive, inspect, handle, and store transfer switches in accordance with manufacturer's instructions.

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

C Handle carefully in accordance with manufacturer's instructions to avoid damage to transfer switch components, enclosure, and finish.

1.07 FIELD CONDITIONS

A Maintain field conditions within manufacturer's required service conditions during and after installation.

1.08 WARRANTY

A Provide minimum five year manufacturer warranty covering repair or replacement due to defective materials or workmanship.

PART 2 PRODUCTS

2.01 MANUFACTURERS

A Transfer Switches - Basis of Design: Kohler KSS-AMVD-0200S.

B Transfer Switches - Other Acceptable Manufacturers:

1. Same as manufacturer of engine generator(s) used for this project.
2. Approved equal.

C Source Limitations: Furnish transfer switches and accessories produced by a single manufacturer and obtained from a single supplier.

2.02 TRANSFER SWITCHES (REFER TO ARCHITECTS LIST OF BUILDING ALTERNATES (ALTERNATE 2) FOR STANDBY GENERATOR & AUTOMATIC TRANSFER SWITCH

A Provide complete power transfer system consisting of all required equipment, conduit, boxes, wiring, supports, accessories, system programming, etc. as necessary for a complete operating system that provides the functional intent indicated.

B Provide products listed, classified, and labeled as suitable for the purpose intended.

C Applications:

1. Utilize open transition transfer unless otherwise indicated or required.

D Construction Type: Either "contactor type" (open contact) or "breaker type" (enclosed contact) transfer switches complying with specified requirements are acceptable.

E Automatic Transfer Switch:
1. Basis of Design: Kohler KSS-AMVD-0200S.
2. Transfer Switch Type: Automatic transfer switch.
3. Transition Configuration: Open-transition (no neutral position).
4. Voltage: As indicated on the drawings.
5. Ampere Rating: As indicated on the drawings.
6. Neutral Configuration: Switched neutral.

F Manual Transfer Switch (Double Throw Switch):
1. Basis of Design: Eaton Quick Connect Double Throw Safety Switch DT464SNSNRKSNLC.
2. Other Acceptable Product(s):
   a. ESL, ASCO, LAKELAND, THOMPSON.

G Comply with NEMA ICS 10 Part 1, and list and label as complying with UL 1008 for the classification of the intended application (e.g. emergency, optional standby).

H MTS -Double Throw Switch
1. 200A rated Switch
2. 600VAC, 4-pole
3. Upper Utility Switch shall be fusible.
4. Lower Generator Switch shall be fusible.
5. Mechanical lugs suitable for copper conductors.

I Construction:
1. Switch Blades and jaws and bus bars shall be visible and plated copper.
2. Switches shall have a red handle that is easily pad lockable with three 3/8" shank locks in the OFF position.
3. Switches shall be double throw design such that both switches may not be closed simultaneously. Handle operation shall have an "OFF" position between the two "ON" positions.
4. Switch shall be equipped with a separate interlocked receptacle compartment containing receptacles for quick-connection and disconnection of portable cord connected generator.
5. Interlock shall prevent the lower generator switch from being closed while cable compartment door is open, and shall prevent the door from being opened while the switch is closed.
6. Compartment shall be equipped with a spring assisted door to allow portable cords to exit the compartment while in use, but shall close when or not in use to effectively seal the compartment to prevent insects and small animals from entry.
7. Recepracles for switches 200 amps and breater shall be of the single cable per phase design- utilizing quarter turn cam type connections.
8. Contractor shal provide 25ft #3/0 AWG lead cables for Generator hook-up.
9. Receptacles shall be Cam-lok type suitable for Roll-up Generator connection.
10. Switches shall be deionizing arc chutes.
11. Switches shall have factory-installed ground lug kit.
12. Switch Assembly and operating handle shall be an integral part of the enclosure base.
13. Switch blades shall be readily visible in the "ON" and "OFF" position.
14. Switch operating mechanism shall be non-teasable, positive quick-make/quick break type. Ball type mechanisms are not acceptable.
15. Fusible switches shall be suitable for service entrance equipment.
16. Switches shall have a solid or switched neutral as indicated in design basis.
17. Switches shall have line terminal shields.
18. Switches shall be suitable for systems capable of 100KA at 600V.
19. Embossed or engraved ON-OFF indication shall be provided.
20. Double-make, double-break switch blade feature shall be provided.
21. Renewal Parts data shall be shown on the inside door.

J Enclosures:

1. All enclosures shall be NEMA-3R rainproof. Support for this equipment shall sustain hurricane winds 150MPH.
2. Paint color shall be ANSI 61 gray.

K Special Modifications :
1. Provide Phenolic Nameplatres
2. Provide Lock "ON" provisions
3. Upper viewing window
4. Lower viewing window
5. Factory installed copper lugs.
6. Factory installed neutral bonding kit.
7. Factory installed Neutral Assemblies.

L Do not use double throw safety switches or other equipment not specifically designed for power transfer applications and listed as transfer switch equipment.

M Service Conditions: Provide transfer switches suitable for continuous operation at indicated ratings under the service conditions at the installed location.

N Enclosures:
1. Environment Type per NEMA 250: As indicated on the drawings.
   a. Outdoor Locations: Type 3R or Type 4.
2. Provide lockable door(s) for outdoor locations.
3. Finish: Manufacturer's standard unless otherwise indicated.

O Short Circuit Current Rating:
1. Withstand and Closing Rating: Provide transfer switches, when protected by the supply side overcurrent protective devices to be installed, with listed withstand and closing rating not less than the available fault current at the installed location as indicated on the drawings.

P Automatic Transfer Switches:
1. Description: Transfer switches with automatically initiated transfer between sources; electrically operated and mechanically held.
2. Control Functions:
   a. Automatic mode.
   b. Test Mode: Simulates failure of primary/normal source.
   c. Voltage and Frequency Sensing:
      1) Undervoltage sensing for each phase of primary/normal source; adjustable dropout/pickup settings.
      2) Undervoltage sensing for alternate/emergency source; adjustable dropout/pickup settings.
      3) Underfrequency sensing for alternate/emergency source; adjustable dropout/pickup settings.
   d. Outputs:
      1) Contacts for engine start/shutdown.
      2) Auxiliary contacts; two set(s) for each switch position.
   e. Adjustable Time Delays:
      1) Engine generator start time delay; delays engine start signal to override momentary primary/normal source failures.
      2) Transfer to alternate/emergency source time delay.
      3) Retransfer to primary/normal source time delay.
      4) Engine generator cooldown time delay; delays engine shutdown following retransfer to primary/normal source to permit generator to run unloaded for cooldown period.
   f. In-Phase Monitor (Open Transition Transfer Switches): Monitors phase angle difference between sources for initiating in-phase transfer.
   g. Engine Exerciser: Provides programmable scheduled exercising of engine generator selectable with or without transfer to load; provides memory retention during power outage.
3. Status Indications:
   a. Connected to alternate/emergency source.

b. Connected to primary/normal source.
c. Alternate/emergency source available.
d. Primary/normal source available.

4. Other Features:
   a. Event log.
   b. Remote Monitoring via BAS system.
5. Automatic Sequence of Operations:
   a. Upon failure of primary/normal source for a programmable time period (engine generator start time delay), initiate starting of engine generator where applicable.
   b. When alternate/emergency source is available, transfer load to alternate/emergency source after programmable time delay.
   c. When primary/normal source has been restored, retransfer to primary/normal source after a programmable time delay. Bypass time delay if alternate/emergency source fails and primary/normal source is available.
   d. Where applicable, initiate shutdown of engine generator after programmable engine cooldown time delay.

Q Manual Transfer Switches:
1. Description: Transfer switches with manually initiated transfer between sources; mechanically operated and mechanically held.

R Interface with Other Work:
1. Interface with engine generators as specified in Section 26 32 13.
2. Interface with building automation system.

2.03 SOURCE QUALITY CONTROL

A Perform production tests on transfer switches at factory to verify operation and performance characteristics prior to shipment. Include certified test report with submittals.

PART 3 EXECUTION

3.01 EXAMINATION

A Verify that field measurements are as indicated.
B Verify that the ratings and configurations of transfer switches are consistent with the indicated requirements.
C Verify that rough-ins for field connections are in the proper locations.
D Verify that mounting surfaces are ready to receive transfer switches.
E Verify that conditions are satisfactory for installation prior to starting work.

3.02 INSTALLATION

A Perform work in a neat and workmanlike manner.
B Install products in accordance with manufacturer's instructions.
C Arrange equipment to provide minimum clearances and required maintenance access.
D Provide required support and attachment in accordance with Section 26 05 29.
E Install transfer switches plumb and level.
F Unless otherwise indicated, mount floor-mounted transfer switches on properly sized 4 inch high concrete pad.
G Provide grounding and bonding.
H Identify transfer switches and associated system wiring.

3.03 FIELD QUALITY CONTROL

A Prepare and start system in accordance with manufacturer's instructions.
B Automatic Transfer Switches:
1. Inspect and test in accordance with NETA ATS Section 7.22.3.
   a. Verify equipment nameplate is in accordance with contract documents.
   b. Inspect physical and mechanical condition.
   c. Inspect anchorage, alignment, grounding, and required clearances.
   d. Verify unit is clean.

e. Verify appropriate lubrication on moving current carrying parts and on moving and sliding surfaces.
f. Perfrom manual transfer operation.
g. Verify positive mechanical interlocking between normal and alternate sources.
h. Perform resistance measurements through bolted connections with a low-resistance ohmmeter.
i. Perform insulation resistance tests for one minute on each pole, phase-to-phase and phase-to-ground with switch in both source positions and across each open pole.
j. Perform contact/pole resistance test.
k. Verify phase rotation.
l. Verify Transfer switch timing:
1) Normal source voltage-sensing relay.
2) Engine start sequence.
3) Time delay upon transfer.
4) Alternate source voltage-sensing and frequency sensing relays.
5) Automatic transfer operation.
6) Time delay and retransfer upon normal power restoration.
7) Engine cool down and shutdown feature.

C Provide additional inspection and testing as required for completion of associated engine generator testing as specified in Section 26 32 13.

D Correct defective work, adjust for proper operation, and retest until entire system complies with Contract Documents.

E Submit detailed reports indicating inspection and testing results and corrective actions taken.

3.04 CLEANING

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

3.05 CLOSEOUT ACTIVITIES

A Demonstration: Demonstrate proper operation of transfer switches to Owner, and correct deficiencies or make adjustments as directed.

B Training: Train Owner's personnel on operation, adjustment, and maintenance of transfer switches.
1. Use operation and maintenance manual as training reference, supplemented with additional training materials as required.
2. Provide minimum of two hours of training.
a. Training may be performed concurrently with generator training.
3. Instructor: Manufacturer's authorized representative.
4. Location: At project site.

C Coordinate with related generator demonstration and training as specified in Section 26 32 13.

3.06 PROTECTION

A Protect installed transfer switches from subsequent construction operations.

3.07 MAINTENANCE

A Provide to Owner a proposal as an alternate to the base bid, a separate maintenance contract for the service and maintenance of transfer switches for two years from date of Project Acceptance; Include a complete description of preventive maintenance, systematic examination, adjustment, inspection, and testing, with a detailed schedule.

END OF SECTION 26 36 00

SECTION 26 43 00
SURGE PROTECTIVE DEVICES

PART 1 GENERAL

1.01 SECTION INCLUDES

A Surge protective devices for service entrance locations.

B Surge protective devices for distribution locations.

1.02 REFERENCE STANDARDS

A UL 1283 - Standard for Electromagnetic Interference Filters; Current Edition, Including All Revisions.

B UL 1449 - Standard for Surge Protective Devices; Current Edition, Including All Revisions.

C NFPA 70 - National Electrical Code; National Fire Protection Association, Including All Applicable Amendments and Supplements; 2020.

1.03 ADMINISTRATIVE REQUIREMENTS

A Coordination: Coordinate size and location of overcurrent device compatible with the actual surge protective device and location to be installed. Notify Architect of any conflicts or deviations from Contract Documents to obtain direction prior to ordering equipment.

1.04 SUBMITTALS

A Product Data: Include detailed component information, voltage, surge current ratings, repetitive surge current capacity, voltage protection rating (VPR) for all protection modes, maximum continuous operating voltage (MCOV), nominal discharge current (I-n), short circuit current rating (SCCR), connection means including any required external overcurrent protection, enclosure ratings, outline and support point dimensions, weight, service condition requirements, and installed features.

1. SPDs with EMI/RFI filter: Include noise attenuation performance.

B Shop Drawings: Include wiring diagrams showing all factory and field connections with wire and circuit breaker/fuse sizes.

C Certificates: Manufacturer's documentation of listing for compliance with the following standards:

1. UL 1449.
2. UL 1283 (for Type 2 SPDs).

D Field Quality Control Test Reports.

E Manufacturer's Installation Instructions: Include application conditions and limitations of use stipulated by product testing agency. Include instructions for storage, handling, protection, examination, preparation, and installation of product.

F Operation and Maintenance Data: Include information on status indicators and recommended maintenance procedures and intervals.

G Warranty: Submit sample of manufacturer's warranty and documentation of final executed warranty completed in Owner's name and registered with manufacturer.

H Project Record Documents: Record actual connections and locations of surge protective devices.

1.05 QUALITY ASSURANCE

A Comply with requirements of NFPA 70.

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

C Product Listing Organization Qualifications: Third party agencies shall be amongst those accredited by the NCBCC (North Carolina Building Code Council) to label Electrical and Mechanical Equipment.

1.06 DELIVERY, STORAGE, AND PROTECTION

A Store in a clean, dry space in accordance with manufacturer's written instructions.

1.07 FIELD CONDITIONS

A Maintain field conditions within manufacturer's required service conditions during and after installation.

1.08 WARRANTY

A Manufacturer's Warranty: Provide minimum five year warranty covering repair or replacement of surge protective devices showing evidence of failure due to defective materials or workmanship.

B Exclude surge protective devices from any clause limiting warranty responsibility for acts of nature, including lightning, stated elsewhere.

PART 2 PRODUCTS

2.01 MANUFACTURERS

A Field-installed, Externally Mounted Surge Protective Devices:
1. ABB/GE: www.geindustrial.com/#sle.
2. Current Technology; a brand of Thomas & Betts Power Solutions.
3. Schneider Electric; Square D Brand Surgelogic Products.
4. Liebert.
5. Approved equal.

B Source Limitations: Furnish surge protective devices produced by a single manufacturer and obtained from a single supplier.

2.02 SURGE PROTECTIVE DEVICES - GENERAL REQUIREMENTS

A Description: Factory-assembled surge protective devices (SPDs) for 60 Hz service; listed, classified, and labeled as suitable for the purpose intended; system voltage as indicated on the drawings.

B Unless otherwise indicated, provide field-installed, externally-mounted SPDs.

C List and label as complying with UL 1449, Type 1 when connected on line side of service disconnect overcurrent device and Type 1 or 2 when connected on load side of service disconnect overcurrent device.

D Protected Modes:
1. Wye Systems: L-N, L-G, N-G, L-L.

E UL 1449 Voltage Protection Ratings (VPRs):
1. 208Y/120V System Voltage: Not more than 700 V for L-N, L-G, and N-G modes and 1,000 V for L-L mode.
2. 480Y/277V System Voltage: Not more than 1,200 V for L-N, L-G, and N-G modes and 2,000 V for L-L mode.

F UL 1449 Maximum Continuous Operating Voltage (MCOV): Not less than 115% of nominal system voltage.

G Enclosure Environment Type per NEMA 250: As indicated on the drawings.

H Mounting for Field-installed, Externally Mounted SPDs: Unless otherwise indicated, as specified for the following locations:
1. Provide surface-mounted SPD where mounted in non-public areas or adjacent to surface-mounted equipment.

2.03 SURGE PROTECTIVE DEVICES FOR SERVICE ENTRANCE LOCATIONS

A Unless otherwise indicated, provide field-installed, externally mounted SPDs.

B Surge Current Rating:
1. Ampacity: 1200 - 2000A 250 kA per mode 500 kA per phase.
2. Ampacity: 600 - 1000A 200 kA per mode 400 kA per phase.
3. Ampacity: 225 - 400A 150 kA per mode 300 kA per phase.
4. Ampacity: 125 - 225A 100 kA per mode 200 kA per phase.

C Opening of supplementary protective devices, internal or external, shall not be permissible during UL 1449 3rd Edition Nominal Discharge testing.

2.04 SURGE PROTECTIVE DEVICES FOR DISTRIBUTION LOCATIONS

A Unless otherwise indicated, provide field-installed, externally mounted SPDs.

B Surge Current Rating:
1. Ampacity: 400 - 800A 150 kA per mode 300 kA per phase.
2. Ampacity: 125 - 225A 100 kA per mode 200 kA per phase.
3. Ampacity: 15 - 100A 50 kA per mode 100 kA per phase.

PART 3 EXECUTION

3.01 EXAMINATION

A Verify that field measurements are as indicated.

B Verify that the service voltage and configuration marked on the SPD are consistent with the service voltage and configuration at the location to be installed.

C Verify that electrical equipment is ready to accept connection of the SPD and that installed overcurrent device is consistent with requirements of drawings and manufacturer's instructions.

D Verify system grounding and bonding is in accordance with Section 26 05 26, including bonding of neutral and ground for service entrance and separately derived systems where applicable. Do not energize SPD until deficiencies have been corrected.

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

3.02 INSTALLATION

A Perform work in a neat and workmanlike manner.

B Install products in accordance with manufacturer's instructions.

C Arrange equipment to provide minimum clearances in accordance with manufacturer's instructions and NFPA 70.

D Unless indicated otherwise, connect service entrance surge protective device on load side of service disconnect main overcurrent device.

E Provide conductors with minimum ampacity not less than manufacturer's recommended minimum conductor size.

F Install conductors between SPD and equipment terminations as short and straight as possible, not exceeding manufacturer's recommended maximum conductor length. Breaker locations may be reasonably rearranged in order to provide leads as short and straight as possible. Twist conductors together to reduce inductance.

G Do not energize SPD until bonding of neutral and ground for service entrance and separately derived systems is complete in accordance with Section 26 05 26 where applicable. Replace SPDs damaged by improper or missing neutral-ground bond.

H Disconnect SPD prior to performing any high potential testing. Replace SPDs damaged by performing high potential testing with SPD connected.

3.03 FIELD QUALITY CONTROL

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

B Perform inspections and tests listed in NETA ATS Section 7.19.1.

C Procure services of a qualified manufacturer's representative to observe installation and assist in inspection, testing, and adjusting. Include manufacturer's reports with field quality control submittals.

3.04 CLEANING

A Repair scratched or marred exterior surfaces to match original factory finish.

END OF SECTION 26 43 00

SECTION 26 51 00
INTERIOR AND EXTERIOR LIGHTING

PART 1 GENERAL

1.01 SECTION INCLUDES

A Interior luminaires.
B Emergency lighting units.
C Exit signs.
D LED Drivers.
E Emergency Power supply units.
F Lamps.
G Accessories.

1.02 REFERENCE STANDARDS

A IES LM-79 - Approved Method: Optical and Electrical Measurements of Solid-State Lighting Products; 2019.
B NFPA 70 - National Electrical Code; National Fire Protection Association, Including All Applicable Amendments and Supplements; 2020.
C NFPA 101 - Life Safety Code; Most Recent Edition Adopted by Authority Having Jurisdiction, Including All Applicable Amendments and Supplements.
D UL 924 - Emergency Lighting and Power Equipment; Current Edition, Including All Revisions.
E UL 935 - Fluorescent-Lamp Ballasts; Current Edition, Including All Revisions.
F UL 1598 - Luminaires; Current Edition, Including All Revisions.

1.03 ADMINISTRATIVE REQUIREMENTS

A Coordination:
1. Coordinate the installation of luminaires with mounting surfaces installed under other sections or by others. Coordinate the work with placement of supports, anchors, etc. required for mounting. Coordinate compatibility of luminaires and associated trims with mounting surfaces at installed locations.
2. Coordinate the placement of luminaires with structural members, ductwork, piping, equipment, diffusers, fire suppression system components, and other potential conflicts installed under other sections or by others.
3. Coordinate the placement of exit signs with furniture, equipment, signage or other potential obstructions to visibility installed under other sections or by others.
4. Notify Architect of any conflicts or deviations from Contract Documents to obtain direction prior to proceeding with work.

1.04 SUBMITTALS

A Shop Drawings:
1. Indicate dimensions and components for each luminaire that is not a standard product of the manufacturer.
B Product Data: Provide manufacturer's standard catalog pages and data sheets including detailed information on luminaire construction, dimensions, ratings, finishes, mounting requirements, listings, service conditions, photometric performance, installed accessories, and ceiling compatibility; include model number nomenclature clearly marked with all proposed features.
1. Drivers: Include wiring diagrams and list of compatible lamp configurations.
2. Lamps: Include rated life, color temperature, color rendering index (CRI), and initial and mean lumen output.
C Certificates for Dimming Drivers: Manufacturer's documentation of compatibility with dimming controls to be installed.
D Field quality control reports.
E Manufacturer's Installation Instructions: Indicate application conditions and limitations of use stipulated by product testing agency. Include instructions for storage, handling, protection, examination, preparation, and installation of product.

F Warranties.

G Operation and Maintenance Data: Instructions for each product including information on replacement parts.

H Maintenance Materials: Furnish the following for Owner's use in maintenance of project.

1. Extra Drivers: Two percent of total quantity installed for each type, but not less than one of each type.

1.05 QUALITY ASSURANCE

A Comply with requirements of NFPA 70.

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

C Product Listing Organization Qualifications: Third party agencies shall be amongst those accredited by the NCBCC (North Carolina Building Code Council) to label Electrical and Mechanical Equipment.

1.06 DELIVERY, STORAGE, AND PROTECTION

A Receive, handle, and store products according to manufacturer's written instructions.

B Keep products in original manufacturer's packaging and protect from damage until ready for installation.

1.07 FIELD CONDITIONS

A Maintain field conditions within manufacturer's required service conditions during and after installation.

PART 2 PRODUCTS

2.01 LUMINAIRE TYPES

A Furnish products as indicated in luminaire schedule included on the drawings.

2.02 LUMINAIRES

A Provide products that comply with requirements of NFPA 70.

B Provide products that are listed and labeled as complying with UL 1598, where applicable.

C Provide products listed, classified, and labeled as suitable for the purpose intended.

D Unless otherwise indicated, provide complete luminaires including lamp(s) and all sockets, ballasts, reflectors, lenses, housings and other components required to position, energize and protect the lamp and distribute the light.

E Unless specifically indicated to be excluded, provide all required conduit, boxes, wiring, connectors, hardware, supports, trims, accessories, etc. as necessary for a complete operating system.

F Provide products suitable to withstand normal handling, installation, and service without any damage, distortion, corrosion, fading, discoloring, etc.

G Recessed Luminaires:

1. Ceiling Compatibility: Comply with NEMA LE 4.
2. Luminaires Recessed in Insulated Ceilings: Listed and labeled as IC-rated, suitable for direct contact with insulation and combustible materials.
3. Luminaires Recessed in Sloped Ceilings: Provide suitable sloped ceiling adapters.
4. Luminaires Recessed in Fire Rated Ceiling: Provide fire rated tenting to match the fire resistant rating of the surrounding ceiling.

H LED Luminaires:

1. Components: UL 8750 recognized or listed as applicable.
2. Tested in accordance with IES LM-79 and IES LM-80.
3. Outdoor: Provide a minimum of 10 kV integral surge suppression.
4. Indoor: Provide a minimum of 2.5 kV integral surge suppression.

I Luminaires Mounted in Continuous Rows: Provide quantity of units required for length indicated, with all accessories required for joining and aligning.

2.03 EMERGENCY LIGHTING UNITS

A Description: Emergency lighting units complying with NFPA 101 and all applicable state and local codes, and listed and labeled as complying with UL 924.

B Operation: Upon interruption of normal power source or brownout condition exceeding 20 percent voltage drop from nominal, solid-state control automatically switches connected lamps to integral battery power for minimum of 90 minutes of rated emergency illumination, and automatically recharges battery upon restoration of normal power source.

C Battery:

1. Sealed maintenance-free nickel cadmium unless otherwise indicated on the lighting fixture schedule.

2. Size battery to supply all connected lamps, including emergency remote heads where indicated.

D Diagnostics: Provide power status indicator light and accessible integral test switch to manually activate emergency operation. All fixtures shall be equipped with self diagnostics in addition to the manual operation.

E Provide low-voltage disconnect to prevent battery damage from deep discharge.

F Accessories:

1. Provide compatible accessory mounting brackets where indicated or required to complete installation.
2. Provide compatible accessory wire guards where indicated.

2.04 EXIT SIGNS

A Description: Exit signs complying with NFPA 101 and applicable state and local codes, and listed and labeled as complying with UL 924.

1. Number of Faces: Single- or double-face as indicated or as required for installed location.
2. Directional Arrows: As indicated or as required for installed location.

B Self-Powered Exit Signs:

1. Diagnostics: Provide power status indicator light and accessible integral test switch to manually activate emergency operation. All fixtures shall be equipped with self diagnostics in addition to the manual operation.

C Accessories:

1. Provide compatible accessory wire guards where indicated.

2.05 DRIVERS

A Drivers - General Requirements:

1. Provide drivers containing no polychlorinated biphenyls (PCBs).
2. Minimum Efficiency/Efficacy: Provide drivers complying with all current applicable federal and state driver efficiency/efficacy standards.

B Dimmable LED Drivers:

1. Dimming Range: Continuous dimming from 100 percent to one percent relative light output unless dimming capability to lower level is indicated in the fixture schedule, without flicker.
2. Control Compatibility: Fully compatible with the dimming controls to be installed. Refer to drawings.
3. Square wave inverters shall not be used with LED emergency lighting. Sinusoidal wave inverters must be used.

2.06 EMERGENCY POWER SUPPLY UNITS

A Description: Self-contained LED Emergency power supply units suitable for use with indicated luminaires, complying with NFPA 101 and all applicable state and local codes, and listed and labeled as complying with UL 924.

B Compatibility:

1. Drivers: Compatible with electronic, standard magnetic, energy saving, and dimming AC ballasts, including those with end of lamp life shutdown circuits.

C Operation: Upon interruption of normal power source, solid-state control automatically switches connected lamp(s) to the emergency power supply for minimum of 90 minutes of rated emergency illumination, and automatically recharges battery upon restoration of normal power source.

D Unit shall have a maximum of 5% total harmonic distortion with sine wave output. Square wave output is not acceptable.

E Battery: Sealed maintenance-free high-temperature nickel cadmium unless otherwise indicated. Normal expected life of 10 years.

F Emergency Lighting Locations as defined on the drawings.

G Diagnostics: Provide accessible and visible multi-chromatic combination test switch/indicator light to display charge, test, and diagnostic status and to manually activate emergency operation.

H Operating Temperature: From 32 degrees F to 122 degrees F unless otherwise indicated or required for the installed location.

2.07 LED LAMPS

A Lamps - General Requirements:

1. Unless explicitly excluded, provide new, compatible, operable lamps in each luminaire.

2. Verify compatibility of specified lamps with luminaires to be installed. Where lamps are not specified, provide lamps per luminaire manufacturer's recommendations.
3. Minimum Efficiency: Provide lamps complying with all current applicable federal and state lamp efficiency standards.
4. Color Temperature Consistency: Unless otherwise indicated, for each type of lamp furnish products which are consistent in perceived color temperature. Replace lamps that are determined by the Architect to be inconsistent in perceived color temperature.
    a. Unless otherwise noted on the drawings color temperatures shall be as listed below. Notify engineer if there is an inconsistency in color temperatures listed in the fixture schedule prior to ordering.
        1) Interior Lighting: 4000 K
        2) Exterior Lighting: 4000 K

PART 3 EXECUTION

3.01 EXAMINATION

A Verify that field measurements are as indicated.

B Verify that outlet boxes are installed in proper locations and at proper mounting heights and are properly sized to accommodate conductors in accordance with NFPA 70.

C Verify that suitable support frames are installed where required.

D Verify that branch circuit wiring installation is completed, tested, and ready for connection to luminaires.

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

3.02 PREPARATION

A Provide extension rings to bring outlet boxes flush with finished surface.

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

3.03 INSTALLATION

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

B All luminaire surge suppression shall be evaluated and tested in accordance with ANSI C62.41.2 standard.

C Install products in accordance with manufacturer's instructions.

D Provide required support and attachment in accordance with Section 26 05 29.

E Install luminaires securely, in a neat and workmanlike manner.

F Install luminaires plumb and square and aligned with building lines and with adjacent luminaires.

G Suspended Ceiling Mounted Luminaires:

1. Do not use ceiling tiles to bear weight of luminaires.
2. Do not use ceiling support system to bear weight of luminaires unless ceiling support system is certified as suitable to do so.
3. Secure surface-mounted and recessed luminaires to ceiling support channels or framing members or to building structure.
4. Secure pendant-mounted luminaires to building structure.
5. Secure lay-in luminaires to ceiling support channels using listed safety clips at four corners.
6. In addition to ceiling support wires, provide two galvanized steel safety wire(s), minimum 12 gauge, connected from opposing corners of each recessed luminaire to building structure.

H Recessed Luminaires:

1. Install trims tight to mounting surface with no visible light leakage.
2. Non-IC Rated Luminaires: Maintain required separation from insulation and combustible materials according to listing.
3. Luminaires Recessed in Fire-Rated Ceilings: Install using accessories and firestopping materials to meet regulatory requirements for fire rating.

I Suspended Luminaires:

1. Install using the suspension method indicated, with support lengths and accessories as required for specified mounting height.
2. Provide minimum of two supports for each luminaire, with no more than 4 feet between supports.

3. Install canopies tight to mounting surface.

J Wall-Mounted Luminaires: Unless otherwise indicated, specified mounting heights are to center of luminaire.

K Install accessories furnished with each luminaire.

L Bond products and metal accessories to branch circuit equipment grounding conductor.

M Emergency Lighting Units:

1. Unless otherwise indicated, connect unit to unswitched power from same circuit feeding normal lighting in same room or area. Bypass local switches, contactors, or other lighting controls.
2. Install lock-on device on branch circuit breaker serving units, where served by a dedicated circuit.

N Exit Signs:

1. Unless otherwise indicated, connect unit to unswitched power from same circuit feeding normal lighting in same room or area. Bypass local switches, contactors, or other lighting controls.
2. Install lock-on device on branch circuit breaker serving units, where served by a dedicated circuit.

O Identify luminaires connected to emergency power system in accordance with Section 26 05 53.

P Install lamps in each luminaire.

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

3.04 WARRANTY

A Exit signs: Provide a minimum five year warranty. The battery shall have an additional 2 year pro rated warranty. Warranty period begins from the date of project acceptance.

B Emergency Luminaires: Provide a minimum of 5 year warranty for emergency luminaires. Batteries shall be warranted for 3 years with an additional 3 year pro-rated warranty. Warranty period begins from the date of project acceptance.

C Emergency Power supplies and inverters shall have a minimum of 10 year prorated warranty.

3.05 FIELD QUALITY CONTROL

A Inspect each product for damage and defects.

B Operate each luminaire after installation and connection to verify proper operation.

C Test self-powered exit signs, emergency lighting units, and fluorescent emergency power supply units to verify proper operation upon loss of normal power supply. Test shall be conducted for 90 minutes in accordance with NEC 700. Test shall be conducted a maximum of 10 days prior to final inspection and light level readings recorded at the beginning and end of the test shall be submitted to the engineer for review.

D Correct wiring deficiencies and repair or replace damaged or defective products. Repair or replace excessively noisy ballasts as determined by Architect.

3.06 ADJUSTING

A Aim and position adjustable luminaires to achieve desired illumination as indicated or as directed by Architect. Secure locking fittings in place.

B Aim and position adjustable emergency lighting unit lamps to achieve optimum illumination of egress path as required or as directed by Architect or authority having jurisdiction.

C Exit Signs with Field-Selectable Directional Arrows: Set as indicated or as required to properly designate egress path as directed by Architect or authority having jurisdiction.

3.07 CLEANING

A Clean surfaces according to manufacturer's instructions to remove dirt, fingerprints, paint, or other foreign material and restore finishes to match original factory finish.

3.08 CLOSEOUT ACTIVITIES

A Demonstration: Demonstrate proper operation of luminaires to Architect, and correct deficiencies or make adjustments as directed.

B After the designer final inspection prior to final AHJ inspection and final acceptance replace all lamps that have failed and clean all lenses.

3.09 PROTECTION

A Protect installed luminaires from subsequent construction operations.

END OF SECTION 26 51 00