

Stopping Fires before They Start: The Arc Fault Circuit Interrupter Standard

Background

During the twentieth century, the safety of household electricity and wiring improved greatly. However, according to the U.S. Consumer Products Safety Commission (CPSC), problems such as electrical arc faults were associated with more than 40,000 home fires, claiming over 350 lives and causing 1,400 injuries annually.

An arc fault is an unintended electrical arc which occurs when current flows through an unplanned path, perhaps caused by a break in the wiring. Arcing creates intense heat, sometimes over 10,000 degrees Fahrenheit, producing burning particles that can easily ignite surrounding material such as wood framing, insulation, or carpets. Often arcing occurs in wiring behind walls or in other places where it cannot be detected easily. Typical household fuses and circuit breakers do not detect low-level hazardous arcing current. By the time these conventional devices open a circuit to defuse unintended arcing, a fire may have already begun.

In 1992, the CPSC asked the electrotechnical industry to make the creation of a protective device that would reduce fires generated by arc faults a priority.

Problem

The CPSC's research revealed that arc faults are a significant hazard that can lead to residential fires. They challenged the industry to develop a product that would respond to these conditions and reduce resulting electrical fires.

The electrotechnical industry needed to develop a device that could control and reduce the effects of arc faults in dwellings. Then, the industry and public safety organizations would work to include the product in the requirements of the electrical code.

Approach

In the mid 1990s, the Molded Case Circuit Breaker (MCCB) Section of the National Electrical Manufacturers Association (NEMA) initiated a project to respond to the CPSC's concern. John Young of Siemens Energy and Automation began by creating a straw man proposal, based on UL 498, Ground Fault Circuit Interrupters. A straw man is a rough draft with many but not all key aspects of the proposal. It is meant to kick off project discussions and begin the development process. For two years, the task force met regularly working on a safety proposal for an Arc Fault Circuit Interrupter (AFCI).

An AFCI uses advanced electronic technology to continuously monitor current flow. When arcing occurs, the AFCI uses unique current sensing circuitry to analyze its characteristics and determine if it is an unwanted, potentially hazardous event. When the

AFCI detects an unwanted arcing condition, its control circuitry trips the internal contacts, de-energizing the circuit and reducing the potential for igniting a fire.

When the task force completed its AFCI standard proposal, the MCCB Section approved the draft standard, then sent it to a NEMA Joint Sections Committee. Representatives from the Flexible Cords, Fuse, Wiring Device, Ground Fault Personnel Protection, Panelboard and Distribution Board, Steel Rigid Conduit and EMT, and Switch Sections contributed input to the final draft. Next, the Codes and Standards Committee authorized submittal of the standard as a NEMA proposal and it was sent to Underwriters Laboratories in October 1997.

Underwriters Laboratories, Inc. (UL) is an independent product safety certification organization that has been testing products and writing safety standards for over a century. In 1998, UL began working with NEMA, manufacturers, and other interested parties to form an Industry Advisory Group (IAG) that would develop a Standard for Safety for AFCI products. The following February, UL published the first edition of the Standard for Safety for Arc Fault Circuit Interrupters – UL 1699.

UL 1699 provides safety testing requirements and some construction requirements for AFCIs. It contains the information necessary for a certifier to test an AFCI and determine whether it meets the minimum acceptable safety requirements. UL 1699 also tells the manufacturer of an AFCI how the product should perform. The tests that demonstrate the effectiveness of an AFCI in detecting and protecting against arcing are unique and were developed specifically for UL 1699. An AFCI that passes certification can display the UL Mark.

While AFCI development and certification were underway, proposals reached the National Fire Protection Agency (NFPA) to include AFCIs as a requirement in the National Electrical Code (NEC), the model code for electrical wiring. The NFPA recognized the value of AFCIs and added them to the 1999 NEC requiring AFCIs in residential bedroom circuits effective January 1, 2002.

Outcome

Fire protection and safety organizations have recognized the effectiveness of AFCIs in preventing fires. Organizations ranging from those named already in this case to the Electrical Safety Foundation International, National Electrical Contractors Association, US Fire Administration, National Association State Fire Marshals, and National Association of Home Inspectors support using AFCIs and including them in the NEC.

By 2005, the NEC required installation of combination AFCIs, which respond to both parallel and series arcs, for all electrical circuits that supply electrical outlets in the bedrooms of new homes by January 1, 2008. The 2008 edition of the NEC, published in September 2007, expands the use of combination AFCIs beyond bedroom circuits to other areas of a home, including family rooms, dining rooms, living rooms, parlors, libraries, dens, bedrooms, sunrooms, recreation rooms, closets, hallways, and similar

rooms. The CPSC has submitted a proposal for the 2011 NEC to include the same requirements for mobile and manufactured homes because “the fire death rate is roughly twice as high in manufactured homes ...and electrical distribution equipment continues to be one of the leading causes of manufactured home fires.”

As studies continue to prove the effectiveness of AFCIs in reducing electric fires, their use is likely to continue expanding.