
30-Cycle Transfer Switches Simplify Selective Coordination

By John Stark

Overview

Recent changes to the National Electrical Code[®] (NEC) require the selective coordination of overcurrent protective devices at hospitals and other mission-critical facilities. Transfer switches with 30-cycle closing and withstand ratings dramatically simplify designing to that requirement.

Selective Coordination Requirements

Selective coordination was first required by the NEC in 1993 for elevator circuits. Amendments to the Code in 2005 and 2008 strengthened the requirements and expanded them to include emergency and legally required standby systems, as well as critical operations power systems (COPS).

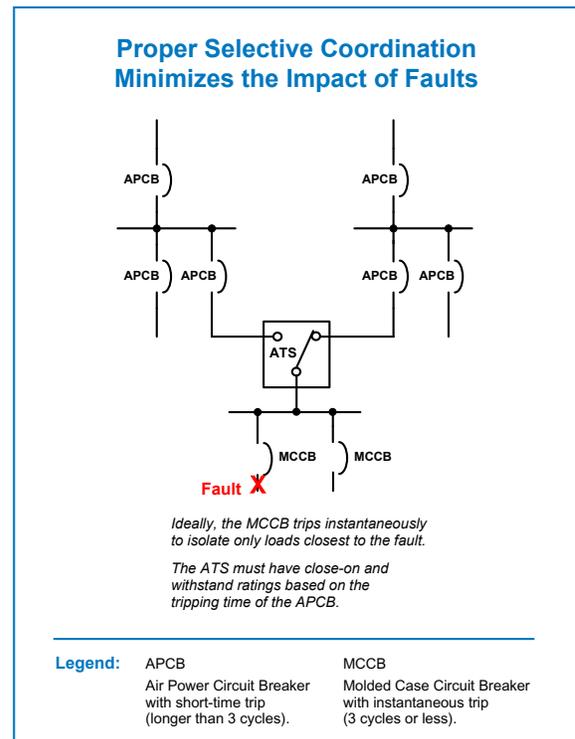
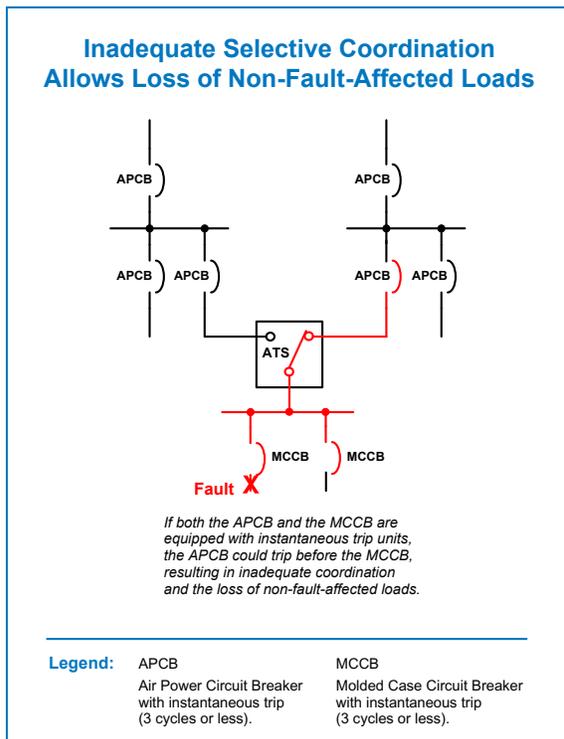
Selective coordination, as defined in the 2011 NEC, Article 100, is the “localization of an overcurrent condition to restrict outages to the circuit or equipment affected, accomplished by the choice of overcurrent protective devices and their ratings or settings.” It is a complicated process of coordinating the ratings and settings of overcurrent protective devices, such as circuit breakers, fuses, and ground fault protection relays, to limit overcurrent interruption (and the resultant power outages) to the affected equipment (on the smallest possible section of a circuit). In other words, in a perfectly coordinated power system, the only overcurrent protective device that should open is the device immediately “upstream” from the circuit/equipment experiencing an overcurrent condition.

UL Standards and Testing

Underwriter Laboratories (UL) Standard 1008 is the industry-accepted standard that establishes the criteria by which automatic transfer switches are listed. The listing process includes passing tests for closing and withstand short-circuit values. Switches may be listed under several different testing protocols, including:

- Testing with a specific overcurrent device so that the listing is dependent on use of that device or another with identical or faster time/overcurrent curves. While this approach makes it easier for the manufacturer to pass testing, it actually complicates the process of selective coordination for the design engineer.
- Testing for a 3-cycle fault duration. A switch passing this test is considered to be coordinated with any molded-case circuit breaker capable of interrupting the test closing and withstand value. This test is more stringent, but in no way simplifies selective coordination.
- Testing for a specific amount of time beyond 3 cycles to establish a short-time rating. To pass this test, a switch has to close in on and withstand a fault current for the specified test duration. Close and withstand for 30 cycles is considered to be coordinated with any circuit breaker having only short-time overcurrent protection (not instantaneous). A 30-cycle-rated switch therefore eliminates a host of coordination considerations and dramatically simplifies the entire selective coordination process.

If transfer switches are being protected by circuit breakers with short-time overcurrent protection only, and the switches have only 3-cycle closing and withstand ratings, they are not properly coordinated with their protective breakers. Under these circumstances, transfer switches with 30-cycle ratings are needed to properly coordinate.



Error and Trial

Selective coordination is best done on the drawing board, at the beginning of the design process. Although achieving genuine, documented selective coordination as defined by the NEC can be time-consuming and expensive, flawed selective coordination is even more so. To comply with requirements, a selective coordination plan must consider — for every pertinent circuit — the full range of maximum available overcurrents, including overloads, all types of faults, and short circuits. As daunting as the process is in theory, it is even more difficult in practice, complicated by differences in the ratings of overcurrent devices from one manufacturer to another. Obviously, choosing a supplier who offers a full line of sizes of a particular device, whether protective device or transfer switch, also makes the coordination process much easier.

Many contracts and code enforcement authorities require a study to evaluate the pertinent circuits and confirm that the protective devices have been selectively coordinated. Performed after construction, such studies are a minefield for systems that were not designed carefully in the first place. Once a system has been determined to be non-compliant, redesigning it and replacing various components can be extremely costly and time-consuming. Even if proper protective devices are installed as a corrective measure, the cable, bus, or conduit ratings may not be adequate. Or a higher-rated transfer switch or new panelboards may

be needed, requiring extra mounting space. Since a change to one component often affects others, new calculations are necessary to see what else must be replaced. Such retrofitting to obtain a certificate of occupancy is a design engineer's nightmare.

Numerous modifications of the NEC requirements have been adopted by local and state governments with varying degrees of enforcement, but let designers be forewarned: It is far better to err on the side of too much protection than not enough. The specifier might be called upon to prove that the time-current curves for circuits in his/her selective coordination scheme comply with the NEC by not overlapping at the available fault current. Even in a locality where selective coordination requirements on the books are not enforced, a specifier and his/her engineering firm could be found liable for injuries suffered due to inferior selective coordination — for the life of the building! So, needless to say, selective coordination should also be done with an eye toward future changes in or the expansion of the power system.

Hold That Line

In a selectively coordinated electrical system using circuit breakers, the breaker for every load circuit must have the proper ratings, interrupting capacity, and settings for the point at which it is installed, based on the highest potential overcurrent from either power source (normal or backup). Progressing "upstream" through the circuit paths, from the smallest load branch circuit all the way to the normal and backup power sources, the specifications of a true selective coordination plan must ensure that every circuit breaker has a higher overcurrent rating and a longer time-delay than the one below it, so that every overload/fault will be cleared by the breaker farthest "downstream" (the breaker immediately "upstream" of the problem).



Certain manufacturers offer both 30-cycle-rated transfer switches and 30-cycle-rated bypass/isolation switches.

Today, most transfer switch designs have only 3-cycle closing and withstand ratings. The ability to withstand fault current for 10 times that duration (one-half second) necessitates that 30-cycle transfer switches are mechanically stronger by orders of magnitude. Because of its function — switching from normal to backup power and back again — a transfer switch is obviously in a key location, and its ability to withstand a fault condition is vital to supply power to the served load. In the event of a fault, a transfer or bypass/isolation switch that can withstand 30 cycles of overcurrent is like a sturdy defensive lineman in a football game. Holding the line long enough to allow the coordinated overcurrent protection to interrupt the fault, a 30-cycle switch assists in protecting downstream equipment, such as expensive medical devices.

Another major benefit of 30-cycle transfer switches is the extra capacity they provide for later expansions of electrical systems. The design phase of a renovation that upgrades available fault current or replaces overcurrent protective devices will proceed more smoothly if 30-cycle switches are already installed. For example, many hospitals are upgrading their power systems to supply backup power to more loads. In the past, the typical hospital backup system covered only NEC-required essential loads (typically only 25-30% of the hospital's total connected load). Recently, the trend is to add the hospital's HVAC system to the backup system to reduce patient discomfort (and perhaps even save lives) in the event of an extended outage. Medical imaging machines are also being added, and as hospitals transition to electronic medical records they often wind up creating their own mini data centers, where computers must not crash. Today, a hospital's standby electrical load can be as much as three times what it used to be - 75% or more of its total connected load.

Another example is today's data centers, many of which are being designed and built on a modular basis. Through the selection of and standardization on specific types (and even brands) of servers, cooling equipment, etc., data center designers have significantly simplified the process of modifying these facilities to accommodate changing needs, or expanding them to accommodate growth. Yet, if the selective coordination process is based on current needs only, there will be little flexibility in the power control system for such changes or growth. And ensuring that the power system complies with selective coordination requirements after it has been reconfigured or expanded may require far more time, effort, and expense than the changes themselves. In many cases, investing more today in equipment that exceeds current requirements will dramatically simplify selective coordination efforts that result from future growth.

Proceed With Caution

Several things should be taken into consideration when selecting a 30-cycle transfer switch. With the right switch, the additional security and system design simplicity offered by a 30-cycle closing and withstand rating can become reality. Asking a few important questions can make a difference.

Does the manufacturer offer a full line of 30-cycle transfer switches? If so, the specification of a switch is simply a matter of its continuous current rating and is not complicated by gaps in the manufacturer's product line, or by the necessity of specifying a much higher continuous-rated switch than the circuit would normally require.

Has the 30-cycle transfer switch been tested according to UL standards, and is it UL listed and labeled? The switch's closing and withstand rating must be a performance value based on actual testing to UL Standard 1008. Because the 30-cycle closing and withstand test is optional under UL-1008, specifiers and purchasers of 30-cycle switches should carefully scrutinize the presentation of any manufacturer's 30-cycle ratings to be certain that they are based on actual testing by UL and that the switches are UL listed and labeled. This listing must include a close-on rating. Withstand ratings without concurrent close-on ratings are not adequate.

Cost is always a consideration in the choice of any piece of equipment. In the final analysis, however, a transfer switch is a key component in an emergency/backup power system designed to protect lives and/or vital assets. Since the switch serves such a critical function in the system — for both normal and emergency loads — and since the potential losses from any malfunction are so great, the cost of the switch should be secondary to its performance. With this in mind, system designers and owners should insist on the best switch they can find. And given the robustness of its design and construction and its proven ability to withstand 30 cycles of punishment, a 30-cycle-rated switch makes perfect sense.

Conclusion

The 30-cycle transfer switch holds tremendous promise as perhaps the single most cost-effective and simple solution to the complex challenges of selective coordination. The right 30-cycle switch can simplify a backup power system's design and offer more reliable protection. Plus, it provides unmatched flexibility for future system upgrades and expansion.

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