

NEC Changes that have Impact on designs

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Changes to the National Electrical Code (NEC) always result in adjustments to products or applications within the industry. The low voltage electrical distribution segment of the industry has never been immune to new code requirements, but four recent changes have had more impact than most of us can remember.

Arc-Fault Circuit-Interrupters

The 2005 NEC mandated that a new kind of protective device that was required be used in certain locations of dwelling units. The Arc-Fault Circuit-Interrupter (AFCI) can recognize characteristics unique to arcing and open the circuit when a fault is detected. The 2008 NEC expanded the requirement to virtually all branch circuits within a dwelling except those that are protected (as required by NEC) by Ground-Fault Circuit-Interrupters. The 2008 NEC also mandated a new type of AFCI. This new "combination type" has the ability to detect arcing faults that are either "series" or "parallel" providing an even higher level of protection. More Information on GE Arc-Fault Circuit-Interrupters can be found in publication DEA-437A that can be downloaded at:

<http://www.geindustrial.com/publibrary/checkout/Brochures|DEA-437A|generic>

In general, the result of this change has been a significant increase in the size, complexity, and price of the load center in a new dwelling.

Branch Circuit Panelboards

In previous editions of the NEC, section 408.14 defined two classes of panelboards. Power panelboards had less than 10 percent of their overcurrent devices serving lighting and appliance branch circuits. All others were designated as lighting and appliance branch circuit panelboards and these panelboards were limited to 42 circuits by section 408.15. In the 2008 NEC, both sections have been removed. In response to this change, lighting and appliance panelboards with more than 42 circuits are showing up on construction projects.

Although there is obvious benefit in having panelboards available with more circuits, many in the industry are concerned about the long-term effect of this change. Old timers remember the days before these sections were written into the NEC, when the "rats nest" of wire emanating from all those branch circuit devices severely hindered additions or modifications to panelboards.

Selective Coordination

Selectivity means that only the protective device closest to the overload or fault trips. Traditionally, selectivity has been an important consideration for all electrical distribution systems but has been of greater concern for:

- 1) Emergency systems, elevators, and standby systems.
- 2) Critical industrial processes.
- 3) Data centers and other data processing applications.

When one examines a typical electrical distribution system, one usually sees large fuses or circuit breakers feeding multiple smaller fuses or circuit breakers. In most cases, these devices are selective for overloads and most faults. Traditionally, many people in our industry have accepted a definition of selectivity that ignored very large faults and focused on selectivity starting 0.1 seconds after the fault occurrence. This definition is widely accepted because:

- 1) Very large or “bolted” faults are also very rare.
- 2) The price tag for selectivity for these very large faults is extremely high.

The 2005 edition of the NEC added the requirement for selective coordination of legally mandated emergency and standby systems. It did not give a definition of selectivity leading many to the conclusion that a new stricter standard had been mandated while others continued to view the traditional definition of selectivity as correct. The 2008 NEC expanded the requirement to other critical applications such as homeland-defense related facilities but did not offer any more of a definition. This controversy has continued for over 5 years and will likely continue. In the last 18 months, we have seen various enforcement jurisdictions either endorse or reject the requirement for the stricter definition while others have no set policy and allow the local authority to make the call. Further complicating the situation is confusion over the “normal” or “utility” protective devices that feed transfer switches that are also required to meet the stricter selectivity requirements. The current situation is very difficult for design engineers working on projects in multiple jurisdictions and many have found that they are “on their own” as to how they should proceed. The best advice we can offer is communicate with the authority that will have jurisdiction “early and often” to avoid a redesign at the last minute.

Faced with the above, manufacturers of protective devices have been developing new products and application methods to deal with the stricter definition. In general, engineers attempting to achieve selective coordination are advised to consider the following actions:

- (1) Reduce available fault current (increase generator impedance or add current limiting reactors).
- (2) Eliminate all lower ampere-rated devices up-stream in a system (even when higher ampere-rated devices would not otherwise be required).

- (3) Consider using a new type of circuit breaker/trip unit that includes the intelligent waveform recognition feature for devices up-stream in a system.
- (4) Minimize the number of protective devices between the source and the load. Eliminate main circuit breakers in panelboards.
- (5) Use only specific “selectivity tested device combinations” in the system.

GE has developed a new series of “look-up” tables that provides combinations of circuit breakers that, under the right conditions, will be selectively coordinated for all overloads and faults. These tables can be found in publication DET-537. To use these tables, it is necessary to perform a complete short circuit study of the system since available fault current is a critical value in determining selectivity. GE has also developed a design tool called InstaPlan. This tool allows the accurate and quick selection of circuit breakers based on their potential for being selective up to the full theoretical bolted fault value where they are applied in a system. GE has published publication DET-654 Guide to Low Voltage Design and Selectivity which examines this topic in much greater depth.

These publications as well as InstaPlan can be downloaded at:

http://www.geindustrial.com/solutions/engineers/selective_coordination.html

GE has developed a new trip unit with intelligent waveform recognition. This trip unit, the EntelliGuard TU, can be set to overlap the instantaneous trip of many downstream protective devices while maintaining full selectivity. When necessary, a circuit breaker equipped with the EntelliGuard TU will trip in less than 3 cycles providing superior arc-flash mitigation. More Information on this new trip unit can be found in publication DEA-461 that can be downloaded at:

<http://www.geindustrial.com/publibrary/checkout/Brochures|DEA-461|generic>

Generator Switchboards

The 2008 NEC includes a new requirement [700.9(B)(5)] for switchboards that are fed directly from a generator or other alternate power source and distribute power to emergency, legally required, and optional standby systems. This new standard requires that each feeder from this type of switchboard must originate from a separate section. Switchboards used in this type of application must now be constructed with only one protective device (circuit breaker or fused switch) per section. The effect of this change has been a substantial increase in the size of this type of equipment, which has forced the redesign of electrical rooms that were sized under the previous standard.

Compounding the problem, Stricter Selective Coordination requirements have resulted in higher ampere ratings for many of the protective devices in these generator switchboards resulting, in some cases, in wider and/or deeper sections.

One solution may be to eliminate the Generator Switchboard all together and use individual enclosed devices that do not have to be at the same location. This solution may be worth considering for smaller projects with limited emergency systems but is not practical for large projects.

Summary

There are always changes to the NEC and it is important that the designer is aware of the changes and complies with them. I hope this condensed article is useful when understanding some of the various requirements. These are important areas to be aware of and consider when designing your electrical systems.