Arc-Fault Circuit Interrupters Spark Controversy

By Don Tuite August 16, 2007

The United States' National Electrical Code (NEC) recently expanded Arc-Fault Circuit Interrupter (AFCI) requirements *(see "Arc-Detecting Circuit Breakers Will See Wider Use" at* www.electronicdesign.com, *ED Online 15682)*. This decision led to some passionate mail from *Electronic Design* readers who said that AFCIs saved them from disaster or were totally incompatible with small appliance motors (see the figure).

Ordinary circuit breakers trip on gross faults. Ground-fault circuit interrupters (GFCIs) trip on an unbalance between line and neutral. But AFCIs trip on arcs. They're now required for circuits in bedrooms and other critical areas in new houses, and as of 2008, they will be required throughout new homes.

AFCIs detect in-line arcing and arcing between phases and between phase in neutral. Ordinary circuit breakers have relatively slow tripping times that may not catch arcs.

But AFCIs are supposed to respond to digitized current signatures that characterize dangerous arcs while ignoring arcs in appliance motors.

SAVED THE HOMESTEAD

Milan Trcka is an EE at an engineering design firm that specializes in medical equipment. While he was adding on to his 1953-vintage house, he had to relocate the main service panel. The inspector accepted everything without question. The only requirement was to add AFCIs to the bedroom sockets. So, Trcka decided to upgrade both socket and light circuits. He was skeptical of the usefulness of AFCIs to begin with. Immediately after the installation of two $36 breakers, one started popping.

"I read all the available information on the Web running into all manner of grousing, but I also saw an article explaining what the breaker is and what it does. Encouraged, I started looking for the culprit. On and off it took me two weeks to separate the circuits to discover that an improperly installed GFCI socket in the bathroom (on the bedroom socket circuit) compressed the hot wire against the grounded socket box," he said.

"Old Romex insulation fractured, crumbled, and allowed arcing to the box. I do not know how long this condition lasted, but now it is fixed," he added. "In six months, neither of the two breakers disconnected. I am a convert and I would encourage retrofitting AFCI breakers, especially in older installations."

FALSE-TRIP NIGHTMARES

Then, there's the other side of the issue. "Last October, my wife and I purchased a new house that had AFCI breakers connected to circuits to the bedrooms per the current NEC," said Joe Blaschka Jr., PE. The AFCI breakers were manufactured by one of the major U.S. manufacturers of electrical panels and switching equipment. Blaschka expected them to be of high quality and designed correctly.

Once the Blaschkas moved in, they tried their top-of-the-line vacuum cleaner, which was several years old but in good condition. But using the vacuum opened the breaker so fast, the motor didn't even have a chance to get started. It was virtually instantaneous. Yet when they plugged the vacuum into another outlet that was protected by a standard thermal breaker, it worked fine.

Blaschka said that in his house, the outlets in the bedrooms as well as those in the hallways in the bedroom area are AFCI-protected. So, powering the vacuum from an outlet that doesn't have an AFCI is generally inconvenient.

There is plenty of documentation on the Web describing botched installations and pre2005 AFCIs that were recalled. But Blaschka isn't Joe Homemaker. He's a licensed Professional Engineer. He said he had detailed conversations with the AFCI manufacturer, who simply blamed the vacuum maker.

ENGINEERING A SOLUTION

In the end, Blaschka bought a new vacuum for the bedrooms, and it only creates false AFCI trips 10% of the time. But that's not a very satisfactory end. Evidently, AFCIs provide safety, but they also have a threshold problem. Could universal appliance motors be fitted with low-pass filters? Would they work? Is there an aftermarket for external LP filters?

CONSUMER EDUCATION

The general public really hasn't been getting the word about AFCIs. It's still hard to find much consumer-directed online information about true and false tripping.

One poster on a consumer-forum thread described how one AFCI in his new house seems to be tripping at random. "I could not find a pattern," he wrote. "Sometimes it would be once a day while I was out at work, and then it would be weeks before it would trip again. Sometimes, it could be twice in a day."

And all of this essentially happened without any loads on the circuit. Other posters responded to tell him to replace his AFCIs with ordinary breakers. Considering Milan Trcka's email about his poor, crumbling insulation, perhaps it's time for this poster to start opening up his drywall!