Lighting Control Safety Tips

Lighting control technologies offer a wide range of options for saving energy—from motion detection and dimming to computer control of lighting systems. (See related article this issue, page 95.) Companies, under pressure to cut costs, are eager to install these systems to reap the energy savings benefits. In the rush to get systems installed, it is easy to forget about safety.

Frequently, lighting control technologies are being installed without regard to the proper short-circuit current ratings (SCCR) of the control equipment. Improperly applied, severe equipment damage, explosion—even injury or loss of life—can occur if a fault condition exists which exceeds the control device SCCR. All too often, designers and manufacturers offer little information in product brochures, catalogs, and instruction sheets as to the actual listed SCCRs of their products.

Here's The Problem
During a high-level short circuit, a tremendous amount of electrical current is generated. For many commercial applications, this fault current can easily exceed 10,000 amps, creating a rapid rise in the heat energy in the power circuit. This can create large electromagnetic forces which may cause damage to the electrical system.

There is often a mistaken assumption that branch circuit protective devices, such as fuses and circuit breakers, will prevent such damage from occurring. Properly selected and installed, circuit protection devices are designed to safely interrupt these fault currents. However, they may or may not protect the downstream equipment.

For instance, Underwriters Laboratories (UL) Standard 489, Molded Case Breakers and Circuit Enclosures, requires circuit breakers to clear a fault before excessive temperatures can damage the insulation of the conductors they are protecting. But this requirement refers only to the conductor's insulation. There is no provision in the standard to protect downstream components, such as lighting controls. So, while a circuit protection device can safely interrupt a fault and protect a conductor's insulation, improperly applied equipment can result in fire or shock hazards on equipment downstream.

What Protection Is Required?
The proper application of such control equipment is covered in the National Electrical Code (NEC) in Section 110-10, Circuit Impedance and Other Characteristics, applying to all components of the circuit. This includes any power switching devices—relays and contactors, occupancy sensors, even light switches and receptacles. All devices should be applied so that the available fault current will not exceed the device's established short-circuit current withstand ratings. For most wiring devices, the fault current available at the device will be limited by the circuit impedance, meaning the fault current is rarely a problem. However, when contactors and relays are located near or adjacent to the service entrance, sufficient short-circuit current may exist to cause serious damage or injury if the control equipment is misapplied.

Underwriters Laboratories (UL) provides various standards for determining the short-circuit current withstand ratings for electrical components. UL508, Industrial Control Equipment, presents a set of tests to determine the ability of a device to withstand a specified fault current for the period of time it takes an upstream branch circuit protective device to open and clear the fault. These tests also determine whether the contactor or relay will cause a hazard during the time the fault current is allowed to flow in the circuit. The procedures assure that there will be no fire, that the integrity of the mounting of live parts will not be impaired, and that the door of the enclosure will remain closed, preventing exposure of personnel to electrical shock, burns, and other injuries.

Some manufacturers of control equipment choose to list their products to UL916, Energy Management Equipment. This standard also includes a short-circuit test but is limited to only 1,000 symmetrical amperes. UL916 does not require this rating to be listed on or with the device.

Remotely controlled circuit breakers for lighting loads, designed to switch branch circuits using an integral motor or solenoid within the circuit breaker, must also meet the same requirements in UL489.

Design Safe Control Systems
When designing or installing a control system, safety comes first. Be sure you know the available fault current of the equipment you're installing and that the components you've selected have short-circuit ratings that exceed the prescribed level of fault current. The procedure for determining fault currents can be found in the Institute of Electrical and Electronic Engineers Standard 141 (The Red Book) or in IEEE Standard 241 (The Gray Book).

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When selecting components for the system, make sure the branch overcurrent protective device is of the type identified in the control device manufacturer's UL listing. This means that if the control device short-circuit current rating was established using a 30A class RK5 fuse, then the upstream overcurrent device must be the same amperage and fuse class. Likewise, if a circuit breaker of one manufacturer was specified in the short-circuit withstand rating, the the designer or installer also should require that the same manufacturer's circuit breaker be used. The use of any branch overcurrent device other than that used in establishing the SCCR cannot be guaranteed to protect the control device.

The safety requirements may modify the layout, design and cost of the distribution system. If fuses were used to establish the SCCR for a contactor or relay, then the upstream device must be the same type of fuse. Thus the common 42-circuit breaker panelboard will now have to be a 42-circuit fusible switchboard.

Another key problem arises when lighting control is packaged with the fixtures while the electrical power distribution gear is purchased separately. The specifying authority in this case must carefully state that the overcurrent devices provided with the gear be capable of protecting the control devices. The designer would be wise to consider specifying remote controlled circuit breakers as a cost- and space-saving alternative.

While energy savings and occupant productivity are primary concerns of a lighting control system, safety must come first. Designers and installers are advised to review the National Electrical Code and UL standards before specifying equipment which—if improperly installed—may cause serious damage and injury resulting from high fault currents.

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