

This document is provided as a reference for the design professionals working for the University of Pennsylvania. This document should not be used directly as written project specifications. This document does not define products for maintenance replacement purposes, but rather should be used for renovation and new construction projects.

PART 1 – GENERAL

A) Summary

- 1) This Section includes lighting design criteria, lighting design deliverables, interior and exterior luminaires, luminaire components, lighting controls, as well as related installation guidelines.

B) Regulatory Agencies

- 1) Lighting design should conform to the applicable requirements of the following agencies' most current edition of regulations and standards adopted by Philadelphia County, unless otherwise stated:
 - a) American National Standards Institute (ANSI)
 - b) American Society for Testing Materials (ASTM)
 - c) Environmental Protection Agency (EPA)
 - d) Federal Communications Commission (FCC)
 - e) Illuminating Engineering Society of North America (IESNA)
 - f) National Electrical Manufacturers Association (NEMA)
 - g) National Fire Protection Association (NFPA)
 - h) Underwriter's Laboratories (UL)
 - i) U.S. Green Building Council (USGBC)
 - j) American Society of Heating, Refrigeration and Air Conditioning Engineers (ASHRAE 90.1)
 - k) International Building Code (IBC)
 - l) International Energy Conservation Code (IECC)

C) Record Drawings and Reports

- 1) Refer to 'Penn Instructions to Design Professionals' for information regarding record drawings and required Penn approvals.
- 2) As part of the Design Development Phase (100%) documentation submitted to Penn for review, comment and approval, the following drawings and reports need to be provided:
 - a) Reflected Ceiling Plans (interior spaces) or Site Plans (exterior spaces)

- (i) Room/Area ceiling type (interior spaces only)
- (ii) Luminaire symbols with luminaire type indicator
- (iii) Lighting Luminaire Schedule (assuming “basis of design” luminaires)
 - (01) Luminaire type correlated to lighting plans
 - (02) Manufacturer’s name and catalog number representing all luminaire options specified
 - (03) Luminaire construction & installation specifications:
 - (001) Luminaire shape
 - (002) Luminaire nominal size
 - (003) Luminaire mounting
 - (004) Luminaire support method
 - (005) Luminaire maintainable from below ceiling (Y/N)
 - (04) Luminaire performance specifications:
 - (001) delivered initial lumens (100% light output @ 25° C)
 - (002) max candela for directional lamps or luminaires
 - (003) L90 rated life (LM-79 data using TM-21 calculations)
 - (004) distribution type or beam spread
 - (005) correlated color temperature (CCT) and R9 value
 - (006) color rendering index (CRI)
 - (007) total wattage (@ 100% light output)
 - (008) lumens per watt (using delivered initial lumens)
 - (009) Specified dimming %
 - (010) voltage
 - (011) luminaire warranty
 - (012) driver information:
 - (0001) mounting: remote, adjacent (accessible from luminaire ceiling opening) or integral to luminaire
 - (0002) drivers/luminaire
 - (0003) driver type
 - (0004) driver manufacturer and catalog #
 - (0005) dimming protocol
 - (0006) expected life (90% failure)
 - (0007) driver warranty

b) Photometric Analysis and Data

- (i) Photometric data
 - (01) Manufacturer .ies file source data for specific luminaire types representing all specified options impacting photometric performance
- (ii) Photometric analysis
 - (01) Photometric analysis should use the following calculation assumptions:
 - (001) LLF = 0.90

- (002) Reflectances:
 - (0001) Interior spaces - 80/50/20
 - (0002) Exterior spaces – use IES pavement classification and associated reflectances defined in the most current version IES RP-8
- (003) Calculation grid: 5' x 5' point spacing at the specified height defined as the work plane height in provided or referenced illuminance tables for interior spaces and at grade for exterior spaces
- (02) Photometric plans must show luminaire types and point by point illuminance analysis for all project spaces/areas
- (03) Photometric analysis should show the following metrics for each space/area within the project scope:
 - (001) Luminaire Type
 - (002) Luminaire Manufacturer and Catalog number
 - (003) Initial Delivered Lumens
 - (004) Light Loss Factor (LLF)
 - (005) Maximum Illuminance
 - (006) Minimum Illuminance
 - (007) Average Illuminance
 - (008) Uniformity Ratio (Avg:Min)
- (04) IESNA referenced standards may define luminance or illuminance performance criteria
- c) Lighting Control Detail Plan Sheets
 - (i) Single line diagram showing all control components and associated wiring
 - (ii) Load schedule indicating circuit and zone number, light luminaire types, lamp source and load per circuit or zone
 - (iii) Catalog cut sheets of control system components
 - (iv) Control settings and sequence of operation (table or matrix preferred)
 - (01) Lighting control narrative (notes) describing control intent for programmable lighting systems
 - (v) Commissioning plan notes
- d) Comcheck Reporting
 - (i) A complete ComCheck report including all buildings, areas, rooms/spaces included in the project scope.
 - (ii) ComCheck should assume the use of the most currently adopted ASHRAE 90.1 energy code
- e) Manufacturer Specification Sheets
 - (i) Must be populated with specification options that match the manufacturer part # on the above referenced luminaire and/or control schedule
- f) Warranty Certification

- (i) Must be applicable to specified equipment
- (ii) 3rd Party component warranties (e.g. LED driver) must also be provided
- g) Installation Instructions
 - (i) For all equipment reflected in the luminaire or control schedules
- h) Maintenance Components List
 - (i) List of all replaceable components including manufacturer, part # and warranty information
- i)
- j) Full size manufacturer's drawings and/or shop drawings with dimensions should be provided for custom designed light luminaires.

D) Substitutions

- 1) Substitutions for luminaires not specified in the Contract Documents shall be coordinated with the University Engineering Department.
- 2) All luminaire substitutions must be requested via a product substitution request in accordance with the Division 1 requirements of the contract. If substitutions are requested, the University is under no obligation to accept them.

PART 2 - DESIGN AND PERFORMANCE CRITERIA

A) Design Guidelines

- 1) Penn has developed lighting application standards to direct design professionals toward standard solutions that meet the Penn's performance requirements. These guidelines provide guidance on preferred new luminaire solutions. For new luminaire solutions, a matrix is provided that defines a space functional type (e.g. laboratory) and provides multiple new luminaire solutions depending on room architecture (interior only), general cost category and other performance parameters. These lighting application standards can be accessed at the following link: [Penn Lighting Application Standards](#)

B) Illuminance Levels

- 1) Penn recognizes the Illuminating Engineering Society of North America (IESNA) Lighting Library as a base reference for recommended illuminance levels for various spaces. The Recommended Practice: Lighting Educational Facilities (IES ANSI/IES RP-3-

20) publication should be used as a primary source for recommended design practices and illuminance levels (Table A-1. Recommended Illuminance Criteria for Spaces Specific to Educational Facilities). Penn may also require adherence to other IESNA design guides and recommended practices for specific building or space types. Penn may choose to modify IESNA standards where deemed applicable. Penn required illuminance criteria for typical spaces are listed or referenced at the end of this section.

- 2) If unique occupant needs require illuminance levels lower than the required levels indicated in these standards, the lighting system should be designed to meet the required standards and an occupant-controlled lighting control system can be used to achieve lower desired levels. If an office, laboratory or other space will use undercabinet or task-specific lighting the general lighting system should be designed to meet the required standards without the consideration of the undercabinet or task-specific lighting. Undercabinet or task-specific lighting should be separately controlled from the general lighting system.
- 3) Locate exterior luminaires to minimize light trespass and glare to adjoining properties. All exterior luminaires should be cut-off type with the exception of luminaires specifically called out in the following exterior luminaire section.
- 4) Lighting levels in unoccupied public spaces such as lobbies with windows or dorm room corridors must at a minimum meet emergency access and egress levels. Stairwells using occupancy or other controls must maintain the minimum illuminance requirements when in the unoccupied control level.
- 5) Lighting design for videoconferencing spaces should follow all guidelines described in the most current version of the IESNA Design Guide DG-17 Fundamentals of Lighting for Videoconferencing.
- 6) If sports and athletic facilities are required to be used for televised events, the lighting designed in these facilities must meet IESNA and NCAA guidelines based on the type of facility and the broadcast category. Consideration must be given to both horizontal and vertical illumination for all areas intended to be included in the televised event.
- 7) Special and High-Risk Use Areas such as wood shops, machine shops, workshops should be designed to allow for both general lighting levels and elevated lighting levels where tasks are performed. Lighting positions should be coordinated with the location of equipment and levels should meet IESNA standards for the specific tasks performed in the specific immediate area where high risk tasks are performed. Meeting average illuminance requirements across the entire space containing high risk applications is not sufficient.
- 8) The following spaces should not use lighting controls for safety purposes: Electrical/Mechanical Spaces, Shop Areas (e.g. wood, machine, etc.). Lighting controls can be used in stairwells to dim (not off) light levels during periods of no occupancy

but must maintain acceptable egress illuminance requirements at the lowest dim level.

Table 1: Exterior Lighting Application & Task Illuminance Requirements			
Application & Task	Work Plan Height & Position in Inches (H = Horizontal, V = Vertical)	Penn Required Maintained Average Illuminance in Foot-Candles	Penn Required Uniformity Ratio (Max:Avg)
Pedestrian Paths ¹	0" H	0.5	10:1
Pedestrian Paths ¹	60" V	0.5	
Parking Lots	0" H	0.5	15:1
Parking Lots	60" V	0.25	
Parking Garages	0" H	1.0	10:1
Parking Garages	60" V	0.5	

Notes:

- 1) Location distant from roadway
- 2) A higher light level is required at parking garage entrances

Other Illumination Requirement References

- IES RP-3-20 > Recommended Practice: Lighting Educational Facilities (Table A-1)
- IES RP-4-20 > Recommended Practice: Lighting Library Spaces (Table A-1)
- IES RP-10-20 > Recommended Practice: Lighting Common Applications (Table A-1)
- Other IES Recommended Practice for other applications or tasks not covered by above standards

C) Energy Code Requirements

- 1) All lighting systems and designs shall comply with the currently adopted version of ASHRAE 90.1. Chapter 9 defines the ASHRAE requirements that pertain to Lighting Systems. The following list provides the primary list of requirement categories, but is not a definitive list of requirements or allowed exceptions:
 - a) General Requirements (section 9.1)
 - (i) Lighting Application Scope (section 9.1.1.) – defines what lighting applications that are included in the ASHRAE 90.1 requirements.
 - (ii) Definition of Lighting Alterations (section 9.1.2) – defines which

ASHRAE requirements apply to different projects based on project scope.

- (iii) Installed Lighting Power (section 9.1.3) and Interior and Exterior Luminaire Wattage (section 9.1.4) – defines what assumptions should be used to calculate luminaire power consumption.

- b) Compliance (section 9.2)
 - (i) Compliance Paths (section 9.2.1) – defines applicable requirement sections and alternate paths (building area or space-by-space methods) for lighting power allowance compliance.

- c) Mandatory Provisions (section 9.4)
 - (i) Interior Lighting Controls (section 9.4.1.1) – defines what control requirements and how many apply to each space type. The following sub-sections define specific control requirements:
 - (ii) Local Control (section 9.4.1.1 (a))
 - (iii) Restricted to Manual ON (section 9.4.1.1 (b))
 - (iv) Restricted to Partial Automatic ON (section 9.4.1.1 (c))
 - (v) Bilevel Lighting Control (section 9.4.1.1 (d))
 - (vi) Automatic Daylight Responsive Controls for Sidelighting (section 9.4.1.1 (e))
 - (vii) Automatic Daylight Responsive Controls for Toplighting (section 9.4.1.1 (f))
 - (viii) Automatic Partial OFF (section 9.4.1.1 (g))
 - (ix) Automatic Full OFF (section 9.4.1.1 (h))
 - (x) Scheduled Shutoff (section 9.4.1.1 (i))
 - (xi) Parking Garage Lighting Control (section 9.4.1.2) – defines control requirements for parking garage spaces.
 - (xii) Special Applications (section 9.4.1.3) – defines lighting types to be controlled separately from general lighting and control requirements for other special applications.
 - (xiii) Exterior Lighting Control (section 9.4.1.4) – defines control requirements for exterior lighting applications not exempted in section 9.1

- d) Functional Testing (section 9.4.3) – defines requirements for lighting control testing.

- e) Building Area Method Compliance Path (section 9.5) – defines the interior lighting power allowance for the building area method. When using the building area method compliance path, it should be noted that the power allowance as defined by the lighting power density (LPD) or watts per square (W/ft²) foot for the School/University Building Area Type is 0.81 W/ft².

- f) Space-by-Space Method Compliance Path (section 9.6) – defines the interior lighting power allowance for the space-by-space area method.
- g) Submittals (section 9.7) – defines project submittal requirements. Penn also defines project submittal requirements in their “Instructions to Design Professionals” documentation and in Section 3.0 (B) of this document.

D) Maintainability

- 1) All lighting systems and components shall be easily maintained by Penn facilities staff. Following product specifications define requirements that ensure ease of maintenance. Penn requires a “Maintainability Review” be provided as part of the Design Development (100%) Phase that confirms all planned products and installation approaches allow for ease of maintenance.
- 2) A Maintenance Review Session with Penn Engineering and Facilities staff assigned to the building should be held as part of the Design Development (100%) Phase. It would be expected in this review session that Reflected Ceiling Plans, Luminaire Schedule Product Specification Sheets, Installation Guidelines and any other relevant information be available for review and discussion.

PART 3 – PRODUCTS

A) Luminaires

- 1) Luminaires should be constructed and installed to allow easy access for luminaire maintenance. Lenses, reflectors, and connectors should be captive to luminaire where practical.
- 2) Interior Lighting
 - a) Penn requires the use of dimmable LED technology in all luminaires. Use of lighting technology other than LED must be approved by the University Engineering Department. Screw-in LED lamps with integrated 0-10V drivers are allowed for luminaire types (e.g. track lighting, downlighting) built for A-style or directional incandescent lamps. The Design Professional must ensure that the specified dimming control is proven to work with the specific LED replacement lamp utilized and for the quantity designed for a given switch circuit. Consideration should be given if replacement LED lamps are suitable in existing incandescent luminaires. Design professional should consult existing manufacturer for potential heat dissipation and LED lamp life issues. In all cases the design professional should verify that any controls are

- compatible with specified LED luminaires or lamps.
- b) Penn will consider acceptance of luminaires manufactured for incandescent lamps paired with LED replacement lamps meeting University standards later defined. In these instances, the design professional must ensure that the specified dimming control is proven to work with the specific LED lamp utilized and for the quantity designed for a given switch circuit.
 - c) Acceptable dimming protocols for non-incandescent relamp applications include 0-10V for LED. DALI, DMX or other dimming protocols must be specifically requested and approved by University Engineering Department. Wireless controls must be specifically requested and approved by University Engineering Department.
 - d) Mounting of luminaires above stairs and in locations that are higher than single floor ceiling heights must allow for access to the luminaires with available maintenance equipment.
 - e) Luminaires must be hard-wired. Flexible cord (SJO) connectors are not acceptable. MC cable is permitted.
 - f) Where required, luminaires should have low iridescent reflectors, baffles, and louvers.
 - g) Adjustable luminaires shall be capable of being locked into position with a legible aiming angle for consistency between luminaires. These luminaires should have the ability to maintain focus position during lamp changes.
 - h) Luminaires shall bear U.L. label or other Nationally Recognized Testing Laboratory (NRTL) tested to U.L. standards.
 - i) Where luminaires utilize flat or side lenses, 100% UV stabilized virgin acrylic with minimum 0.125" thickness shall be specified. When lensed luminaires are specified in areas where the luminaires are subject to damage, polycarbonate lenses shall be specified in lieu of acrylic.
 - j) Luminaires with painted components should be painted after fabrication.
 - k) Luminaires using LED technology should have the following performance specifications:
 - (i) Consider LED sources based on durability, energy efficiency, and reduced maintenance.
 - (ii) LED luminaires are to be provided by manufacturers with a minimum (2) years of product line market presence, (10) years' manufacturer experience and provide minimum (5) years warranty on all electrical parts.
 - (iii) LED components and luminaires shall comply with ANSI chromaticity standards, LM79 and IES LM-80 lumen maintenance testing standards.
 - (iv) Dimmable LEDs will utilize Constant Current Reduction or Pulse Width Modulation controls. The design professional is responsible for ensuring performance compatibility between specific LED luminaires and controls.

- (v) LED lighting systems with unmatched drivers and power supplies will not be considered.
 - (vi) Lumen packages sufficient to meet space design requirements including: maximum watts/square foot allowed by current energy codes adopted by Penn, uniformity ratios as defined in tables 1-4 in this document (excluding non-critical lighting locations) and minimum Penn light levels for the applicable space type. The assumed Driver mA rating should be indicated when reporting initial delivered lumens of a specified luminaire.
 - (vii) Lumen/watt efficacy performance greater than 80, assuming Lumens are measured as delivered lumens @ 35-degree Celsius multiplied by a 90% Light Loss Depreciation Factor and Watts are the total system watts of the luminaire. Lumen/Watt performance meeting or exceeding 100 is the University's goal.
 - (viii) Rated life of 50,000 when lumens depreciated to 90% of initial rating using IESNA TM-21 testing methodology and data extrapolation. This is commonly referred to L90 rated life.
 - (ix) Design Lights Consortium (DLC) certification and PECO rebate eligible required. Where DLC does not apply Energy Star certification can be used. Exceptions must be noted by designer and approved by Penn.
 - (x) Color Rendering Index equal or greater than 80.
 - (xi) Correlated color temperature of 3,500K (interior), 4,000K or 3,000K (exterior)
- l) Design professionals are required to provide LED luminaires that are compatible with existing or newly specified dimming controls.
 - m) All luminaires recessed or suspended from the ceiling shall be supported by the structure above the ceiling at a minimum of two locations for every four feet of luminaire length.
 - n) All recessed luminaires (in any ceiling type) may not be less than 4" square or round aperture (opening with trim removed) to allow for maintenance from below the ceiling.
 - o) All replaceable luminaire components must be easily accessible from below the ceiling. Replaceable components must not be permanently or otherwise affixed to any structures that would limit easy replacement. Remote mounted components must be identified on Reflected Ceiling Plans and easy to access.
 - p) Any exceptions to the above specifications must be approved by University Engineering Department.
- 3) Exterior Lighting
- a) Mission Statement: The University's primary mission for exterior lighting of the campus is to enhance safety. In the process, lighting should improve the appearance of the campus, be energy efficient, utilize long life sources to

minimize maintenance and minimize light pollution. Lighting must be adaptable for future campus development and changing technologies and be responsive to input from campus users.

- b) All measures should be made to match existing campus standard lighting however LED lighting should be considered as the source for illumination of all new pathway and drive lane lighting.
- c) Exterior pathway light poles shall be either of the following existing luminaires. Any deviations must be pre-approved by the University Engineering Department. The office of the architect will define which of the following luminaire and pole options shall be utilized.
 - (i) For pedestrian path applications. Decorative exterior pole luminaire with overall 12' tall dimension, pole with decorative aluminum base cover and traditional style luminaire, both with custom color finish. Post shall be tapered aluminum construction with 3" diameter top and 5" diameter base. Luminaire shall have Lexan diffuser and injection molded clear closer with specular reflectors. Lamp is 175-watt metal halide.
 - (1)Catalog number: Street Lighting Corporation PLV/3-14MH 175 MODIFIED SPECIAL
 - (2)Refer to following link for updated specifications: [Penn Exterior Pathway Pole and Luminaire Standards.](#)
 - (ii) For pedestrian walkways adjacent to roadways typically referred to as streetscape lighting. Decorative exterior pole luminaire with nominal 14' tall pole with decorative tapered base and traditional style luminaire. Post shall be aluminum cast construction with 4-1/4" diameter shaft with wiring access door within base and 3" by 3" round tenon. Luminaire shall be 18" diameter by 40-1/2" tall with aluminum cage, roof, and finial, and clear textured acrylic globe and clear acrylic dome lens, and stainless-steel hardware. Lamp is 150-watt metal halide with medium base. Luminaire and pole shall have a custom finish to match Rockwood Shutter Green, SW#2809.
 - (1)Catalog number: Antique Street Lamps, Philadelphia Series PX PD18 13-11 S4X FG-S AB4/11 CM PD28 S 150M MED ACT TB CDL L-6355A CM
 - (2)Refer to following link for updated specifications: [Penn Exterior Pathway Pole and Luminaire Standards.](#)
 - (iii) The above exterior pole luminaires (a. and b., above) shall utilize LED light source as per the following:
 - (1)Beacon Products Type V Indirect Retrofit Kit
 - (2)Refer to following link for updated specifications: [Penn Exterior Pathway Pole and Luminaire Standards.](#)
 - (3)Poles shall be spaced a maximum of thirty (30) feet on center.

Luminaires should be either located or specified to prevent possible damage from vandalism.

(iv) An alternate allowed for applications where the aesthetic of the above Acorn style fixtures is not preferred is the following:

(01) Description: 15' tall pole having (1) or (2) 35-watt 3000K LED asymmetric pathlight with type III distribution. Fixture finish to be custom RALxxxx color. Pole diameter at top to be 3". Pole finish to be custom RALxxxx color.

(02)Catalog number: WE-EF 683-3151 Asymmetric (luminaire), 693-3314 (pole), 683-933x (x = 1 or 2 clamps) using Philips CDM35/T6/830 lamp(s).

(03)Description: 15' tall pole having (1) or (2) 28-watt 3000K LED asymmetric pathlight with type III distribution. Fixture finish to be custom RALxxxx color. Pole diameter at top to be 3". Pole finish to be custom RALxxxx color.

(04)Catalog number: WE-EF 147-0685 (28-watt) Asymmetric (luminaire), 693-3314 (pole), 683-933x (x = 1 or 2 clamps) using Philips CDM35/T6/830 lamp(s).

(05)Refer to following link for updated specifications: [Penn Exterior Pathway Pole and Luminaire Standards](#).

d) Exterior luminaires and poles shall have the ability to withstand wind speeds of 80 miles per hour.

e) Exterior wall packs and garage lighting, both new and replacement units, shall utilize LED lamping. Luminaires shall have superior glare control with lighting directed downward. Luminaires with light distribution above 90 degrees shall not be acceptable.

B) LED Lamps

1) General

a) Screw-in LED lamps are allowed for luminaire types (e.g. track lighting, downlighting) built for A-style or directional incandescent lamps. Incandescent, fluorescent, high pressure sodium, metal halide, mercury vapor and low-pressure sodium lamps or systems should not be used.

2) LED Lamps Performance Requirements:

a) Consider LED sources based on durability, energy efficiency, and reduced maintenance. The use should be approved by the University Engineering Department prior to specification.

b) LED lamps are to be provided by manufacturers with a minimum (2)

years of product line market presence, (8) years' manufacturer experience and provide minimum (5) years warranty on all electrical parts. All LED lamps must have a minimum 25,000 hour rated life (L70).

- c) LED components and luminaires shall comply with ANSI chromaticity standards, LM79 and IES LM-80 lumen maintenance testing standards. Dimmable LED sources will utilize Constant Current Reduction or Pulse Width Modulation controls.
- d) Design professionals are required to provide LED lamps that are compatible with existing or newly specified dimming controls.
- e) LED lighting systems with unmatched drivers and power supplies will not be considered.
- f) Energy Star certification recommended and preferred.

3) All LED lamps should be by:

- a) Philips
- b) GE
- c) Osram Sylvania

4) Other manufacturers of LED lamps will be considered for specific projects and applications but must be pre-approved by the University Engineering Department.

C) Drivers

- 1) LED luminaires are to use electronic drivers utilizing 0-10V dimming protocol. Other dimming protocols must be approved by the University Engineering Department.
- 2) All drivers should have a 50,000-hour rated life (based on 90% failure rate) and end-of-life protection.
- 3) Drivers used in luminaires mounted in an exterior location shall have a starting temperature of 0°F.
- 4) Drivers shall be remote, adjacent (accessible from luminaire ceiling opening) or integral to luminaire. Remote mounted components must be identified on Reflected Ceiling Plans and easy to access.

D) Emergency lighting

- 1) All projects with area scope including egress paths must confirm that NFPA

illumination requirements are achieved. This confirmation can be provided with a separate photometric analysis of all egress paths within the project area scope.

- 2) All emergency lighting circuits shall be provided by a dedicated Emergency Lighting Inverter System or Emergency Generator. The use of Emergency Battery Drivers installed in lighting luminaires should not be considered.
- 3) Provide self-contained emergency lighting units in all generator, switchgear, ATS, and UPS rooms, regardless of whether generator power is available on the project. C. All new exit signs shall be LED purpose built at the manufacturer.
- 4) All emergency lighting units should have self-diagnostics.
- 5) When generator power is unavailable, emergency battery ballasts utilized within general lighting luminaires or self-contained emergency battery units are acceptable for code required egress lighting. Coordinate with the University Engineering Department.
- 6) Radioactive self-luminous exit signs are not acceptable. Self-luminous exit signs which are toxin free may be considered on a case by case basis.
- 7) Emergency lighting levels shall meet National Fire Protection Association (NFPA) 101 and International Building Code (IBC) requirements.
- 8) Identified Egress Paths (i.e. corridors, stairwells & assembly areas) must meet both currently adopted code requirements for minimum illumination levels and sufficient directional signage when normal power is not available.

E) Controls

- 1) Penn has developed interior lighting control guidelines to direct design professionals toward control solutions that meet Penn performance requirements. These interior lighting control guidelines can be accessed at the following link: [Penn Lighting Application Standards](#).

- 2) Penn requires that interior and exterior spaces meet the control requirements defined by the 2016 version of ASHRAE 90.1.
- 3) Ceiling mounted occupancy sensors should be used as the default approach to lighting control. Ceiling mounted sensor(s) should be placed in a space such that detection area(s) cover the entire space. When a corner or wall mounted occupancy sensor(s) is used it should be located on the “door wall” in the corner farthest from the door. Wall mounted occupancy sensors will be considered for small spaces pre-approved by University Engineering Department.
- 4) Where applicable, occupancy sensors should be specified with separated isolated relays.
- 5) Occupancy sensors shall be specified as the control method in all private offices, restrooms, classrooms, conference rooms, storage rooms and other enclosed areas of intermittent use.
- 6) Override wall switches or dimmers should be incorporated in offices, conference rooms, and classrooms. In any applications requiring occupancy sensor control, Penn requires that occupancy sensors operate in a “vacancy” or “manual on” mode utilizing a power pack or room controller controlled by a low voltage momentary wall switch or scene control device. Any other operating approach would require approval by the by University Engineering Department.
- 7) Dual Technology (infrared and ultrasonic/microphonic) sensors should be used in all room applications.
- 8) Follow manufacturer's recommendations for coverage specification and sensor placement.
- 9) Wireless sensors are allowed when battery life meets or exceeds a 10-year rated life and provide a low battery indicator.
- 10) No automatic lighting controls should be used in mechanical spaces with devices that without appropriate light levels would create a safety hazard.
- 11) The location of switch pack relays located above ceilings should be identified with a discrete label on the ceiling tile or access panel directly below the unit.
- 12) MRI room lighting system shall be direct current (DC).

- 13) Lighting control systems should be tested and calibrated by the Commissioning Agent for all projects.
- 14) Interior lighting controlled by relay panels for code required automatic shut-off shall have local override switches located at exits, entrances and accessible to occupants.
- 15) The contractor will be responsible for the programming of preset lighting control systems shall be coordinated with the University Engineering Department and building administrators. This includes providing factory trained technicians for programming and commissioning of the systems as well as training of personnel responsible for the upkeep of the systems as well as arranging a time conducive to both client and design team to meet and provide direction to the programmer. Factory technicians shall provide an after-occupancy follow-up programming, commissioning and training site visit for up to 12 months after installation. A record of the settings shall be provided to building administrator. Manufacturer service contracts should not be required for re-programming or maintenance of purchased control systems.
- 16) Acceptable manufacturers shall be by the following manufactures or approved equal by University Engineering Department:
 - a) Acuity
 - b) Hubbell
 - c) Wattstopper
 - d) Eaton
 - e) Leviton
 - f) Lutron (requires Engineering Department pre-approval)
- 17) Any exceptions to the above manufacturers must be approved by the University Engineering Department.