

A16.1 Standard of Practice - Emergency Lighting Systems

GENERAL

Designers shall verify that all applicable portions of these standards are incorporated into the project's design, drawings, specifications and final construction. Requests for variances from these standards shall be submitted in writing to the DCM Project Manager, using the KU Standards Variance Request Form found in [Appendix A1.1](#), for review and written approval or rejection as indicated on the form.

OBJECTIVE OF STANDARD

The University is concerned with its ability to protect building occupants from harm or injury upon loss of power to the lighting systems in egress pathways and assembly areas of campus buildings. Minimum requirements for emergency lighting systems that would allow safe exit from suddenly darkened building areas are given by the National Fire Protection Association *Life Safety Code*, NFPA 101.

In order to satisfy these requirements, it is the University's intent to provide each campus building with a centralized emergency lighting system utilizing an emergency generator. The emergency generator may also serve security systems, elevators, fire pumps, fire alarm systems, and similar equipment, as requested or approved by the University.

In general, egress lighting in accordance with NFPA 101, section 7.9.2.2 is required to be sensed at the branch circuit to activate the emergency lights. Therefore, if existing egress lighting circuits can not be isolated or organized by re-circuiting in a manner that is economical for sensing purposes, a normally "on" or "night light" system can be utilized. This night light system shall be designed to the minimum light levels possible for energy conservation and maintenance considerations.

It is the University's long term objective to provide similar and compatible central emergency lighting systems in all major buildings on campus.

An additional objective is to so specify and install these units that they may be remotely monitored for operational status as well as for periodic, code-mandated reporting data. All newly installed central emergency lighting systems shall be compatible with, and shall be installed to report to, the University's campus-wide BACS network.

BATTERY INVERTER SYSTEMS

Battery-based inverter systems have a history of being expensive and labor-intensive to maintain and are only allowed with specific direction from the University. The monitoring, testing, and maintenance demands that these systems place on facilities maintenance staff make it imperative that considerable forethought and planning precede system installation.

DESIGN PROCESS

It is the Designer's responsibility to prepare a code-compliant emergency lighting design. The Designer shall use the following guidelines in the completion of emergency lighting system designs on campus.

Limited Code Footprint: A limited code study and resulting graphic code footprint shall be completed by the consultant to determine egress paths within the building, if a pre-existing code footprint is not available. This should be developed per the applicable portions of the State Fire Marshall's code footprint criteria, and submitted for review and approval by the University and the State Fire Marshall's office. Assembly spaces with a calculated occupant load of over 50 occupants, all egress paths and the location of all required exits shall be identified. Existing construction type, allowable design criteria and other code information not specifically related to the establishment of egress paths will not be required to be included as part of this code study and footprint, on projects limited to the provision of a new emergency lighting system.

Performance: If existing lights are to be utilized for emergency lights, actual existing lighting levels shall be measured and existing footcandle levels shall be documented by the Designer to determine quantity and spacing of the emergency lights. At the conclusion of the project, egress lighting levels shall be checked during the commissioning and testing of the system to determine if lighting levels are within a reasonable range above minimum lighting levels as stated in the lighting criteria.

The University's experience, from previous completed projects, is that this range shall be an average of between 1 and 3 foot-candles, with a minimum level of .01 foot-candles and a maximum level of 20 foot-candles. A level of 20 foot-candles below any fixture would allow for a .5 footcandle minimum between fixtures, which stays within the 40 to 1 ratio as required by NFPA 101.

Design Criteria: The Designer shall use the following criteria as guidelines in evaluating and selecting a system with the appropriate functional performance for the specific project circumstances.

- Switched lighting system with normally-off capabilities:** This system would utilize existing lights that can be switched off at either a corridor wall switch or centrally timed controller. This would require control relays at each switch.

- Separate lighting system (centrally powered lighting packs):** This system would utilize bug eye lights or other decorative lights positioned correctly to yield light levels desired. This is normally-off lighting and would required control relays.

- ❑ **Always-on lighting system (night light system):** This system would re-circuit existing lights to a separate, (always-on) circuit connected to the inverter or emergency generator. In this system, it is imperative that the lighting levels be at the minimum design criteria since they will be on 24 hours a day. This is generally the most economical system since existing lighting circuits are not easily re-grouped for control purposes. This also keeps control relays to a minimum. They would only be needed in normally-off areas such as classrooms and lecture rooms.
 - ❑ Smart, self-diagnosing battery packs could be utilized in these situations if approved by the University on a case by case basis.

General lighting criteria:

- ❑ Emergency light fixtures shall be located in exit paths, assembly areas which may contain more than 100 occupants, or over 2,000 SF, and all other areas required by code.
- ❑ Emergency lights shall also be provided in electrical and mechanical equipment rooms.
- ❑ Emergency light fixtures shall be located in restrooms and all classrooms with occupancy of over 50, or over 1000 SF in area, if devoid of exterior windows. Normal classrooms and labs with exterior windows shall not receive emergency lights.
- ❑ Emergency lights in restrooms, if provided, shall be the minimum allowed by Code. If existing circuits cannot be isolated to switch a single fixture to the emergency lights, then a separate fluorescent fixture may be added.
- ❑ Emergency light fixtures shall be located at the exit doors and at intervals that are designed to maintain an average light intensity of 1 footcandle and a minimum light intensity of 0.1 footcandle at floor level in the exit path. In a normal 8-foot wide corridor it has been found that a 35 to 45 foot spacing for a typical 2 light T-8 fluorescent fixture is acceptable. This yields approximately 1 to 3 foot-candles minimum, which is 10 times code minimum.
- ❑ Emergency lights within stairwells shall be located at the mid-landing for most conditions. A simple test shall be done during design to determine if this yields the required lighting levels. New fixtures shall be installed where incandescent lights are existing.
- ❑ Control relays shall be fused.

Exit Sign Criteria: New exit signs shall be placed in all locations required by the Uniform Building Code.

- ❑ New exit signs shall be LED type, without flashing function.
- ❑ Areas of refuge, if any, shall be identified by exit signs connected to the emergency lighting system in compliance with applicable codes and the ADA. Text on the sign shall read "AREA OF REFUGE", and shall display the universal accessibility symbol.

SPECIFICATION DETAILS

The Designer shall use the following as guidance in the preparation of specification documents for installation of emergency lighting system equipment on campus.

General: An Integrated Life Safety System shall be furnished to provide a reliable source of power and shall operate during a utility line deficiency without interruptions of power to the load.

- The Integrated Life Safety (ILS) System shall be UL listed.
- Applicable codes and standards include UL924 Standard for Emergency Lighting and Power Equipment; UL1778 Standard Uninterruptable Power Supplies; and ANSI C62.41.

Emergency Generator: Natural gas is the preferred fuel source. When diesel generators are used, the fuel shall be # 2 diesel and the storage quantity shall be as small as possible and still meet code and maintenance requirements. Consult NFPA 110 for specific fuel requirements.

- Environmental air permitting is required for emergency generators. No construction work can begin on the project until the required permits are obtained. Permitting process is a minimum of six months.
 - Provide University with required data on the generator so that permit application can be submitted.
 - Generator sets shall be located to disperse exhaust fumes and noise without affecting the normal functions of the building and surrounding site.
 - Specify a method of damping vibrations to acceptable levels.
- The Designer shall specify that the manufacturer provides contacts for remote indication of generator status, alarm and shutdown, and battery charger alarm to the campus BACS network. Provide auxiliary contacts for remote indication of transfer switch position.

Centralized Inverter: Centralized inverter-based systems are ONLY allowed with specific direction or approval from the University. The transfer from utility power to battery power shall utilize a true no-break; sine wave output system to maintain a zero transfer time. The system shall be capable of powering any combination of electronic ballast; power factor corrected ballast, and self-ballasted fluorescent, incandescent or HID lighting, building management systems, and any other critical emergency or frequency-sensitive electronic loads. The systems shall operate loads at 0.5 lagging to 0.5 leading from 0 to 100% loading and shall be rated to deliver its full kW rating at unity power factor.

The system shall be completely microprocessor-controlled. Upon return of the normal AC utility line power, the system shall recharge the batteries within 24-hours without any interruptions of power supplied to the load. Upon an inverter failure, the load shall automatically connect to the AC utility line. Line power shall constantly pass through the ferroresonant transformer to provide continuous, on-line conditioned power.

The Designer shall include the following considerations in preparation of a central battery inverter specification:

- Unit on-line operation: Full load rectification and inverting.
- Provide integral bypass/isolation circuit breakers for all stationary hard-wired UPS equipment to permit servicing the unit without interrupting the load.

- Batteries:** The batteries will provide sufficient power to maintain the output voltage of the inverter for a period of 1.5-hours, maintaining 87.5% on nominal battery voltage. The batteries shall be enclosed in a cabinet that permits easy maintenance without requiring removal from it and shall be sealed Lead Calcium, VRLA (S) type. The batteries shall require no addition of water over the life of the battery. The case and cover shall be constructed of polypropylene, contain low-pressure safety release vents, and be non-gassing in normal use with 10-year, minimum design life expectancy.
 - Specify startup and acceptance testing including battery testing and full load test.
 - The design shall address the effect of input current harmonics on the distribution system and on standby generation equipment serving UPS units. In general, designs shall comply with the IEEE 519-1992 requirements for a "general system" at the point of common coupling between the UPS and the building distribution by the Designer.
 - Clearly specify sealed batteries with a minimum 10-year life expectancy. Require a straight pro-rated replacement agreement or better from the battery manufacturer.
 - Design shall address the environmental requirements for batteries. Provide ventilation and cooling of battery rooms and battery cabinets adequate to provide full life expectancy.
 - Batteries shall be arranged on racks or in cabinets to permit access to individual cell or unit terminals for testing and torque verifications. Each cell or unit shall be numbered to facilitate maintenance records.

- Acceptable Manufacturers:** The Designer shall edit ¶2.1 of specification section 16265 to reflect the following list of acceptable manufacturers:
 - Best-Lites; Best Power Technology, Inc.
 - Dual-Lite.
 - Hubbell Lighting Corp.
 - Lithonia Lighting, Emergency Lighting Systems.

- Local and Remote Monitoring:** The system shall incorporate both manual test function and automatic test modes. The user should be able to perform a system test at any time. The system shall also perform a programmable, weekly, self-diagnostic test of its subsystems to insure the system will operation in the emergency condition, a monthly test of a University-determined programmable discharge time (5-minute default), and an annual test for a University-determined programmable discharge time (90-minute default). Automatic recording in memory of recent inverter events, including all automatic weekly and user programmed tests, shall be logged.

- The Designer shall delete standard Masterspec® references to Instrumentation and Controls and Remote Alarm panel. In lieu of this standard specification, the Designer

shall specify that the installed Inverter be capable of integrating into the University's Building Automated Controls System (BACS) network. This integration requires connection to a Johnson Controls, Inc. Metasys® N2 bus, and may require a translation device known as a Metasys® Integrator.

- ❑ Additional guidance regarding the University's BACS is available in [Appendix A15.1](#), Standard of Practice - Building Automation Control System. The following table shows points that should be mapped by this system:

NPT	Description	NPT	Description
AI	AC Volts In	BO	System Mode – On/Off
AI	AC Volts Out	BO	Audible Alarm– Disable/Enable
AI	AC Line Current In	BO	Invoke Inverter Test
AI	AC Line Current Out	BO	Invoke Battery Test
AI	Output Load	BO	
AI	Battery DC Amps		
AI	Battery DC Volts		
AI	Frequency		
AI	Runtime Remaining		
AI	Ambient Temperature		
BI	Any Alarm		
BI	Inverter – On/Off		
BI	Charger – On/Off		
BI	Line Conditioning – On/Off		

- ❑ **Factory Startup:** The factory shall provide Field Service Technicians to inspect, energize, and thoroughly test the operation of the ILS system following installation and provide hardcopy reports of satisfactory performance. Following initial startup, the field service technician shall instruct Owner personnel in procedures necessary for proper operation, monitoring, programming, and maintenance.
- ❑ **Warranty:** The ILS system shall be guaranteed, under normal and proper use, against defects in workmanship and materials for a period of two years from the date of shipment.
 - ❑ Batteries supplied, as part of the ILS systems, shall be covered under a separate pro-rated warranty as described elsewhere herein.