SPECIFYING RELAY PANELS FOR LIGHTING CONTROL

I. Overview

Relay panels are the heart of many modern lighting control systems, facilitating sophisticated control solutions for energy savings and convenience. When specifying these systems, engineers often focus primarily on control features, considering the relay panels simply as commodity items. However, a building owner's satisfaction with the lighting control system, from its performance to its operating costs, can be affected significantly by the relays themselves and by the panel design. Relay and panel selections can impact reliability, flexibility, safety, security and maintenance as well as the sustainability of the building design.

When evaluating the relays that will perform the actual switching duties in a public space, engineers should consider not only the features of various relays, but the inherent characteristics of traditionally accepted mechanically held, latching relays compared with the newer electrically held relays. This paper points out areas of operations that can be affected by relay selection and illustrates why the careful specifier will best serve the owner by choosing mechanically held, latching relays and requiring specific features for flexibility and modularity. The discussion is confined to key spec points and code requirements to consider when evaluating relays and panels and does not extend to controls.

II. Energy Consumption

Most relay panels are installed to save energy, so it is important to consider the power consumption of the panel. Surprisingly, many people fail to do so, and can waste a significant amount of energy as a result.

The mechanically held, latching relays installed in lighting control panels use two coils, and one or the other is energized momentarily to open or close the contacts. This fundamental design is extremely energy efficient. The relays draw power only when a coil is energized in response to a command to change state, thus they generate little heat, are inexpensive to operate and are inherently green devices.

Electrically held relays, as the name

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implies, use electricity to maintain closed contacts, so they draw power continuously whenever the associated load is on. While this power draw is just a couple watts per relay, the total draw of a full panel, or multiple panels, becomes significant. Just one 48-relay panel can draw over 100 watts. That's the same as burning an extra 100-watt light bulb for every panel, whenever the lighting is on, and there is no performance benefit derived from this extra energy use.

Clearly mechanically held, latching relays are the better choice from a sustainable or green building perspective, and building owners will appreciate the utility savings and associated lower operating costs.

III. Life Safety

When designing a control system, care should be taken to specify products that will most reliably keep lighting on when it is needed. Mechanically held, latching relays provide a clear advantage from this standpoint because the relays remain in the last switched state whether or not power is present. If the power supply for a relay panel fails or is accidentally turned off, but power is still available, mechanically held, latching relays will not change state. Any lighting that is on at the time will remain on and building occupants will not be left in the dark or endangered. Unless they need to change the lighting, they will not be inconvenienced or aware of a problem.

Conversely, if a power supply on a normally open electrically held relay panel fails or is shut off, all the lighting controlled by that panel will immediately go off. At the very least this will be disruptive to building occupants. There may also be financial consequences due to lost productivity, especially if the problem is not quickly corrected.

Depending on the design of the emergency lighting in the building, such a failure could leave an area entirely dark, threatening security and life safety. Buildings at risk would certainly include those using unit emergency equipment, but could also include facilities with transfer systems, depending on the details

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of the design.

Because of their inherent design characteristics, mechanically held, latching relays provide optimal reliability. This makes them an obvious choice when life safety is a consideration.

IV. Ability to Override

Both building owners and contractors find it beneficial to have relays that can be manually overridden. Before controls are installed, a manual override allows lighting to be turned on for use or testing during construction. After system commissioning, an override can help maintenance personnel work around any electronic component issue, minimizing inconvenience to building occupants.

Many high quality mechanically held, latching relays can be manually overridden using an actuator on the relay itself. Panels employing electrically held relays often include a provision to override the controls, but this may not offer all the same benefits as the overrides on latching relays. An override for electrically held relays requires that the power supply for the panel be operational or it will not work. Additionally, the override may not be for each individual relay.

Specifiers wishing to ensure the most flexible relay panel system will include requirements for individual relay overrides that will function even in the absence of a panel power supply.

V. Maintenance Considerations

Lighting loads are harsh. Modern electronic ballasts are the source of significant inrush currents during startup, and if the relays that are used to switch these loads are not robust, they will fail prematurely. NEMA Standards Publication 410-2004, "Performance Testing for Lighting Controls and Switching Devices with Electronic Fluorescent Ballasts," was developed to help manufacturers of control devices test their equipment, and be confident it can withstand the kinds of conditions that exist in the field today. To ensure system longevity, specifiers should require that relays used in lighting control panels be tested to this NEMA standard.

Of course no matter how rugged the

relay, there are bound to be occasional failures. When this occurs, the design of the panel will affect the cost of maintenance, in terms of both parts and labor. A modular panel should be required to facilitate maintenance and, ideally, the design should allow relays to be replaced individually. It is also preferable to be able to replace relays without having to replace any other components.

VI. Short Circuit Current Ratings

In its 2005 version of the National Electric Code, the NFPA (National Fire Protection Agency) added a new article, "Article 409 Industrial Control Panels." The main goal of this article is to prevent danger from the misapplication of control panels and it focuses on the safe design, application and inspection of panels. To ensure safety, it requires short circuit current rating (SCCR) markings on equipment and components and requires proper installation of appropriately rated equipment.

Article 409 does not specify a particular SCCR level. Rather, it requires that a system be engineered so that the available fault current at a given device cannot exceed the rating of the device. Because line impedance reduces the available fault current quite dramatically the necessary SCCR will vary widely at different points in the system. The engineer must therefore consider the length and gauge of the wire between the circuit breakers and the relays when calculating the available fault current at the relays.

In practice, relays with an SCCR of 14,000 amps are suitable for virtually all lighting control applications since the relays will be likely be installed adjacent to branch circuit breakers having interrupting ratings of 14,000 amps at 277 volts or 10,000 amps at 120 volts. Only in a case where the associated branch circuit breaker has a rating above 14,000 amps will additional consideration need to be given to the installation. However, in most cases this is minor because even the short run of wire required to connect relay panels to adjacent breaker panels negates the need for relays with ratings equal to the available fault current at

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the breaker panel, as the current would be substantially less when it reached the relays. For example, it would require less than seven feet of #12 AWG interconnecting wire to allow relays with an SCCR of 14,000 amps to be used safely with a breaker panel equipped with branch breakers rated for 22,000 amps. In some cases, relays with an SCCR below 14,000 amps would be acceptable, but as a rule of thumb relays with ratings below 10,000 amps are likely to provide insufficient protection or require unwieldy lengths of cabling. Relays with a higher than necessary SCCR rating do not provide any additional benefits to the system.

VII. Conclusion

Under ideal conditions, light duty electrically held relays will perform adequately in lighting control panels, but over the lifetime of most installations such components are very likely to adversely impact the utility of the system. Many manufacturers use electrically held relays on their standard products, but will provide heavier duty mechanical relays when required to do so.

To ensure a robust and reliable lighting control system engineers must be certain that the relay panel itself is properly designed to function as the workhorse of the system. They should specify mechanically held, latching relays, tested to NEMA 410, with a manual override switch, a quick connect plug and an appropriate SCCR rating and not accept electrically held relays. There may be a slightly higher initial cost, but lower operating costs and greater reliability warrant the possible upfront investment by providing benefits to the building owner over the life of the system.