

MINOR REVISION

Modify *Division 26, 26 00 00 Electrical* per the following (deletions are shown struck through and additions are double underlined). Remainder of section is unchanged.

26 00 00 ELECTRICAL

26 00 01 Owner General Requirements and Design Intent

.01 General

A. Service Voltage

1. At University Park, service shall be provided from the 12,470V distribution network whenever possible. The 4,160V network may be used where adequate capacity exists with approval of ES (Engineering Services).
2. At other locations, services may be provided by a local utility or the campus distribution network as appropriate. Details will be provided by Engineering Services.
3. Identify any medium voltage (600V and greater) raceway system within a building by painting it red in its entirety.

B. Building Voltages

1. For loads greater than 750kVA, consider 480Y/277V distribution with 208Y/120V step down transformers for receptacles and other 120V loads.
2. Step down transformers shall be located in rooms with adequate fire ratings and transformers connected for sound isolation using flexible conduit, isolation pads and when supported from the building steel, spring hangers.

C. Utility Demand and Consumption

1. The Design Professional shall complete the [Utility Demand and Consumption](#) form on all projects. It is used to inform the University of the impact on the distribution system capacity. Submit to Engineering Services at the Preliminary Design review submission and at the Final Design submission.

D. Building or Facility Electrical Load Determination

1. The Design Professional shall complete the [Electrical Load Determination](#) form for all projects that involve new buildings, major renovations, new electrical services or electrical service upgrades. It is used to inform the University of the impact on the distribution system capacity and the building or facility's distribution system. Submit to Engineering Services at the Preliminary Design review submission and at the Final Design submission. Prepare a separate copy of the form for three types of power; Normal, Emergency and (if required) Standby power.

E. Specification Editing

1. Generally, use the “listed manufacturers” option in lieu of “available manufacturers.” Confirm any manufacturer preference with Engineering Services.
2. Note at least 3 manufacturers, unless otherwise approved by Engineering Services. Publicly funded projects require equals unless a formal exception has been granted by the State.
3. Confirm Requirement for extra materials with Engineering Services. Typical items to provide are occupancy sensors, specialty luminaire lenses, fuses, indicating lamps, and enclosure keys.

4. First edit of specifications shall use "strike-through" instead of actually deleting items to be removed. This will allow Engineering Services to see what is to be deleted rather than search for what is missing.
5. Create an Excel spreadsheet list of spare parts, etc. that are to be turned over to PSU at substantial completion (based upon the final contract documents).
6. Data Sheet Instructions:
 - a. Engineer completes "SPEC DATA" column with information about equipment including but not limited to ratings, features and options. The data sheet is then submitted with completed specifications for bid.
 - b. Manufacturer completes "VENDOR DATA" column and returns completed data sheet with bid or submittal.
 - c. Engineer verifies that design specifications have been met by checking that specified features match submitted features.
 - d. Click here for [Data Sheet Completion Instructions](#).

F. Mounting Heights

1. Heights are measured to device centerline, unless otherwise noted.
2. Mount switches, card readers, and similar devices at 44" AFF.
3. Mount receptacles and similar wiring devices at 18" AFF.

G. National Electric Code (NEC)

1. Any exceptions taken while using the latest edition of the NEC shall only be used with the express approval of Engineering Services.

.02 LEED

Refer to the [PSU LEED Policy](#) for our sustainable design philosophy. Refer to the [PSU Green Buildings](#) web page for additional information.

.10 Scope (Basis of Design/Application of Systems)

A. Motors

1. Motors less than 3/4 hp. shall be single phase, 115 volts for operation on 120-volt circuits. Motors 3/4 h.p. and larger shall be three phase. Motors operating on three phase, 208V shall be rated at 200V. Motors operating on three phase, 480V shall be rated at 460 volts.
2. On motors 25 hp and above at 480V or 10 hp and above at 208V, discuss the use of soft start and variable speed drives. Voltage sag exceeding 3% on motor start is unacceptable. Download and edit the [Variable Frequency Drive specification](#) from Engineering Services.
3. Where reduced voltage starters of the wye-delta type are used, only closed transition types are acceptable.
4. Three phase motors rated 25Hp and larger, 480V AC or 208V AC shall utilize Variable Frequency Drive rated cable, as outlines in the Variable Frequency Drive specification and section [26 05 19.01](#).

B. Elevator Service and Support Circuitry

1. Service:
 - a. Where required by code, service to elevator machine shall be derived from an alternate source of power, in addition to the normal source. Alternate sources of power, whether generator or dual-primary services, shall be reviewed with Engineering Services.

1. If standby supplies more than one (1) elevator, provide a selector switch so that only one (1) elevator can run simultaneously. This reduces yearly PSU testing requirements.
 - b. Alternate source transfer switch shall contain SPDT contacts for central control system and sufficient number of poles to switch phase wires. Refer to [Transfer Switch](#) Requirements.
 - c. Provide combination fused disconnect/Shunt Trip operator unit. Equipment shall include three (3) Class J dual-element time delay fuses (sized appropriately for motor HP), 100VA CPT, 10 amp 120VAC Fire Safety Switch interface relay, key to test switch, green pilot light all mounted in a NEMA 1 enclosure. Unit shall be equal to the Bussmann "Elevator Power Module" PS series, Eaton "Elevator Control" ES series, Little Fuse LSP series, or Ferraz Shawmut ES series.
 1. Where elevator machine service includes an alternate source [transfer switch](#), the shunt trip circuit shall originate from a normal/ emergency circuit. Shunt trip normal / emergency circuit shall include a voltage-sensing, time delay on release (off) relay, field set for seven (7) second delay to off. Relay shall include NC contact for tie-in to fire alarm panel to annunciate "trouble". Where tie-in to fire alarm system is not possible, provide a stand-alone fire alarm system with the control panel in the machine room.
2. Support Circuitry:
- a. Cab lighting: Dedicated 20A Life Safety circuit shared only with emergency telephone consolidator. Fuse the cab lighting disconnect at 20A, slow-blow fuse. Each additional cab requires its own dedicated lighting circuit.
 - b. Emergency Phone Consolidator: Dedicated 20A Life Safety circuit shared only with elevator cab lighting. Direct the contractor to tap the line side of the cab lighting disconnect and provide a single red receptacle with red cover at the consolidator. Engrave the receptacle cover to read "FOR EMERGENCY PHONE USE ONLY". Request further emergency phone installation design requirements from Engineering Services.
 - c. Pit Sump Pump: Dedicated circuit and devices as required by load.
 - d. Pit lighting and GFI receptacle: Dedicated 20A normal circuit for GFI receptacle(s) and required lighting fixtures. Provide two (2) 3-lamp 48 inch shallow depth (4 inches or less) lensed T8 luminaires in the pit. Luminaires may be mounted horizontal. Provide 3-way switching for pit luminaires at the top and bottom of and within reach of, pit ladder. Mount all devices in the pit higher than 24 inches AFF.
 - e. Hoistway lighting: Dedicated 20A normal circuit for required lighting fixtures. Provide one (1) 2-lamp 48 inch shallow depth (4 inches or less) lensed T8 luminaires at each landing above the pit at a maximum distance of 10 feet center-to-center. Mount luminaires vertically in a corner. Provide separate 3-way switching for hoistway luminaires (in pit and top of shaft) and 4-way switches at each access point into the hoistway (elevator door). Mount switches 48" above landing floor level and within reach of access opening.
 - f. Machine Room lighting and GFI receptacle: Dedicated 20A circuit for GFI receptacle. Provide minimum of one (1) 3-lamp 48" luminaire on a switched standby power circuit. Connect lighting and related control on line side of GFI receptacle.
 - g. Provide two (2) emergency stop switches, one (1) at the entrance to the pit and one (1) at the bottom of the pit ladder in the pit. Switch shall be similar to Square D #SKR9R05H13, 2-position, maintained pull, mushroom head with

"PUSH EMERGENCY" engraved on the unit. Connect switches to the elevator controller(s).

- h. Illumination at each landing sill (lobby side) must be a minimum maintained level of 10 fc at all times. Source shall be unswitched, on emergency power.

C. Building Automation Systems (BAS)

1. Coordinate the monitoring of certain electrical equipment with the design of the BAS system. Equipment to be monitored shall include, but not be limited to:
 - a. Arc Flash Reduction Maintenance switches on service entrance equipment (when applicable). EC shall daisy-chain all switch outputs together so that if one is enabled the BAS system sends an alert to CCS.
 - b. Occupancy sensors with relay for HVAC setback for stand-alone room deployments, or digital lighting control systems integration with BAS via BACnet where deployed. All building-wide digital lighting control systems shall use BACnet interface and not contact closures via occupancy sensors. Discuss the deployment options with Engineering Services.
 - c. Exterior lighting circuits including building-mounted exterior luminaires. EC shall wire each CT to the BAS monitoring interface.
 - d. Engine Generators (when applicable). Refer to [Generator](#) section for points to wire to the BAS monitoring interface.
 - e. Automatic Transfer Switches. Refer to [ATS](#) section for points to wire to the BAS monitoring interface.
 - f. UPS's (when applicable).
2. Electrical Equipment BAS Monitoring Interface - Install BAS low voltage work separate from line voltage (>50VAC), specify that a BAS Interface box is provided. Box shall be minimum of 12x12 with clear cover and contain a labeled terminal strip for each piece of monitored electrical equipment. EC shall wire each point from the equipment to the terminal strip and label the wires at each end.
3. Provide a dedicated circuit or circuits to BAS equipment, from the appropriate branch of power. Not every piece of BAS equipment requires a 20A circuit, they may be combined when appropriate. Require that the EC field coordinate with the BAS vendor exact locations and provide a single receptacle for their UPS.

.20 Definitions

- A. CCS: Central Control System that monitors all Building Automation Systems at University Park Campus.
- B. Provision(s): Electrical space that is built for installation of future overcurrent device without the requirement of any additional parts.
- C. Night Lighting: CCS term for exterior lights mounted to the building. These "Night" lights are usually controlled by the campus master photo cell. "Night Lighting does not include exterior lighting for walkways, roadway or parking, or egress lighting to the Public Way.
- D. Site Lighting: CCS term for exterior lighting covering free standing walkway lights and "shoebox" roadway or parking lots. These "Site" lights are typically controlled by the campus master photo cell. "Site" Lighting does not include exterior lights mounted to the building or egress lighting to the Public Way.

.30 Submittals

A. Design Calculations

The University requires that the Design Professional submit calculations for all projects, including:

1. Illumination (Interior and Exterior) including copies of all proposed luminaires.

2. Short Circuit
 3. Voltage Drop
- B. Construction Submittals
1. Engineering Services has the right to request any submittal for review, but it is the sole responsibility of the Design Professional to approve or reject that submittal. Do not mark any item “Approved As Noted – Pending PSU Review” (or similar). Discuss any questions or concerns with Engineering Services prior to returning the document to the contractor.
 2. Require all submittals in PDF format so that they may be shared electronically.
 3. Provide a submittal schedule to ES and include ES on any transmittal of review comments.
 4. Contact ES regarding which, if any, submittals should be transmitted for review. Again, this review shall be simultaneous to that of the Design Professional.
- C. As-Built Submittals
1. Utilize the spreadsheet list of spare parts to be turned over to PSU at substantial completion. Require that the contractor provide documentation of each product turned over and note on spreadsheet when PSU received the materials and who accepted it.
 2. Refer to the Lighting section for additional As-Built submittal requirements.

.40 Standard of Quality/Quality Assurance (reserved)

.50 Coordination (reserved)

26 09 00 INSTRUMENTATION AND CONTROL FOR ELECTRICAL SYSTEMS

26 09 23 Lighting Control Devices

.01 General

- A. Intent – PSU designs shall strive for simple and effective methods of lighting control that is robust and easy to maintain.
- B. Automatic Lighting Controls:
1. All interior building spaces shall be controlled via automatic means, typically occupancy sensors.
 - a. Utilize primarily ceiling or aimable wall/ceiling mount as they provide better coverage than wallbox style. Deploy wall mounted sensors where possible to minimize HVAC air stream conflicts with sensors using ultrasonic technology.
 - b. Use “vandal-resistant” models for wallbox mounting in individual bathrooms and small public rooms.
 - c. Use dual relay models for offices and similar spaces requiring dual level lighting (switch closest to the door frame controls the low-light level).
 - d. Dual-technology is typically preferred, but consider whether the use of one technology over another is more appropriate for specific applications.
 - e. When ceiling/wall sensors are used, always provide manual switch(es) on the load side to allow user control.
 - f. Allowable manufacturers of stand-alone equipment are Leviton, Sensor Switch, and Watt Stopper.
 - g. Discuss with Engineering Services the use of networked sensor systems for new construction and major renovation projects. Acceptable products are Lutron Energi Savr Node, Sensor Switch nLight and Watt Stopper DLM. These systems are also appropriate for more complicated control of specific spaces such as:

1. classrooms
 2. conference spaces
 3. daylight harvest of large areas
2. Specify all ceiling and wall-mount (non-wallbox) sensors with output relays to allow the BAS system to monitor occupancy so that local HVAC can reduce to minimum levels when no occupancy is sensed. This is especially effective for large offices, classrooms, labs, and similar spaces. Discuss control strategy with Engineering Services at schematic design phase. Sensor relays shall not be used when a digital networked system is deployed. BACnet interface shall be provided for all networked systems.
 3. Require in the contract documents that the successful controls vendor submit final layout drawings for review and approval as part of the shop drawing package. Include that the Vendor may have to modify their layout from that designed, as necessary to meet vendor-specific requirements or limitations. No extra costs to be allowed.
 4. Specify an allowance for additional sensors and include spare parts turned over to PSU.
 5. Provide wallbox timer switches for Telephone, Mechanical, Janitor, and similar rooms. Switch(es) must give visual warning 5 minutes and audible/visual warning 1 minute before lights turn off, similar to Watt Stopper TS-400. ~~Set switch to 30 minute delay.~~ Refer to 265000.01.B for PSU Lighting Control Matrix outlining required time delay settings for each space where deployed.

C. Central Lighting Controls:

1. When appropriate, and approved by Engineering Services, interior building lighting in common spaces and certain “Night” lights shall be controlled through ~~motorized circuit breakers (refer to [Controlled Breaker Panels section of 26-24-00](#))~~ a digital networked lighting control system via wallbox controls, occupancy sensors and per schedule set by the building users. ~~Provide timed override stations for certain spaces that may be occupied after normal business hours. Refer to the “Interior Public Space Lighting” section of the [BAS \(Building Automation System\) Specification](#) for further information.~~ Discuss this type of control with Engineering Services prior to specifying. Refer to 265000.01.B for PSU Lighting Control Matrix outlining required time delay settings for each space where deployed.
 - a. Exterior building mount “Night” lights shall be controlled through ~~motorized circuit breakers (refer to [Controlled Breaker Panels section of 26-24-00](#))~~ lighting contactors via the Central Control System. Refer to the “SITE/NIGHT LIGHTING” section of the [BAS Specification](#) for requirements. Contactors shall be fail-safe with device failure to “on”.
 - b. Exterior “Site” (walkway, roadway, and parking) lights shall be controlled from the CCS (Central Control System) through lighting contactors ~~via motorized circuit breakers~~, utilizing 4-20mA CT’s to confirm circuit activation. ~~In lieu of motorized breakers, contactors and CT’s may be used for buildings that would not otherwise utilize a motorized breaker panel.~~ Refer to the “SITE/NIGHT LIGHTING” section of the [BAS Specification](#) for requirements and discuss options with Engineering Services. Contactors shall be fail-safe with device failure to “on”.

26-09-26 Lighting Control Panelboards

1. Refer to ~~[26-24-00 Controlled Breaker Panels](#)~~ for information.

26 50 00 LIGHTING

.01 General

- A. Design shall follow PSU AD64 Energy Conservation Policy.
- B. All interior and exterior lighting controls shall be designed, deployed and commissioned in accordance with the PSU Lighting Control Matrix. Areas not specifically addressed in the matrix shall be coordinated with PSU Engineering Services.

Document	Version Date	Description
26 50 00-Lighting-PSU Lighting Control Matrix.pdf	July 2016	University's required interior and exterior lighting control standards; to be used by the Design Professional

26 51 00 INTERIOR LIGHTING

.01 Lighting Design

- A. Base bid shall utilize dimmable LED source for all general lighting. Discuss luminaire application with Engineering Services. Although LED is preferred, certain areas such as Mechanical, Electrical, and Telecom may use T8 lamping if approved by Engineering Services. The use of LED will save energy, reduce material sent to recycling, decrease maintenance costs, eliminate Mercury use, and save money on lamp replacements.
- B. The professional shall submit PDF computer generated point-by-point calculations of most interior spaces to Engineering Services for review. The use of certain “typical” rooms shall be acceptable except when the amount of fenestration or the room orientation changes. Show calculations for each space without daylight contribution as well as with daylight contribution and lighting controls. Point levels shall be legible, shown on a scaled drawing. All pertinent calculation parameters shall be indicated, highlight where the design is non-IES compliant. Engineering Services will provide direction and variance where deemed adequate. Utilize AGI-32 full calculation mode or similar program, as approved by Engineering Services.
- C. The Illuminating Engineers Society Lighting Handbook, current edition, shall be used as a standard for lighting levels. Provide a spreadsheet showing all room names and numbers along with target illumination levels. For television studios and classrooms used for TV production, consult Engineering Services for guidelines.
 - 1. Refer to [26 00 01 .10 - B Elevator Service and Support](#) for applicable illumination requirements.
- D. Medium and high bays in shops, lobbies, etc. shall be LED. Drivers must be rated for high temperature environment.
- E. Provide a PDF copy of the Luminaire fixture cutsheets with every design review submittal showing lighting layouts. Booklet shall be in color and include the light fixture schedule as well as target illumination levels and proposed lighting controls. Include point-by-point calculation results and summary table with submittals.
- F. Specify the proper disposal of mercury containing lamps per [PSU Policy SY-31](#) and PCB ballasts per [PSU Policy SY-26](#) for all renovation work.
- G. Include the luminaire fixture schedule within the drawings, not within the specifications. As-built drawings shall include final installed luminaire information.

.02 Lamps

- A. Unless otherwise approved, 48-inch linear fluorescent lamps shall be "extra-long life", either full-wattage (32-watt) T8, or the reduced wattage (28-watt) T8. Typically use low-wattage but confirm selection with Engineering Services.
- B. The use of other fluorescent lamps is discouraged. Linear T5HO (high-output) fluorescent lamps are allowed where design applications exist, but only as approved by Engineering Services.
- C. Compact fluorescent lamps shall not be specified. LED luminaires or lamps shall be specified instead.
- D. Coordinate other lamp wattages and styles with Engineering Services prior to specification.
- E. All fluorescent lamps will typically incorporate a 4100 degree Kelvin color temperature and a minimum CRI of 82.
 - 1. Qualifying extra-long life 32 watt T8, 48 inch linear lamps are as follows:
 - a. GE Super Long Life: F32T8/SXL/SPX41/ECO
 - b. Philips XLL: F32T8/TL841/XLL/ALTO
 - c. Sylvania Octron XP/XL: FO32/841/XP/XL/ECO3
 - 2. Qualifying reduced wattage T8, 48 inch linear lamps are as follows:
 - a. GE Ecolux UltraMax: F28T8/XL/SPX41/ECO
 - b. Philips XLL: F32T8/ADV841/XLL/ALTO 28W
 - c. Sylvania Octron XP/XL: F028/841/XP/XL/SS/ECO3
- F. Do not use incandescent lamps, unless specifically approved by Engineering Services. When allowed, provide the following:
 - 1. "A" lamps shall be long-life, rated 125 volts, with inside frost.
 - 2. MR-16 lamps, up to 50 watt, shall be replaced with LED equivalent.
 - 3. Any wallbox dimmers or dimming system shall be set to only allow lamp operation to 90% output. This is to conserve energy as well as to extend lamp life by double.
- G. Require that the contractor obtain all similar lamp types through one source from a single manufacturer.
- H. Dimming: All dimming luminaires shall be LED. Most applications only require a minimum dimming range of 5% to 10%. Confirm the use of 1% dimming with Engineering Services.
- I. CFL Lamp Disposal and Cleanup: Refer to PSU Environmental Health and Safety data sheet for disposal and/or cleanup of broken CFL lamps.
- J. LED shall be used instead of CFL for all applications (downlights, decorative luminaires, etc.). Specify luminaire with a minimum lumen output (typically 1000 or 2000 lumen), minimum CRI of 80, minimum L70 of 50,000 hours, and minimum efficiency of 70 lumens per watt. Require testing to IES LM-79 and LM-80 standards and life calculations based on IES TM-21. CCT shall be 4000K. Chips shall be binned to no more than a 2-step MacAdam Ellipse. Consult Engineering Services as to acceptable manufacturers.
- K. LED screw-in lamps using medium base, GU24, GU10, bi-pin etc. shall be approved by Engineering Services prior to specification. PSU prefers purpose-built LED luminaires over socket based solutions.

.03 Ballasts & Drivers

- A. Fluorescent ballasts shall be NEMA "premium" efficiency, electronic, CBM and ETL approved with a sound rating of A. Ballast shall also be Class P, thermal cut-out switch, rated where required by U.L. Investigate use of high or low ballast factor as part of the illumination calculations. Linear ballasts shall be as follows:
 - 1. PRS (programmed rapid start ballast) with parallel lamp operation – use with occupancy sensors or in frequent switching applications.
 - a. Advance "Optanium" (PRS)
 - b. GE "UltraStart"

- c. Sylvania “PROStart”
 - d. Universal “ULTim8” (PRS, HE)
2. IS (instant start ballast) – use with manual switched lighting and unswitched emergency luminaires.
- a. Advance “Optanium” (IS)
 - b. GE “UltraMax”
 - c. Sylvania “QHE”
 - d. Universal “ULTim8” (IS, HE)
- B. Provide label sticker on each fluorescent luminaire ballast chamber (in 1/8” lettering) to read either “___ V; Instant-Start; Ballast Factor” or “___ V; Program-Start; Ballast Factor” (insert the voltage and ballast factor in each underlined space). As an example, label might read “120V; Program Start; 0.88 Ballast Factor.” Label is to be visible when luminaire cover is opened or, for indirect luminaires, when viewed from a ladder looking into the fixture.
- C. LED drivers shall have the following characteristics (unless approved by Engineering Services):
1. Maximum drive current: 350mA.
 2. Minimum Efficiency: 85%.
 3. Operating Temperature Range: -40°C to 50°C.
 4. Minimum Rated Life: 50,000 hours.
 5. Dimming range: 100% to 10%
 6. UL Class I or II output.
 7. Power Factor: 90%.
 8. Total Harmonic Distortion: 20%.
 9. Comply with FCC 47 CFR part 15 non-consumer RFI/EMI standards.
 10. Consult Engineering Services as to acceptable manufacturers.
- D. Specify an in-line disconnect to meet NEC. Further require that the lighting manufacturer provide a “wire nut” connection on the load side of the disconnect to facilitate ballast replacement. Refer to picture below:



.04 Luminaires

- A. All luminaires shall be UL or CSA/US approved and labeled.

- B. Lens shall be 100% virgin acrylic injection molded prismatic diffusers meeting the ASTM specifications for methacrylate molding compounds D.788-69A. Minimum lens thickness shall be 0.125”.
- C. In mechanical rooms, storage rooms, and other unfinished areas consider lensed fluorescent strip lighting with wire guard protection. LED technology may be considered pending cost evaluation or as directed by Engineering Services.
- D. Classrooms
 - 1. For ceilings up to 10 feet, use high quality lensed "volumetric" recessed LED luminaires. ~~Most~~ Fixtures shall incorporate 0-10v ~~5% dimming ballasts~~, 10% dimming LED drivers.
 - 2. In certain applications, utilize high quality pendant mount indirect/direct lighting (with fully separate indirect and direct components) for large lecture halls, as long as luminaires don't interfere with sight-lines and ceiling-mount projection equipment.
 - 3. Refer to the classroom committee recommendations for additional information.
- E. ~~Use~~ Consider high quality pendant mount indirect/direct LED lighting for ~~offices~~, laboratories. Provide 2-level switching and occupancy sensing. Incorporate daylight harvesting as appropriate.
- F. Use volumetric LED lighting for most office and common space lighting deployments. Review all other deployment types with Engineering Services.
- G. HID luminaires shall not be used indoors.

.05 Installation

- A. When approved, recessed 2x2 luminaires shall be installed such that they are aligned in the same relative orientation from one fixture to the next. Confirm the use of this luminaire type with Engineering Services prior to specification.
- B. Cleaning: All luminaires shall be thoroughly cleaned and clear from dust, paint, construction debris and fingerprints after all other trades are complete, but prior to the date of substantial completion.

.06 Commissioning

- A. Require that the lighting control elements be properly set and tested for optimal operation. Commissioning agent shall provide a report for the following systems (edit as required for the project):
 - 1. Daylight harvesting
 - 2. Occupancy sensors
 - 3. ~~Motorized breaker panels, to include basic programming and~~ interface of BAS for CCS dusk/dawn signals. Also review the settings of the BAS CT's and run tests to confirm when CCS is signaled due to loss of multiple lamps/ballasts
 - 4. Dimming Systems
 - 5. Emergency relays (similar to Bodine GTD)
 - 6. Networked and non-networked digital lighting control systems including all control system functions, scheduling events, and networking operational parameters. Commissioning will not be considered complete until the University provides assigned IP addresses for the networked system and communication is proven successful.
- B. Engineering Services shall be invited to attend these sessions. Provide at least 7 days notice prior to any session.

.07 As-Built Documentation

- A. Require that the Luminaire Schedule be emended on the as-built documents to reflect the actual products installed.
- B. Require that an Excel spreadsheet of the as-built Luminaire Schedule is provided to PSU that includes the information above, including warranty information of lamps, ballasts, LED modules, LED drivers and contact information regarding each luminaire and/or component.
- C. Require that all digital lighting control systems devices be located and labeled to reflect actual products installed and final locations.

.08 Spare Parts

- A. Discuss with Engineering Services what spare parts to require in the specifications. Typically require the following:
 - 1. 10% of each lamp type, minimum of five (5).
 - 2. 10% of each ballast or driver, minimum of five (5).
 - 3. 5% of each LED module type, minimum of two (2) of each. On projects with a large number of a single type, limit the number of spare parts as they will become outdated quickly.
 - 4. 10% of replacement lenses and globes, minimum of three (3) of each. Note specifically to which luminaire types this applies and reference the spare parts in the luminaire schedule. If decorative bowls are large, confirm with the end user whether they have space to store these materials.

26 52 00 EMERGENCY LIGHTING

.01 General

- A. Each building shall be equipped with an egress lighting system as required by the Pennsylvania Department of Labor and Industry or other applicable code(s).
- B. Provide emergency lighting along the path of egress, including the exterior of a building and ending at a public way (or as approved by Engineering Services).
- C. All egress lighting (which includes stairwell lights, exit lights, selected corridor lights), fire extinguisher identification lights, and elevator cab lights shall operate twenty-four (24) hours a day and shall be connected to the Life Safety panel. There may be some deviation from this depending on the type emergency lighting installed and the amount of daylight available in any given space.
- D. Battery type emergency lighting is not allowed without prior approval from Engineering Services. Battery type emergency lighting should be provided in all interior building spaces housing the life-safety/stand-by power source (generator), or inside an exterior walk-in enclosure where deployed.
- E. Stairwells, lobbies, hallways and entrances shall have ample lighting to allow for night cleaning. Wall mounted ADA compliant fixtures with integral occupancy sensors and dimming drivers ~~ballasts are preferred for stairwells because they reduce energy usage and eliminate the need of high ladders and scaffolds for re-lamping~~ shall be provided for step-dim operation. Utilize the Lamar Lighting “VOL” LED series, Lumax “CODLED”, or equal luminaire.
- F. Do not use of lamps with end-of-life protection (compact fluorescent and T5) in Normal/emergency lighting applications. Ballasts for these lamps have “end of life” circuitry that can turn off lamps in certain power fluctuation conditions and leave the building without egress lighting until fixtures are de-energized and re-energized. Specify these ballasts to have automatic re-strike capability.
- G. Illuminate the corridor-side elevator landing sills to 10 fc maintained (minimum). Do not switch any luminaire required for this purpose.

- H. All lighting in the building main Electrical Room housing the main switchgear/switchboard lineup shall be connected to a normal/emergency source. Luminaires in this space shall be switched with select luminaires unswitched, operating 24x7. Coordinate layout and switching with Engineering Services.

26 53 00 EXIT SIGNS

.01 General

- A. Exit lights shall be green LED and have stencil face with green letters. In small renovation projects, red LED may be used to match existing signs.
- B. Flush mount types are desirable because they are more vandal-proof. Consider vandal-resistant models for dormitory design.
- C. Self-contained exit signs powered by a radioactive source (tritium or similar) are not acceptable.
- D. Equipment shall be UL or CSA/US approved and labeled.

26 56 00 EXTERIOR LIGHTING

.01 General

- A. Roadway and Open Parking Area Lighting
 - 1. Light Source: Light sources for roadway and open parking area lighting shall be 4100K LED. Discuss the use of lower kelvin temperature LED sources with Engineering Services where University property is adjacent to residential areas.
 - 2. Luminaire: Luminaire shall utilize a cut-off optical assembly, LED source, and IES distribution as required to maintain recommended lighting and uniformity levels. Luminaires shall be rectangular in shape and conform to a “shoebox” design. Integral driver shall be 0-10v dimming, multi-voltage or as directed by Engineering Services. Luminaires shall be similar to Lumark Ridgeview LED series, finished dark bronze with a 10 inch arm for connection to square pole. Any exception to this luminaire must be approved by Engineering Services Architect prior to the final design submission.
 - 3. Pole: Poles shall be 25 ft, 5” square, non-tapered fiberglass with handhole at base, finished dark bronze. Professional shall coordinate final height of poles with local ordinance stipulations and other University requirements. Basis of design for pole is Shakespeare, series AR (heavy duty with metal sleeve inside pole base). Allow equal by CMT or as approved by PSU Engineering Services. Use of poles lower than 25 ft is discouraged and must be approved by Engineering Services.
 - a. For aesthetic reasons, a 4" square pole may be considered for the Lumark Ridgeview or other luminaires of similar size. Pole manufacturer must approve in writing that the smaller pole meets appropriate wind loading for the application. Use caution in applying this pole size to a competitive bid as many shoebox luminaires would be inappropriate on a 4" pole (both in size and wind loading).
 - 4. Controls: Contact Engineering Services to discuss the use of automatic controls to reduce illumination levels in parking areas to 35% based upon activity in the area. Discuss the use of individual versus group control.
 - a. Typically apply pole-mount directional sensor(s) to provide adequate coverage.
 - b. Luminaire-mount sensors are not acceptable unless the coverage is a minimum of 90' diameter (45' any direction).

5. Concrete Base: Concrete bases shall utilize rebar reinforcement and embedded anchor bolts, and shall be designed to support the pole and luminaire assembly utilizing local wind load parameters and assembly effective projected area (EPA). Bases shall protrude above grade 6" with a top beveled edge. Bases shall protrude 36" above grade where damage from vehicles is possible. Above grade concrete shall be finished smooth.
6. Refer to Guideline Details list at the end of this section for PSU installation requirements.
7. Illumination Levels:
 - a. Roadway and open parking area maintained illumination levels shall comply with the following tables (Ratios listed are maximum values). Areas not covered herein shall comply with the latest IES recommendations. Roadway illumination levels outside of core campus shall be reviewed with Engineering Services. Lower average levels may be acceptable.

ROADWAYS

	Avg Maintained FC (Min)	Avg/Min Ratio (Max)
Roadway Illumination @ Grade	1.50	3 : 1

BUS PULL-OFF AREAS

	Avg Maintained FC (Min)	Avg/Min Ratio (Max)
* Bus Pull-Off Area Illumination @ Grade	2.50	3 : 1

* Bus pull-off area shall include the area of roadway traversing the length of the bus pull-off and all roadway pedestrian crosswalks within the area of the pull-off.

EXTERIOR OPEN PARKING FACILITIES

	General Parking & Pedestrian Areas		Vehicle Use Only	
Activity Level	Min FC @ Grade	Avg/Min Ratio (Max)	Avg FC @ Grade	Avg/Min Ratio (Max)
*High	0.9	4 : 1	2.0	3 : 1
Medium	0.6	4 : 1	1.0	3 : 1

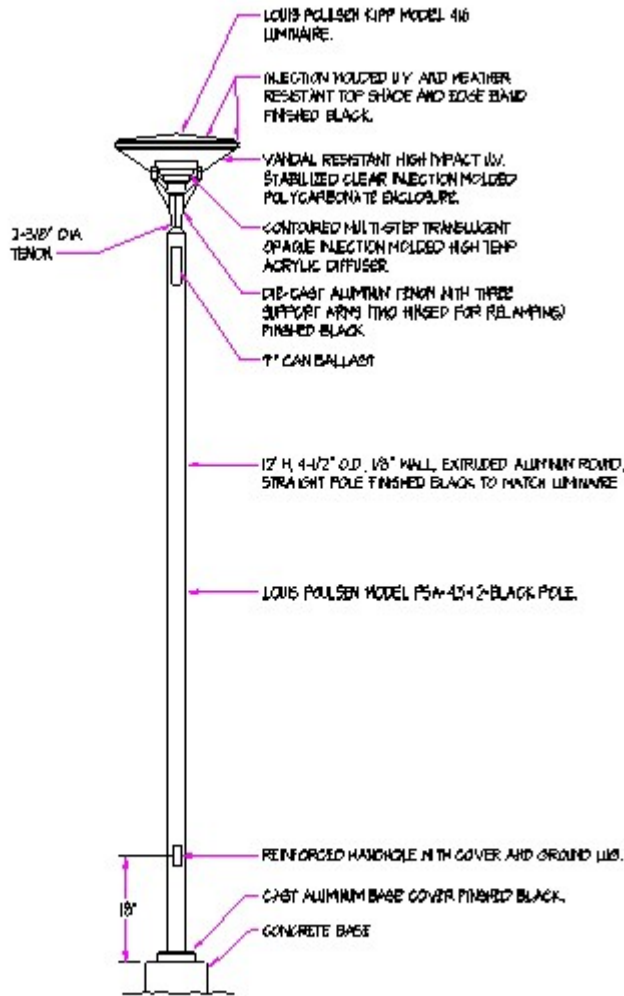
* Beaver Stadium and Jordan Center are considered areas of high activity levels.

8. Calculations – The professional shall submit two (2) copies of computer generated point-by-point calculations to Engineering Services for review. Point levels shall be legible and plan to scale. All pertinent calculation parameters shall be indicated and highlighted where non-compliant. Engineering Services will provide direction and variance where deemed adequate.
9. Sub-metering of Parking Lots – Provide provisions for Square D power meter (actual meter by PSU) for all parking lots. Provisions shall match those as noted in [“Electricity Metering”](#) section. Confirm requirements with Engineering Services.

B. Walkway Lighting, University Park Campus:

1. Light Source: Light source for walkway lighting shall be 10,000 lumen LED with a minimum color rendering index (CRI) of 82 and a correlated color temperature of 4000K, unless otherwise directed by Engineering Services
2. Driver: Luminaire shall include the electronic dimmable driver dual-rated at 120V and 277V.
3. Luminaire: Luminaire shall be conical shaped, low profile, incorporating a pressure die-cast UV and weather resistant black top shade, vandal resistant high impact UV stabilized clear injection molded polycarbonate enclosure and a three-arm support. Source shall be concealed by use of a Conical white opal acrylic diffuser that creates a symmetrical round type V distribution.
4. Model: Luminaire shall be Louis Poulsen KIPP, model 416. Any exception to this luminaire must be approved by the University Architect prior to the final design submission.
5. Pole: Pole shall be 4.5 inch diameter, round, straight aluminum pole with handhole at base, split cast aluminum base cover and shoe base. Pole shall be 12 ft in height and finished black. Pole shall be Louis Poulsen model RSA-4.5-12-Black.
6. Concrete Base: Concrete bases shall utilize rebar reinforcement and embedded anchor bolts and shall be designed to support the pole and luminaire assembly utilizing local wind load parameters and assembly effective projected area (EPA). Bases shall protrude above grade 6” with a top beveled edge. Above grade concrete shall be finished smooth.
7. Where sidewalks are adjacent to roadways, the roadway light source shall be deemed acceptable where the minimum lighting levels are satisfied. Otherwise, the professional shall review alternatives with Engineering Services.

8. Contact Engineering Services for typical CADD details.



STANDARD WALKWAY LUMINAIRE AND POLE DETAIL

9. Illumination Levels:

- a. Walkway area maintained illumination levels shall comply with the following. Areas not covered herein shall comply with the latest IES recommendations. Walkway calculation areas (distant from roadways) shall include a 6 ft area bordering the walk on each side, illuminated to a level of one-third the levels suggested for walkways for additional pedestrian safety. Walkways leading to a building entrance shall be designed for the specified walkway illumination levels, and not the levels set forth by IES Building Entrance requirements.

Walkway Classification	Avg Maintained FC @ Grade (Min)	Min Vertical FC @ 6 ft Above Grade	Avg/Min Ratio (Max)
Roadside Walkways	1.0	1.5	4 : 1 or less
Walkways Distant from Roadways	0.5	0.5	4 : 1 or less

10. Calculations:

- a. The professional shall submit two (2) copies of computer generated point-by-point calculations to Engineering Services for review. Point levels shall be legible and plan to scale. All pertinent calculation parameters shall be indicated and highlighted where non-compliant. Engineering Services will provide direction and variance where deemed adequate.
- b. Coordinate the method of calculating the vertical footcandle requirement for Walkways with Engineering Services.

11. Façade Lighting – Do not light the building façade unless otherwise approved by Engineering Services.

.02 “Site” (Walkway, Roadway, and Parking) Lighting Circuitry

- A. All underground circuitry shall be installed in 1-1/4” PVC schedule 40 conduit with burial depths in accordance with the latest edition of the NEC, or as directed by Engineering Services.
- B. Utilize multiple phases of power for circuit (minimum of three (3)), luminaires shall be connected to alternate phases (to neutral) throughout run to avoid the loss of a single phase shutting off all lights. When the electrical service includes ground-fault protection, utilize an interposing transformer to avoid an over-trip of a ground-fault to the upstream breaker(s), possibly including the service entrance.
- C. A direct buried handhole shall be installed adjacent to the base of each concrete pole base. Handholes installed within grass areas shall be similar to Penncell model PE-9. Handholes installed in concrete shall be similar to Quazite model PG, minimum 12” x 12” square OR 9” diameter round, with open bases. Provide heavy-duty covers where subject to vehicular activity.
- D. Provide in-line waterproof fuseholders with appropriate fuse for each luminaire, installed in handhole serving the pole. Fuse holders shall be similar to Bussman HE Style.
- E. Provide 5/8” x 8’ copper clad ground rod for each pole, installed inside direct buried handhole. Rod shall be connected / bonded to equipment ground and pole grounding lug, where applicable.
- F. All wiring connections made at or below grade shall be waterproof with UL listed waterproof connectors.
- G. Run separate circuit(s) to each type of site lighting (roadway, parking, and walkway). Refer to [“Lighting Control Devices” in Section 26 09 00](#).
- H. Contact Engineering Services for typical CADD details.
- I. Control Site and Night lights with a contractor ~~or motorized breaker~~ setup. Provide upstream current limiting devices as needed based on contactor withstand ratings, available system fault current, and contactor manufacturer recommendations. Review final design approach with Engineering Services. Confirm which method with Engineering Services and request the appropriate detail to use. Contractor setup shall be fail-safe using an electrically-held, normally-closed setup that turns lights ON in case of any component failure.

END of revision

Update Commentary:

Section was updated primarily for the following reasons:

- 1) *An update to the University's lighting standards throughout division 26; to accomplish needed change and revision.*