DIVISION 26 – ELECTRICAL

26 0501 - MINOR ELECTRICAL DEMOLITION

A. Coordinate utility service outages with the UND Electrical Department.

B. Verify the abandoned wiring and equipment serve only abandoned facilities.

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 and follow the safe working practice requirements of NFPA 70E.

D. Demolition and extension:

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

2. Remove abandoned wiring to source of supply.

3. Provide revised typed circuit directory in panelboards that have circuits removed.

4. Remove exposed abandoned conduit and abandoned conduit above accessible ceiling finishes. Cut conduit flush with walls and floors, and patch surfaces.

5. Disconnect abandoned outlets and remove devices. Remove abandoned outlets if conduit and wiring serving them is abandoned and removed. Provide blank cover for abandoned outlets which are not removed.

6. Disconnect and remove abandoned panelboards and distribution equipment.

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

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

E. PCB Ballast Handling:

1. Generally, all high-power factor fluorescent light ballasts manufactured before 1978 and some HID ballasts contain polychlorinated biphenyl (PCB) compounds in their capacitors. The Contractor shall inspect all ballasts in all light fixtures and take the actions described below.

   a. The disposal of all ballasts labeled as “NON-PCBs” or NO PCBs” shall become the responsibility of the Contractor. If the PCB content is not stated on the ballast label, the ballast shall be handled as a PCB ballast.

F. Lamp and PCB Ballast Disposal:

1. All lamps (fluorescent, incandescent, and HID) contain mercury and/or lead (in the base) as well as other heavy metals and compounds which are regulated by the EPA and DNR during the disposal process. As a result, regulations have been issued covering the handling and disposal of all lamps.

26 0513 - MEDIUM-VOLTAGE DISTUBUTION

SECTION INCLUDES:

A. MEDIUM VOLTAGE CABLE

B. NEUTRAL/GROUND CABLE

C. LIGHTINING ARRESTORS

D. CABLE TERMINATIONS

E. PAD MOUNT TRANSFORMERS

F. MEDIUM VOLTAGE OIL SWITCHES

G. ACCESORIES

MANUFACTURERS:

1. Okonite
2. Superior Essex
3. Southwire

H. Cable Type: Type MV 105.

I. Conductor: Aluminum compact stranded conductor with water resistant filling.

J. Conductor Insulation: Ethylene-propylene rubber. Voltage Rating: 15 kV.

K. Insulation Thickness: 220 mils with a 133 percent insulation level.

L. Shielding: 1/3 neutral solid copper wires, helically applied over semiconducting insulation shield.

M. Construction: Single conductor cable with extruded semi conducting EPR layer, 133% EPR insulation 220 Mils, extruded semi conducting EPR layer over insulation, concentric copper wire neutral and overall jacket with three red stripes

GROUNDED NEUTRAL WIRE

A. Description: Single Conductor Insulated wire

B. Conductor: Copper

C. Insulation Rating: 600 volts, 75 Degrees C wet or dry

D. Insulation: NFPA 70, Type THWN or USE-RHH-RHW

CABLE TERMINATIONS

A. Cable terminations shall be completed by a certified Cable Splicing and Terminating Medium Voltage Technician

SURGE ARRESTORS AND ACCESSORIES

A. IEEE 386 and ANSI C62.11, Metal Oxide Varistor Elbow (M.O.V.E) surge arrestor

B. Manufacturer:

1. Cooper Power Series

C. Duty Cycle Rating:

1. 3kV (2,400v/4,160v system)

2. 9kV (7,200v/12,470v system)

MODULAR CABLE TERMINATIONS AND ACCESSORIES

A. Manufacturer:

1. Cooper Power Series

- Bushing Insert: IEEE 386, 200A, 15kV Class load break bushing insert. Cooper Model LBI215
- Load Break Terminations: IEEE 386, 200A, 15kV Class load break elbow connector with test point. Cooper Model LE215XXXT
- Dead Break Connector: IEEE 386, 600 Amp 15kV class T-OP II deadbreak connector T-body with test point and loadbreak reducing tap plug (LRTP)

MEDIUM VOLTAGE TRANSFORMERS

A. MANUFACTURER:

1. Cooper

2. ABB

B. Liquid Filled

1. Medium Voltage Transformers: Factory assembled and tested, general purpose, liquid filled.

2. Windings: 2 winding type. Aluminum or Copper, Auto-Transformers are not acceptable.

3. Liquid-filled: ANSI C57.12.00; Class OA. 65 degrees C, self cooled

4. Insulating Liquid: Natural organic fluid conforming to IEEE C57.147

C. SERVICE CONDITIONS:

1. Meet requirements for usual service conditions described in ANSI C57.12.00 and specified unusual service conditions

2. Minimum Ambient Temperature: -35 degrees F

3. Altitude: 3,000 feet

4. Transformer Loading Requirements: 100%

D. ACCESSORIES:

1. Accessories: ANSI C57.12.00, IEEE C57.12.01 standard accessories and one inch drain valve with sampling device, dial type thermometer, liquid level gauge, two welded ground lug attachment points, pressure vacuum gauge, provisions for securing access doors in open position, pressure relief device, self sealing with indicator, mounting provision for low voltage current transformers and potential transformers, Bay-O-Net oil drip tray for each fuse and one line electrical diagram stenciled in clear view when HV door is open.

2. Parking Stands: Provide six brackets for parking energized load break connectors

3. Name Tags: Provide, in LV compartment, stenciled letters designating building name. Keep letters size 3/8" or larger

4. Tap Changer: Externally hook stick operated type

5. Primary Terminations: Universal bushing wells to IEEE 386; provide six for loop feed. Include bushing for insulated loadbreak elbow connectors.

6. Primary Switching: One (1) two-position switch for transformer primary (3 phase gang operated 200A internal liquid immersed gang operated load break switches) located in primary compartment; hook stick operated. Each switch shall be rated 15kV and 10,000AIC

7. Primary Overcurrent Protection: Replaceable current limiting Bayonet type, liquid immersed fuses with oil immersed type ELSP backup fuse inside tank to limit energy let through from a faulted transformer.

E. FABRICATION

1. Conform to ANSI C57.12.28

2. High and low voltage compartments shall be located side by side separated by a steel barrier. When facing the transformer, the low voltage compartment shall be on the right. Terminal compartments shall be full height, air filled with individual doors. High voltage door fastenings shall not be accessible until low voltage door has been opened. Low voltage door shall have a 3 point latching mechanism with vault type handle having provisions for a single padlock. Doors shall be equipped with lift off type stainless steel hinges and door stops to hold doors open when working in compartments. Front sill of compartment shall be removable to allow transformer to be rolled or skidded into position over conduit stubs. ANSI tank grounding provisions shall be furnished in each compartment. Provide penta head bolt in both HV and LV compartment doors. Penta head bolts to be concealed when LV door is closed, latched and padlocked. Undercoat all surfaces in contact with pad.

3. Low voltage bushings shall be molded epoxy and provided with blade type spade terminals with NEMA standard hold spacing arranged for vertical take off. The low voltage neutral shall be an insulated bushing grounded to the transformer tank by removable ground strap. Wye-wye connected transformers shall have the high and low voltage neutrals internally tied with a removable link for testing.

F. FACTORY FINISH:

1. Degrease, clean and phosphatize surfaces before applying paint

2. Apply corrosion resisting primer to all surfaces

3. Apply finish coat of baked enamel paint to 4 mils thick. Undercoat all surfaces in contact with pad.

4. Finish Color: Manufacturer's standard Munsell Green

MEDIUM VOLTAGE OIL SWITCHES

A. MANUFACTURER:

1. Cooper, RVAC Series

B. OIL SWITCH:

1. Cutout: ANSI/IEEE C37.44 sealed type

2. Design Voltage: 15kV

3. Basic Impulse Level: 60kV

4. Rated Continuous Current: 600 Amps

5. Interrupting Rating: 10,000 rms symmetrical amperes.

6. Rated load break, making and short time currents: ANSI/IEEE C37.44

7. All source and tap connections shall have separate switches. All tap connections shall have ELSG fuse protection.

8. Bushing Inserts: 200A Tap and 600A Source

9. Grounding Kit: Ground Bars

10. Additional enclosure space (depth) on 600A switch side to accommodate T-OP II with piggy backed 200A load break elbows or lighting arrestors.

C. FACTORY FINISH:

1. Finish Color: Munsell Green

INSTALLATION:

A. Cable:

1. Avoid abrasion and other damage to cables during installation.

2. Use suitable lubricants and pulling equipment

3. Sustain cable pulling tensions and bending radii below recommended limits.

4. Ground cable shield at each termination and splice

5. Install cables in manholes along wall providing longest route.

6. Protect installed cables from entrance of moisture

7. Pull in full sized copper 600V neutral/ground cable with each MV circuit. Do not use MV cable shield as the sole grounded conductor.

8. Arrange cable in manholes and switch basements to avoid interference with duct entrances.

B. Transformers:

1. Install in accordance with IEEE C57.94

2. Fill units with oil and install fuses

3. Provide ring configured ground grid around pad, 1/0 copper minimum with four 5/8" x 10 foot ground rods at each corner (4 minimum). Bond ground grid to ground rods using mechanical connections.

4. Install safety labels to NEMA 260

26 0519 - LOW-VOLTAGE ELECTRICAL POWER CONDUCTORS AND CABLES

A. SECTION INCLUDES

1. Building wire and cable rated 600V and less

2. Wiring connectors and connections rated 600V and less

3. Sleeves for Cables

B. CONDUCTOR MATERIAL APPLICATIONS

1. Feeders: Copper for feeders smaller than No. 2 AWG: copper or aluminum for feeders No. 2 AWG and larger.

2. Brand Circuits: Copper; Solid or stranded for No. 12 AWG and smaller; stranded for No. 10 AWG and larger.

a) Use stranded conductors for control circuits

b) Use conductor not smaller than 12 AWG for power and lighting circuits

c) Use conductor not smaller than 16 AWG for control circuits

C. WIRING METHODS

1. Service Entrance: Type THHN-THWN single conductors in raceway or Type XHHW-2, single conductor in raceway

2. Feeders: Type THHN-THWN or XHHW-2 single conductor in raceway

3. Branch Circuits:

a) Multi-wire branch circuits shall not be acceptable. Provide dedicated neutral conductor for each circuit. Acceptable use of multi-wire branch circuits shall include multi-circuit feeds to mult-outlet assembly and to modular furniture.

b) Home Runs (from circuit breaker to junction box at accessible location adjacent to first wiring device) Type THHN-THWN single conductor in raceway

c) Exposed (including in crawl spaces, electrical rooms, mechanical rooms, and above accessible ceilings) Type THHN-THWN single conductor in raceway

d) Concealed (e.g. in ceilings, walls, partitions) Type THHN-THWN single conductor in raceway

e) Concealed (e.g. in ceilings, walls, partitions) Type MC cable shall be allowed as follows:

1) MC Cable is generally permitted to be installed concealed within walls only or above non accessible ceilings.

2) All homeruns to be single conductor in raceway and each homerun shall have a junction box installed above the accessible ceiling in each room. From this junction box, MC Cable shall be allowed in lengths of up to 8' exposed above the accessible ceiling routed to the wall.

3) Type MC Cable shall not be installed where it is subject to physical damage.

f) MC Cable shall not be acceptable for the following installations.

1) Home runs to panelboards

2) Panelboard, switchboard and other feeders

3) For branch circuits larger than 30 amps

4) Above accessible ceilings, except lengths up to 8' routing circuit to walls.

5) For Legally Required Standy-by branch circuits

6) In food service areas (Kitchens, serving lines, etc.)

7) In research areas to include the open labs, alcoves, vivariums, core labs

8) Wet Locations

g) Direct Burial (outdoors): Direct buried cables are not accepted

PRODUCTS

A. CONDUCTORS AND CABLES

1. Manufacturers:

a) AFC Cable Systems (Multiconductor cable)

b) Alcan Products Corp (Aluminum Cable)

c) Aflex Corp. (Southwire)

d) American Insulated Wire Corp.

e) American Wire Group

f) Cerrowire

g) Coleman Cable, Inc

h) Encore Wire, Ltd

i) Essex Cable Company

j) Service Wire Co.

k) Substitutions as submitted and approved

2. Copper Conductors (THHN/THWN)

a) Comply with NEMA WC 70, NFPA 70, and UL 83 or UL 44, UL 1063, UL 1581

b) Type THHN cable shall meet all applicable ASTM standards

c) Type THHN cable shall meet Federal Specification A-A-59544

d) Sizes 14 AWG through 10 AWG may be solid or stranded, 8 AWG and larger shall be stranded

e) Conductor shall be soft annealed copper

f) Insulation shall be high heat and moisture resistant PVC

g) Jacket shall be abrasion, moisture, gasoline and oil resistant or listed equivalent

3. Aluminum Alloy Conductors

a) Alcan Cable Sabiloy or approved equal

b) Comply with UL 1581

c) Compact stranded, aluminum association 8000 series aluminum alloy conductor material

4. Type MC Cable:

a) Comply with the following:

1) UL 1569 Standard for Metal Clad Cables

2) UL Standard 83 for thermoplastic insulated wire and cables or UL Standard 44 for thermoset insulated wires and cables

3) UL Standard 1479 standard for fire tests of through penetrations firestops.

4) UL Classified 1, 2 and 3 hour through penetration firestop systems.

b) Cable Construction:

A. Subject to review with owner

26 0526 - GROUNDING AND BONDING FOR ELECTRICAL SYSTEMS

A. Accurately record actual locations of grounding electrodes.

B. Rod Electrode:

1. Material: Copper-clad steel.
2. Diameter: 3/4 inch.
3. Length: 8 feet.

C. Exothermic Connections: Manufacturers: Caldwell

D. Installation:

1. Provide grounding electrode conductor and connect to reinforcing steel in foundation footing.
2. Bond together metal siding not attached to grounded structure; bond to ground.
3. Equipment Grounding Conductors: Provide separate, insulated conductor within each feeder circuit and branch circuit raceway. Terminate each end on suitable lug, bus, or bushing.
4. Bonding: All interior metal water, sewer and gas piping shall be bonded together and connected to the grounding electrode conductor. Connect a bonding conductor from the structural steel system to the grounding electrode conductor.
5. Resistance to ground and between multiple ground electrodes shall be measured and recorded.

26 0529 - HANGERS AND SUPPORTS FOR ELECTRICAL SYSTEMS

A. Steel Slotted Support Systems – galvanized steel.

B. Anchors and Fasteners:

1. Manufacturers
   a. RACO
   b. Appleton
   c. Caddy
   d. B-line
2. Concrete Structural Elements: Use precast insert system, expansion anchors and preset inserts.
3. Steel Structural Elements: Use beam clamps, spring steel clips steel ramset fasteners, and welded fasteners.
4. Concrete Surfaces: Use self-drilling anchors and expansion anchors.

5. Hollow Masonry, Plaster, and Gypsum Board Partitions: Use toggle bolts and hollow wall fasteners.

6. Solid Masonry Walls: Use expansion anchors and preset inserts.

7. Sheet Metal: Use sheet metal screws.

8. Wood Elements: Use wood screws.

9. Plastic anchors are unacceptable in concrete or block walls. Properly applied nylon tap ins are acceptable.

C. Installation:

1. Do not fasten supports to pipes, ducts, mechanical equipment, and conduit.

2. Do not use spring steel clips and clamps.

3. Do not use powder-actuated anchors.

4. Install surface-mounted cabinets and panelboards with minimum of four anchors.

5. In wet and damp locations, use steel channel supports to stand cabinets and panelboards one inch off wall.

6. Provide a 3/4 inch plywood backboard for all communication and electrical closets. Cover with two coats of gray paint.

7. Mount enclosures so that at least 1/4 inch air space is provided between the enclosure and the supporting surface.

26 0534 - CONDUIT

A. A half inch (1/2”) conduit shall be run from the top of entrance frames (both hollow metal frames and aluminum frames) to above the finished ceiling for door frames for electronically access controlled doors.

B. All spare and empty conduits to be used in the future shall be identified on termination end of each conduit for area served.

C. Electrical Metal Tubing (EMT): Set screw fittings are acceptable. Compression fittings are to be used where required.

D. Electrical Metal Tubing (EMT): Shall not be used in areas where subject to corrosive conditions unless specifically indicated, and then only a type with a bonded polyvinyl coating.

26 0535 - SURFACE RACEWAYS

A. Wireway shall be galvanized sheet steel provided with full length hinged covers and coordinated fittings including tees, collars, elbows and a closing plate required for a completely enclosed raceway. Sheet metal parts shall be coated with a rust inhibitor and finished with baked enamel. Hardware shall be plated to prevent corrosion.

26 0536 - CABLE TRAYS FOR ELECTRICAL SYSTEMS

26 0537 - BOXES

A. Provide a junction box above dropped ceilings in outlet home run circuit for individual rooms.

B. Provide a junction box above dropped ceilings in individual rooms if multiple rooms exist on one run for future wiring.

C. Install pull boxes and junction boxes above accessible ceilings and in unfinished areas only.

D. Inaccessible ceiling areas: Install outlet and junction boxes no more than 6 inches from ceiling access panel or from removable recessed luminaire.

E. All home run junction boxes shall be legibly identified on cover with panel and circuit number.

F. Floor Boxes: Fully adjustable, concrete tight. Formed steel. Rectangular.

26 0540 - UNDERFLOOR DUCTS

A. Duct shall be 14 gauge steel with a corrosion resistant finish. System shall include all junction boxes, couplings, conduit adapters, elbows, crossunders, offsets and service fittings for a complete system.

26 0553 - IDENTIFICATION FOR ELECTRICAL SYSTEMS

A. Nameplates and Labels:

1. Construction shall be laminated phenolic plastic, white front and back with black core for normal power systems, and red front and back with white core for emergency power systems.

2. Lettering. Shall be at least 3/16” high for items where attached to a device plate.

3. Lettering shall be engraved 1 line Helvetica. Nameplates shall be securely fastened to the equipment to be identified, with No. 4 Phillips round head, cadmium plated, steel self-tapping screws, or nickel plated brass bolts.

4. Letter Size: Motor Control Centers, Switchboards and distribution panelboards shall be provided with 5/8” – 3 line Helvetica lettered nameplates.

B. Equipment requiring identification shall include:

1. Motor starters, magnetic and manual; motor control centers; push button stations; control panels.

2. Disconnect switches, fused and unfused; circuit breakers, contactors, or relays in separate enclosures.

3. Switchboards – panelboards; cabinets; distribution boards.

4. Switches (wall) controlling outlets for lighting fixtures or equipment where outlets are not located within sight of switch.

5. Switches controlling electrically operated breakers or shunt trip breakers.

6. Special systems at junction boxes, pull boxes, terminal cabinets, equipment racks, etc., or as detailed on the drawings. (Fire alarm, security system, etc.)

7. Communication cabinets.

C. Conduit identification shall be as follows:

1. Label spare conduits.

2. Legend:

a. Fire alarm System: FA

b. Telephone System: Tele.

c. Data System: Data

d. Fiber Optic System: FO

D. Application:

1. Secondary service, feeder and branch circuit conductors throughout the project secondary electrical system shall be color coded as follows:

	COLOR:	
208/120V	480/277V	PHASE
Black	Brown	A
Red	Orange	B
Blue	Yellow	C
White	Gray	Neutral
Green	Green	Equipment ground and bonding.
Green/Yellow	Green/Yellow	Isolated Ground

2. Switch-loop and traveler conductors and color identification shall be other than above.

26 0573 - OVERCURRENT PROTECTIVE DEVICE COORDINATION STUDY

26 0914 - ELECTRICAL POWER MONITORING

A. See section 26 2100

26 0915 - PEAK LOAD CONTROLLERS

26 0916 - ELECTRIC CONTROLS AND RELAYS

26 0917 - PROGRAMMABLE CONTROLLERS

26 0918 - REMOTE CONTROL SWITCHING DEVICES

26 0919 - ENCLOSED CONTACTORS

26 0923 - LIGHTING CONTROL DEVICES

A. SPST motion control devices shall be passive infrared and ultrasonic types.

B. Ceiling motion control devices shall be passive infrared types suitable for use with relay controlled lighting. Sensors shall be flush mounted in the ceilings. All control wiring shall be in raceway.

C. Use consideration for light level sensors and daylight controls where natural light can reduce artificial lighting requirements by owner approval.

D. Refer to ASHRAE 90.1 Lighting Control Standards

26 0924 - LIGHTING CONTROLS – Lutron Vive

GENERAL

1.01 RELATED REQUIREMENTS

A. Section **23 xxxx** : Building automation system, for interface with lighting control system.

B. Section **26 0553 - *Identification for Electrical Systems***: Identification products and requirements.

C. Section **26 *2726 - Wiring Devices - Lutron***:

1. Finish requirements for wall controls specified in this section.

2. Accessory receptacles and wallplates, to match lighting controls specified in this section.

D. Section **26 *5133 - Luminaires, Ballasts, and Drivers - Lutron***.

1.02 REFERENCE STANDARDS

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

B. ANSI C82.11 - American National Standard for Lamp Ballasts - High Frequency Fluorescent Lamp Ballasts - Supplements**;** ***2011***.

C. ANSI/ESD S20.20 - Protection of Electrical and Electronic Parts, Assemblies and Equipment (Excluding Electrically Initiated Explosive Devices)**;** ***2014***.

D. ASTM D4674 - Standard Practice for Accelerated Testing for Color Stability of Plastics Exposed to Indoor Office Environments**;** ***2002a (Reapproved 2010)***.

E. CAL TITLE 24 P6 – California Code of Regulations, Title 24, Part 6 (California Energy Code)**;** ***2013***.

F. CSA C22.2 No. 223 – Power Supplies with Extra-low-voltage Class 2 Outputs**;** ***2015***.

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

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

I. IEC 61347-2-3 - Lamp Control Gear - Part 2-3: Particular Requirements for A.C. and/or D.C. Supplied Electronic Control Gear for Fluorescent Lamps**;** ***2011, with Amendments, 2016***.

J. IEEE 1789 - Recommended Practice for Modulating Current in High-Brightness LEDs for Mitigating Health Risks to Viewers***; 2015***.

K. IEEE C62.41.2 - Recommended Practice on Characterization of Surges in Low-Voltage (1000 V and less) AC Power Circuits**; *2002 (Cor 1, 2012)***.

L. ISO 9001 - Quality Management Systems-Requirements**; *2008***.

M. NECA 1 - Standard for Good Workmanship in Electrical Construction**; *2015***.

N. NECA 130 - Standard for Installing and Maintaining Wiring Devices; National Electrical Contractors Association**; *2010***.

O. NEMA 410 - Performance Testing for Lighting Controls and Switching Devices with Electronic Drivers and Discharge Ballasts; National Electrical Manufacturers Association**; *2015***.

P. NEMA WD 1 - General Color Requirements for Wiring Devices; National Electrical Manufacturers Association**; *1999 (R 2015)***.

Q. NFPA 70 - National Electrical Code; National Fire Protection Association**; *Most Recent Edition Adopted by Authority Having Jurisdiction, Including All Applicable Amendments and Supplements***.

R. UL 20 - General-Use Snap Switches**; *Current Edition, Including All Revisions***.

S. UL 508 - Industrial Control Equipment; Underwriters Laboratories Inc.**; *Current Edition, Including All Revisions***.

T. UL 924 - Emergency Lighting and Power Equipment**; *Current Edition, Including All Revisions***.

U. UL 935 - Fluorescent-Lamp Ballasts**; *Current Edition, Including All Revisions***.

V. UL 1310 – Class 2 Power Units**; *Current Edition, Including All Revisions***.

W. UL 1472 - Solid-State Dimming Controls**; *Current Edition, Including All Revisions***.

X. UL 1598C - Light-Emitting Diode (LED) Retrofit Luminaire Conversion Kits**; *Current Edition, Including All Revisions***.

Y. UL 2043 - Fire Test for Heat and Visible Smoke Release for Discrete Products and Their Accessories Installed in Air-Handling Spaces**; *Current Edition, Including All Revisions***.

Z. UL 8750 - Light Emitting Diode (LED) Equipment for Use in Lighting Products**; *Current Edition, Including All Revisions***.

1.03 ADMINISTRATIVE REQUIREMENTS

A. Coordination:

1. Coordinate the placement of sensors and wall controls with millwork, furniture, equipment, etc. installed under other sections or by others.

2. Coordinate the placement of wall controls with actual installed door swings.

3. Coordinate the placement of daylight sensors with windows, skylights, and luminaires to achieve optimum operation. Coordinate placement with ductwork, piping, equipment, or other potential obstructions to light level measurement installed under other sections or by others.

4. Coordinate the work to provide luminaires and lamps compatible with the lighting controls to be installed.

5. Notify Architect of any conflicts or deviations from the contract documents to obtain direction prior to proceeding with work.

B. Sequencing:

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

1.04 SUBMITTALS

A. See Section **01 3000 - *Administrative Requirements*** for submittal procedures.

B. Design Documents: Where Lighting Control Manufacturer Sensor Layout and Tuning service is specified in Part 2 under "LIGHTING CONTROLS - GENERAL REQUIREMENTS", Lighting Control Manufacturer to provide plans indicating occupancy/vacancy and/or daylight sensor locations.

C. Product Data: Include ratings, configurations, standard wiring diagrams, dimensions, colors, service condition requirements, and installed features.

1. Occupancy/Vacancy Sensors: Include detailed basic motion detection coverage range diagrams.

2. Wall Dimmers: Include derating information for ganged multiple devices.

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.

1.05 QUALITY ASSURANCE

A. Conform to requirements of NFPA 70.

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

1.06 DELIVERY, STORAGE, AND HANDLING

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 manufacturers required service conditions during and after installation.

1. Basis of Design System Requirements ***- Lutron***, Unless Otherwise Indicated:

    a. Ambient Temperature:

        1) Lighting Control System Components, Except Fluorescent Electronic Dimming Ballasts: Between 32 and 104 degrees F (0 and 40 degrees C).

        2) Fluorescent Electronic Dimming Ballasts: Between 50 and 140 degrees F (10 and 60 degrees C).

    b. Relative Humidity: Less than 90 percent, non-condensing.

    c. Protect lighting controls from dust.

1.08 WARRANTY

A. See ***Section 01 7800 - Closeout Submittals***, for additional warranty requirements.

B. Manufacturer's Standard Warranty, Without Manufacturer Full-Scope Start-Up:

1. Manufacturer Lighting Control System Components, Except Wireless Sensors, Ballasts/Drivers and Ballast Modules: One year 100 percent parts coverage, no manufacturer labor coverage.

2. Wireless Sensors: Five years 100 percent parts coverage, no manufacturer labor coverage.

3. Ballasts/Drivers and Ballast Modules: Three years 100 percent parts coverage, no manufacturer labor coverage.

1.09 LIGHTING CONTROLS - GENERAL REQUIREMENTS

A. Sensor Layout and Tuning: Include **as an alternate to the base bid**; additional costs for Lighting Control Manufacturer's Sensor Layout and Tuning service***; Lutron LSC-SENS-LT***:

1. Lighting Control Manufacturer to take full responsibility for wired or wireless occupancy/vacancy and daylight sensor layout and performance for sensors provided by Lighting Control Manufacturer.

2. Lighting Control Manufacturer to analyze the reflected ceiling plans, via supplied electronic AutoCAD format, and design a detailed sensor layout that provides adequate occupancy sensor coverage and ensures occupancy and daylight sensor performance per agreed upon sequence of operations. Contractor to utilize the layouts for sensor placement.

3. During startup, Lighting Control Manufacturer to direct Contractor regarding sensor relocation, as required, should conditions require a deviation from locations specified in the drawings.

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

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

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

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

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

G. Wireless Devices:

1. Wireless device family includes area or fixture level sensors, area or fixture level load controls for dimming or switching, and load controls that can be mounted in a wallbox, on a junction box, or at the fixture.

2. Wireless devices including sensors, load controls, and wireless remotes or wall stations, can be set up using simple button press programming without needing any other equipment (e.g. central hub, processor, computer, or other smart device).

3. RF Range: 60 feet (18 m) line-of-sight or 30 feet (9 m) through typical construction materials between RF transmitting devices and compatible RF receiving devices.

4. Electromagnetic Interference/Radio Frequency Interference (EMI/RFI) Limits: Comply with FCC requirements of CFR, Title 47, Part 15, for Class B application.

H. Device Finishes:

1. Wall Controls: As indicated on the drawings; To be selected by Architect

I. Network connection from Vive wireless hub to UND network switch is required and shall meet all UND networking standards and requirements.

J. Interface with building automation system by other.

1.10 WIRELESS SENSORS

A. General Requirements:

1. Operational life of 10 years without the need to replace batteries when installed per manufacturer's instructions.

2. Communicates directly to compatible RF receiving devices through use of a radio frequency communications link.

3. Does not require external power packs, power wiring, or communication wiring.

4. Capable of being placed in test mode to verify correct operation from the face of the unit.

B. Wireless Occupancy/Vacancy Sensors:

1. General Requirements:

a. Provides a clearly visible method of indication to verify that motion is being detected during testing and that the unit is communicating to compatible RF receiving devices.

b. Utilize multiple segmented lens, with internal grooves to eliminate dust and residue build-up.

c. Sensing Mechanism: Passive infrared coupled with technology for sensing fine motions***; Lutron XCT Technology***. Signal processing technology detects fine-motion passive infrared (PIR) signals without the need to change the sensor's sensitivity threshold.

d. Provide optional, readily accessible, user-adjustable controls for timeout, automatic/manual-on, and sensitivity.

e. Turns off lighting after reasonable and adjustable time delay once the last person to occupy the space vacates a room or area. Provide adjustable timeout settings of 1, 5, 15, and 30 minutes.

f. Capable of turning dimmer's lighting load on to an optional locked preset level selectable by the user. Locked preset range to be selectable on the dimmer from 1 percent to 100 percent.

g. Color: White.

h. Provide all necessary mounting hardware and instructions for both temporary and permanent mounting.

i. Provide temporary mounting means for drop ceilings to allow user to check proper performance and relocate as needed before permanently mounting sensor. Temporary mounting method to be design for easy, damage-free removal.

j. Sensor lens to illuminate during test mode when motion is detected to allow installer to place sensor in ideal location and to verify coverage prior to permanent mounting.

k. Ceiling-Mounted Sensors:

1) Provide surface mounting bracket compatible with drywall, plaster, wood, concrete, and compressed fiber ceilings.

2) Provide recessed mounting bracket compatible with drywall and compressed fiber ceilings.

l. Wall-Mounted Sensors: Provide wall or corner mounting brackets compatible with drywall and plaster walls.

2. Wireless Combination Occupancy/Vacancy Sensors:

a. Typical of common spaces such as vestibules, corridors, sitting areas and etc.

b. Ceiling-Mounted Sensors: Programmable to operate as an occupancy sensor (automatic-on and automatic-off), an occupancy sensor with low light feature (automatic-on when less than one footcandle of ambient light available and automatic-off), or a vacancy sensor (manual-on and automatic-off).

c. Wall-Mounted Sensors: Programmable to operate as an occupancy sensor (automatic-on and automatic-off), or a vacancy sensor (manual-on and automatic-off).

d. Product(s):

1) Ceiling-Mounted Occupancy/Vacancy Sensor*;* Lutron Radio Powr Savr Series, Model LFR2-OCR2B-P-WH; Coverage from 324 square feet (30.2 sq m) to 676 square feet (62.4 sq m) depending on ceiling height from 8 to 12 feet (2.4 to 3.7 m); 360 degree field of view.

2) Wall-Mounted Occupancy/Vacancy Sensor*;* Lutron Radio Powr Savr Series, Model LFR2-OWLB-P-WH Minor motion coverage of 1500 square feet (139.4 sq m) and major motion coverage of 3000 square feet (278.7 sq m) with mounting height of 6 to 8 feet (1.8 to 2.4 m); 180 degree field of view.

3) Corner-Mounted Occupancy/Vacancy Sensor*;* Lutron Radio Powr Savr Series, Model LFR2-OKLB-P-WH Minor motion coverage of 1225 square feet (113.8 sq m) and major motion coverage of 2500 square feet (232.3 sq m) with mounting height of 6 to 8 feet (1.8 to 2.4 m); 90 degree field of view.

4) Hallway Occupancy/Vacancy Sensor*;* Lutron Radio Powr Savr Series, Model LFR2-OHLB-P-WH Major motion coverage of up to 150 feet (45.7 m) with mounting height of 6 to 8 feet (1.8 to 2.4 m); narrow field of view.

3. Wireless Vacancy-Only Sensors:

a. Operates only as a vacancy sensor (manual-on and automatic-off)

1) Typcal for offices, conference rooms, class rooms and non-common spaces

b. Product(s):

1) Ceiling-Mounted Vacancy-Only Sensor*;* Lutron Radio Powr Savr Series, Model LFR2-VCR2B-P-WH Coverage from 324 square feet (30.2 sq m) to 676 square feet (62.4 sq m) depending on ceiling height from 8 to 12 feet (2.4 to 3.7 m); 360 degree field of view.

2) Wall-Mounted Vacancy-Only Sensor*;* Lutron Radio Powr Savr Series, Model LFR2-VWLB-P-WH Minor motion coverage of 1500 square feet (139.4 sq m) and major motion coverage of 3000 square feet (278.7 sq m) with mounting height of 6 to 8 feet (1.8 to 2.4 m); 180 degree field of view.

3) Corner-Mounted Vacancy-Only Sensor; Lutron Radio Powr Savr Series, Model LFR2-VKLB-P-WH Minor motion coverage of 1225 square feet (113.8 sq m) and major motion coverage of 2500 square feet (232.3 sq m) with mounting height of 6 to 8 feet (1.8 to 2.4 m); 90 degree field of view.

4) Hallway Vacancy-Only Sensor***;*** Lutron Radio Powr Savr Series, Model LFR2-VHLB-P-WH Major motion coverage of up to 150 feet (45.7 m) with mounting height of 6 to 8 feet (1.8 to 2.4 m); narrow field of view.

4. Contact Closure Output Modules:

a. Provide one contact closure output module per space/HVAC zone, coordination with HVAC design is required. The intent is to add control capabilities based on the occupancy of the space.

b. Product: **Lutron PowPak CCO Module Model RMJS-CCO1-24-B Communicates** via radio frequency with up to ten compatible occupancy/vacancy sensors, ten wireless control stations, and one daylight sensor.

c. Contact Closure Output:

1) Single contact closure output with normally open and normally closed dry maintained contacts suitable for connection to third party equipment (e.g. building management system, HVAC system, etc.).

2) Contact Ratings: Resistive load; 1 A at 0-24 VDC, 0.5 A at 0-24 VAC.

3) Operation affected by associated occupancy/vacancy sensors and wall controls.

1.11 WIRED RECEPTACLES WITH WIRELESS COMMUNICATION INPUTS

A. When design and/or regulatory requirements require load control follow this section

B. Communicates via radio frequency with up to ten compatible occupancy/vacancy sensors and ten wireless control stations.

C. Relay:

1. Load switched in manner that prevents arcing at mechanical contacts when power is applied to and removed from load circuits.

2. Rated for switching of general purpose loads.

3. Motor rating of 0.5 HP at 120 V for 15 A receptacles, and 1 HP at 120 V for 20 A receptacles.

D. Finish: To be selected by Architect.

E. Product(s):

1. Half switched duplex receptacle, 15A, 125V, NEMA 5-15R***; Lutron Wireless Receptacle with Clear Connect Technology; Model CAR2S-15-STR***.

2. Full switched duplex receptacle, 15A, 125V, NEMA 5-15R***; Lutron Wireless Receptacle with Clear Connect Technology; Model CAR2S-15-DTR***.

3. Half switched duplex receptacle, 20A, 125V, NEMA 5-15R***; Lutron Wireless Receptacle with Clear Connect Technology; Model CAR2S-20-STR***.

4. Full switched duplex receptacle, 20A, 125V, NEMA 5-15R***; Lutron Wireless Receptacle with Clear Connect Technology; Model CAR2S-20-DTR***.

1.12 LUMINAIRE COMPONENTS (FACTORY-INSTALLED)

A. **Factory installed fixture control is the UND preferred method of fixture control as it provides the greatest long term flexibility, as well as reduces installation materials and labor.**.

B. Wireless fixture control components to be factory-installed in luminaires as specified in Section ***26 5113***.

C. Luminaires specified in Section ***26 5113*** to be provided with factory-installed wireless fixture control components as specified below unless otherwise indicated.

D. Wireless Fixture Control Dongle:

1. Product(s):

   a. RF only (no integral sensing capability); ***Lutron Vive Wireless Fixture Controller; Model DFCSJ-OEM-RF***.

   b. RF with occupancy/vacancy and daylight sensing; ***Lutron Vive Wireless Fixture Controller; Model DFCSJ-OEM-OCC***.

2. Communicates via radio frequency with up to ten compatible occupancy/vacancy sensors, ten wireless control stations, and one daylight sensor.

3. Selectable minimum light level.

4. Supports configurable high- and low-end trim.

5. Plenum rated in accordance with UL 2043.

6. Mounts to fixture through hole.

7. Wireless Fixture Control Dongle with Integral Sensing Capabilities:

   a. Occupancy/Vacancy Sensing:

      1) Passive infrared coupled with technology for sensing fine motions**;** ***Lutron XCT Technology***. Signal processing technology detects fine-motion passive infrared (PIR) signals without the need to change the sensor's sensitivity threshold.

2) Coverage: 300 square feet (28 sq m) with mounting height of 8 to 12 feet (2.4 to 3.7 m); 360 degree field of view.

3) Sensor Timeout: 15 minutes.

(a) Sensor timeout adjustable via ***Lutron Vive*** wireless hub.

b. Daylight Sensing:

1) Automatic calibration.

2) Provide linear response to changes in perceived light level.

(a) Response adjustable via ***Lutron Vive*** wireless hub.

3) Closed loop proportional control scheme.

4) Sensor Range: 0 to 150 footcandles (0 to 1600 lux).

c. Coordination between Integral and Wireless Sensors:

1) Occupancy/Vacancy Sensing: Integral and wireless sensors work in conjunction (occupancy detected by either sensor turns lights on and vacancy detected by both sensors turns lights off).

2) Daylight Sensing: Wireless sensor takes precedence over integral sensor.

E. Digital Bus Interface:

1. Product: Use ***Lutron OEM Digital Bus Interface; Model DFC-OEM-DBI*** when a DALI Driver with integrated self-powered DALI Link is not utilized by the fixture manufacturer.

2. Provides power for wireless fixture control dongle and up to four LED drivers (60mA at 17-19 VDC).

3. DALI compliant.

4. UL listed.

1.13 WIRELESS CONTROL STATIONS

A. Product(s):

1. 2-Button Control; ***Lutron Pico Wireless Control Model PJ2-2B***

a. Button Marking: Light (icons); As indicated on drawings

2. 2-Button Control with Night Light***; Lutron Pico Wireless Control Model PJN-2B***.

3. 2-Button with Raise/Lower Control; ***Lutron Pico Wireless Control Model PJ2-2BRL***

a. Button Marking: Light (icons); As indicated on drawings

4. 3-Button Control; ***Lutron Pico Wireless Control Model PJ2-3B***.

    a. Button Marking: Light (icons); As indicated on drawings

5. 3-Button with Raise/Lower Control; ***Lutron Pico Wireless Control Model PJ2-3BRL***.

    a. Button Marking: Light (icons); As indicated on drawings

6. 3-Button with Raise/Lower Control and Night Light***; Lutron Pico Wireless Control Model PJN-3BRL***.

7. 4-Button; ***Lutron Pico Wireless Control Model PJ2-4B***

    a. Button Marking: As indicated on drawings

8. Screw Mounting Kit***; Lutron Model PICO-SM-KIT***.

9. Wallbox Adapter***; Lutron Model PICO-WBX-ADAPT***.

B. Quantity: As indicated on the drawings

C. Communicates directly to compatible RF receiving devices through use of a radio frequency communications link.

D. Does not require external power packs, power or communication wiring.

E. Includes LED to indicate button press or programming mode status.

F. Mounting:

1. Mounted directly to a wall under a faceplate.

2. Faceplates: Provide concealed mounting hardware.

G. Power: Battery-operated with minimum ten-year battery life (3-year battery life for night light models).

H. Finish: To be selected by Architect.

1.14 WIRELESS HUBS

A. Product(s):

1. Wireless hub with BACnet***; Lutron Vive Premium Hub***.

    a. Flush-mount wireless hub***; Model HJS-2-FM***; supports up to 700 total paired devices.

    b. Surface-mount wireless hub***; Model HJS-2-SM***; supports up to 700 total paired devices.

B. Integrated processor and web server allows hub to set up and operate the system without any external connections to outside processors, servers, or the internet.

C. Utilizes Ethernet connection for:

1. Networking hubs together

2. Integration with Building Management System (BMS) via native BACnet;

3. Remote connectivity capabilities, including maintaining system date/time and receiving periodic firmware updates (requires internet connection).

D. A single hub or network of hubs can operate on either a dedicated lighting control only network or can be integrated with an existing building network as a VLAN. Typical UND installation would be VLAN

E. Communicates directly to compatible ***Lutron Vive*** RF devices through use ***Lutron Clear Connect*** radio frequency communications link; does not require communication wiring; RF range of 71 feet (23 m) through walls to cover an area of 15836 square feet (1471 sq m) (device and hub must be on the same floor).

F. Communicates directly to mobile device (smartphone or tablet) or computer using built-in Wi-Fi, 2.4 GHz 802.11b/g; wireless range of 71 feet (23 m) through walls (device and hub must be on the same floor).

G. Allows for system setup, control, and monitoring from mobile device or computer using ***Vive*** web-based software:

1. Supports paired devices up to maximum number indicated including compatible wireless sensors, wireless control stations, and wireless load devices.

2. Allows for timeclock scheduling of events, both time of day and astronomic (sunrise and sunset).

a. Timeclock is integrated into the unit and does not require a constant internet connection.

b. Retains time and programming information after a power loss.

c. 365-day schedulable timeclock allows for:

1) Scheduling of events years in advance.

2) Setting of recurring events with exceptions on holidays.

d. Time clock events can be scheduled to:

1) Send lights to a desired level.

2) Adjust level lights go to when occupied.

3) Adjust level lights go to when unoccupied.

4) Enable/disable occupancy.

5) Adjust timeout of sensors (requires ***Model FC-SENSOR*** wired fixture sensor or ***Model DFCSJ-OEM-OCC*** wireless fixture control dongle with integral sensing capabilities).

3. Daylighting:

a. Daylighting can be enabled/disabled. Can be used to override the control currently taking place in the space.

b. Daylight set point can be adjusted with the software to increase or decrease the electric light level in the room based on the same amount of natural light.

4. System using ***Lutron Vive*** wireless hub(s) to operate with connection to the internet.

5. Supports energy reporting.

a. Reports measured energy data for ***PowPak*** fixture control modules at accuracy of plus/minus 2 percent or 0.5 W (whichever is higher).

b. Reports calculated energy data for ***PowPak*** junction box mounted modules at accuracy of 10 percent.

6. Supports automatic demand response for load shedding via:

a. Local contact closure without need for separate interface.

7. Wireless hub can be firmware upgraded to provide new software features and system updates.

a. Firmware update can be done either locally using a wired Ethernet connection or Wi-Fi connection, or remotely if the wireless hub is connected to the internet.

H. Contact Closure Interface: Provide two contact closure inputs; accepts both momentary and maintained contact closures that can be used for automatic demand response.

I. Rated for use in air-handling spaces as defined in UL 2043.

EXECUTION

1.15 EXAMINATION

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

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

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

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

1.16 PREPARATION

A. System and Network Integration Consultation***; Lutron LSC-INT-VISIT***: Include ***as an alternate to the base bid;*** additional costs for Lighting Control Manufacturer to conduct meeting with facility

representative and other related equipment manufacturers to discuss equipment and integration procedures.

1. Coordinate scheduling of visit with Lighting Control Manufacturer. Manufacturer recommends that this visit be scheduled early in construction phase, after system purchase but prior to system installation.

1.17 INSTALLATION

A. Perform work in a neat and workmanlike manner in accordance with NECA 1 and, where applicable, NECA 130 unless otherwise indicated.

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

C. Sensor Locations:

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

2. Sensor locations indicated are diagrammatic. Within the design intent, reasonably minor adjustments to locations may be made in order to optimize coverage and avoid conflicts or problems affecting coverage, in accordance with manufacturer's recommendations.

D. Ensure that daylight sensor placement minimizes sensor view of electric light sources. Locate ceiling-mounted and luminaire-mounted daylight sensors to avoid direct view of luminaires.

E. 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.

F. Lamp Lead Lengths: Do not exceed 3 feet (0.9 m) for T4 4-pin compact and T5 BIAX lamps and 7 feet (2.1 m) for T5, T5-HO, T8 U-bend, and T8 linear fluorescent lamps.

G. LED Light Engine/Array Lead Length: Do not exceed 100 feet (31 m).

H. Identify system components in accordance with Section **26 0553**.

1.18 FIELD QUALITY CONTROL

A. See Section **01 4000 - *Quality Requirements***, for additional requirements.

B. Manufacturer's Full-Scope Start-Up Service

C. Manufacturer’s Programming Service bid ***as an alternate to the base***:

1. Include ***as an alternate to the base*** additional costs for manufacturer to perform ***on-site;*** programming tasks for ***8 hours Lutron LSC-OS-PROG8-SP***.

D. Manufacturer's Full-Scope Start-Up Service: ***as an alternate to the base***

1. On-Site Full-Scope Start-Up Service***; Lutron LSC-OS-SU-VIVE***: Manufacturer's authorized Service Representative to conduct site visit upon completion of lighting control system installation to perform system startup and verify proper operation:

    a. Where Lighting Control Manufacturer Sensor Layout and Tuning service is specified in Part 2 under "LIGHTING CONTROLS - GENERAL REQUIREMENTS", authorized Service Representative to verify sensor locations, in accordance with layout provided by Lighting Control Manufacturer; Lighting Control Manufacturer may direct Contractor regarding sensor relocation should conditions require a deviation from locations indicated.

    b. Verify connection of power wiring and load circuits.

    c. Verify connection and location of controls.

    d. Energize wireless hubs.

    e. Associate occupancy/vacancy sensors, daylight sensors, wireless remotes, and wall stations to load control devices.

    f. Provide initial rough calibration of sensors; fine-tuning of sensors is responsibility of Contractor unless provided by Lighting Control Manufacturer as part of Sensor Layout and Tuning service where specified in Part 2 under "LIGHTING CONTROLS - GENERAL REQUIREMENTS".

    g. Program timeclock schedules per approved sequence of operations.

    h. Configure load shed parameters per approved sequence of operations.

    i. Verify system operation control by control.

    j. Obtain sign-off on system functions.

    k. Train Owner's representative on system capabilities, operation, and maintenance, as specified in Part 3 under "Closeout Activities".

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

1.19 CLEANING

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

1.20 COMMISSIONING

A. See Section ***01 9113*** for commissioning requirements.

B. See Section **01 7800 - *Closeout Submittals***, for closeout submittals.

C. See Section **01 7900 - *Demonstration and Training***, for additional requirements.

1.21 PROTECTION

A. Protect installed products from subsequent construction operations.

END OF SECTION

26 0943 - NETWORK LIGHTING CONTROLS –

A. To be reviewed case by case. Crestron, Lutron or Wattstopper may be considered depending on application. Lutron Vive is preferred unless design limitations exist based on space use.

26 1116 - SECONDARY UNIT SUBSTATIONS

26 1200 - MEDIUM-VOLTAGE TRANSFORMERS

A. Subject to review by the Engineer with the Owner.

B. Medium-voltage transformers shall be Cooper.

C. Accessories:

1. One inch drain valve with sampling device.
2. Dial type thermometer.
3. Liquid level gage.
4. Two welded ground lug attachment points.
5. Pressure vacuum gage.
6. Provision for securing access doors in open position.
7. Pressure relief device, self-sealing with indicator.
8. Bay-O-net oil drip tray for each fuse.
9. One line electrical diagram stenciled in clear view when HV door is open.
10. Provide six brackets for parking-energized load-break connectors.
11. Primary Terminations: Universal bushing wells to IEEE 386; provide six for loop feed. Include bushings for insulated load break elbow connectors.

D. Finish Color: Manufacturer’s standard Munsell Green.

26 1300 - MEDIUM-VOLTAGE SWITCHGEAR

26 1321 - AIR INTERRUPTER SWITCHES

26 1322 - MEDIUM-VOLTAGE OIL SWITCHES

A. Subject to review by the Engineer with the Owner.

B. Medium-voltage switches to have concrete basements.

C. Medium-voltage switches to be Cooper RVAC switches.

D. Switches to have ground bar with clamps on each side.

E. Switches to have side hinged doors with pentahead bolt and padlock hasp on each side.

F. T-OP11 load break elbows on all 600 amp bushings.

G. All sources and tap connections shall have separate switches. All tap connections shall have ELSG fuse protection.

H. Surge Arresters: One (1) per each primary phase as shown on drawings.

I. Finish Color: Manufacturer's standard Munsell Green

J. Load-Break Cable Terminators: Elbow-type units with 200-A-load make/break and continuous-current rating; coordinated with insulation diameter, conductor size, and material of cable being terminated. Include test point on terminator body that is capacitance coupled.

26 1839 - MEDIUM-VOLTAGE MOTOR CONTROLLERS

26 2100 - LOW-VOLTAGE ELECTRICAL SERVICE ENTRANCE

A. All service entrance into campus buildings shall be 480/277 volts.

B. Termination cabinets are not required.

C. All metering shall be in main switchboard and compatible with existing campus metering.

D. Dent Power Scout metering shall be used (PS3037-E-D)

E. Be sure all meters are properly installed per Manufacturers Requirements. Electrician is to verify new installations to assure proper installation of supplied components.

26 2200 - LOW-VOLTAGE TRANSFORMERS

A. Sound Levels: Maximum sound levels: 30 dB for 45 or less KVA and 40 db for larger transformers as measured per ANSI C89.2.

26 2413 - SWITCHBOARDS

26 2416 - PANELBOARDS

A. When room numbers are changed panel legends need to be upgraded.

B. Each panel should be supplied with twenty percent (20%) spare capacity.

C. Provide spare conduits out of each recessed panel board to an accessible location above ceiling minimum spare conduits: 5 empty 3/4".

D. Panelboard Bus: Cooper, ratings are required. Provide copper ground bus in each panelboard; provide insulated ground bus where required. Provide copper main and neutral lugs. Provide 200% neutral bus when needed.

E. Molded Case Circuit Breakers: Bolt-on type thermal magnetic trip circuit breakers, with common trip handle for all poles. Provide circuit breakers UL listed as Type SWD for lighting circuits. Do not use tandem circuit breakers. Provide copper lugs.

26 2419 - MOTOR-CONTROL CENTERS

26 2501 - LOW-VOLTAGE BUSWAYS

26 2501 - LOW-VOLTAGE BUSWAYS - SCHNEIDER ELECTRIC I-LINE

26 2501 - LOW-VOLTAGE BUSWAYS - SCHNEIDER ELECTRIC POWER BUS

26 2600 - POWER DISTRIBUTION UNITS

26 2717 - EQUIPMENT WIRING

A. Make conduit connections to equipment using flexible conduit. Use liquid tight flexible conduit with watertight connectors in damp or wet locations.

B. Make wiring connections using wire and cable with insulation suitable for temperatures encountered in heat producing equipment.

C. Provide receptacle outlet where connection with attachment plug is required. Provide cord and cap where field – supplied attachment plug is required.

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

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

F. Provide air tight seals in and around conduits and busway between inside and outside areas and in walk-in coolers and freezers.

G. All conductor connections to mechanical equipment shall be copper conductors.

H. MC Cable shall not be excessive in length. No coiling of cable.

26 2723 - INDOOR SERVICE POLES

26 2726 - WIRING DEVICES

A. Furnish at least 120-volt duplex outlet on each wall in each classroom and office and every 25 feet in corridors, and one outlet on each level in the stair towers.

B. Provide outside receptacle within 3 feet of downspout for heat tape.

C. Dual USB charging receptacle outlet to be as manufactured by Leviton model Power 2U or equal.

D. Provide receptacle outlets in equipment rooms for maintenance.

E. Wired receptacles with wireless communication inputs

1. When design and/or regulatory requirements require load control follow this section

2. Communicates via radio frequency with up to ten compatible occupancy/vacancy sensors and ten wireless control stations.

3. Relay:

a. Load switched in manner that prevents arcing at mechanical contacts when power is applied to and removed from load circuits.

b. Rated for switching of general purpose loads.

c. Motor rating of 0.5 HP at 120 V for 15 A receptacles, and 1 HP at 120 V for 20 A receptacles.

4. Finish: To be selected by Architect.

5. Product(s):

a. Half switched duplex receptacle, 15A, 125V, NEMA 5-15R***; Lutron Wireless Receptacle with Clear Connect Technology; Model CAR2S-15-STR***.

b. Full switched duplex receptacle, 15A, 125V, NEMA 5-15R***; Lutron Wireless Receptacle with Clear Connect Technology; Model CAR2S-15-DTR***.

c. Half switched duplex receptacle, 20A, 125V, NEMA 5-15R***; Lutron Wireless Receptacle with Clear Connect Technology; Model CAR2S-20-STR***.

d. Full switched duplex receptacle, 20A, 125V, NEMA 5-15R***; Lutron Wireless Receptacle with Clear Connect Technology; Model CAR2S-20-DTR***.

26 2813 - FUSES

A. Fuses subject to review by the Owner.

1. Main disconnect over 600 amps. Shall be class L – Current limiting type.

2. Main disconnect under 600 amps. Shall be Class RK-1 – Current limiting with rejection features.

3. Feeders to panels equipped with 10,000 A.I.C. circuit breakers.

a. Up to 150 amps – Class RK-5.

b. 175 amps through 600 amps – Class RK-1.

4. Feeders to power panels, motor control centers or transformers up to 600 amps. Class Rk-5.

5. Motors served from Fusible control centers, power panels or individually shall be protected by dual-elements fuses sized at 125% of actual nameplate rating.

a. 100 amps or less – Class Rk-5.

b. Over 100 amps – Glass RK-5.

26 2817 - ENCLOSED CIRCUIT BREAKERS

26 2818 - ENCLOSED SWITCHES

26 2913 - ENCLOSED CONTROLLERS

26 2923 - VARIABLE-FREQUENCY MOTOR CONTROLLERS

A. The frequency drives shall be ABB, Allen Bradley or Square D.

B. Installed VFDs must be capable to be bypassed in case of drive failure so the equipment can be run without the drive.

C. The drive fault must be setup to be reset from the front-end automation system.

D. VFDs shall be configured to restart automatically after a power outage/bump or after a building fire alarm has returned to normal.

E. VFDs are to be capable of BAC net MS/TP. Monitored and controlled points are listed in the Facilities Management standard controls specification.

F. Provide monitoring of VFD fault, start/stop, status, alarm and percentage of operation for each VFD.

G. Install VFD close to motor installation. Do not go over 50 feet for motor lead length.

H. Install an equipment grounding conductor throughout the VFD circuit. Provide a dedicated circuit for each VFD.

I. Provide a VFD stand-alone installation. No gutter or wiring is to be common to several VFD's.

J. Install line, load, and control conductors in three separate raceways.

K. Automation controls should not be mounted inside VFD's.

26 3100 - PHOTOVOLTAIC COLLECTORS

26 3213 - ENGINE GENERATORS

A. Subject to review by the Engineer with the Owner.

B. Install separate emergency lighting panel for all exit lights, fire alarm circuits, stairwell lights, and mechanical equipment spaces.

C. Self-powered units or auxiliary power source are necessary.

D. Generator (natural gas preferred) for life safety, condensate pumps, sump pumps, building automation and heating pumps.

E. Generator manufacturer must have service within 1 hour of location.

F. Emergency generators do not require programmable exerciser.

G. Power quality measures should be taken to protect equipment. It is Facilities' recommendation to use UPSs, power conditioners and/or generator backup systems for all critical equipment and critical building systems where the department needs to maintain consistency with those systems or where necessary to protect equipment.

H. Non resettable hour meter

I. All generators shall meet the most correct emissions standards and regulations including but not limited to 40CFR63 subpart zzzz

26 3229 - ROTARY CONVERTERS

26 3233 - ROTARY UNINTERRUPTIBLE POWER UNITS

26 3305 - BATTERY EMERGENCY POWER SUPPLY

26 3353 - STATIC UNINTERRUPTIBLE POWER SUPPLY

26 3513 - LOW-VOLTAGE POWER FACTOR CORRECTION CAPACITORS

26 3600 - TRANSFER SWITCHES

26 4113 - LIGHTNING PROTECTION FOR STRUCTURES

26 4200 - CATHODIC PROTECTION

A. Cathodic protection shall be installed to protect the steam distribution system from corrosion.

26 4300 - SURGE PROTECTIVE DEVICES

26 5013 - LUMINAIRE SCHEDULE

26 5100 - INTERIOR LIGHTING

A. Refer to 90.1 Lighting Control Standards

B. Interior light shall be mounted so the lamp can be replaced from a ten-foot stepladder. Fixtures that require special equipment, scaffolds, or other paraphernalia to re-lamp or service are to be kept to a minimum.

C. Minimum lighting used only for decorative purposes.

D. Energy efficient lighting to be installed.

E. All fixtures to be LED 4100K.

F. All fixtures to be DLC, QPL and UL listed.

G. Lighting controlled by occupancy sensors wherever functionally feasible. Fixtures to include Lutron Vive Clear Connect RF and Sensing integrated controls Lutron Model DFCSJ-OEM-OCC, whenever possible. HVAC controls are to work off the same occupancy sensor and or through the lighting controls.

H. Occupancy sensors to control lights in offices, corridors and bathrooms. Lighting should not be shut off in stairwells. Stairwells to dim on unoccupied status. Labs, classrooms, lecture bowls and auditoriums to have light switches. When using the Lutron Vive system switches to be wireless.

I. Provide adequate light in all equipment rooms.

J. Refer to ASHRAE 90.1 Lighting Control Standards

26 5113 - LUMINAIRES, BALLASTS, AND DRIVERS

A. All fixtures to include 0-10V mark 10 dimmable driver for all LED fixtures.
B. All fixtures to be DLC, QPL and UL listed
C. All fixtures to be equipped with Lutron Vive enabled wireless fixture control components factory-installed in luminaires as specified in Section ***26 0924***.
D. Common fixture type is Columbia LCAT24-40MLG-EDU-LVS LCAT Led contemporary Architectural troffer or equivalent.

26 5537 - OBSTRUCTION AND LANDING LIGHTS

26 5561 - THEATRICAL LIGHTING

26 5600 - EXTERIOR LIGHTING

A. Refer to ASHRAE 90.1 Lighting Control Standards

B. Parking Lot and Street Lighting: Use LED fixtures for outdoor lighting with photoelectric cells on-off control with override switch for maintenance. Fixtures are to match existing fixtures as approved by owner.

C. Walkway lighting shall be LED fixtures with photoelectric cell on-off control.