

2-65 - ( 210-11(b) ):

**Submitter** Dan Leaf  
Palmdale, CA

**COMMENT ON PROPOSAL NUMBER:** 2-85

**RECOMMENDATION:**

Accept in principle revised:

(b) Load evenly proportioned among branch circuits. ~~Where the load is computed on a volt amperes/square foot (0.093m<sup>2</sup>) basis the~~ wiring systems up to and including the branch-circuit panelboard(s) shall be provided to serve not less than the compute ~~calculate~~ load. This load shall be evenly proportioned insofar as practicable among ~~multiwire~~ branch circuits within the panelboard(s). Branch-circuit overcurrent devices ~~and circuit~~ shall ~~need~~ only be required to be installed ~~to serve the connected load~~ for circuits installed

**SUBSTANTIATION:**

My proposal substantiation was unclear re: VA per circuit loads such as small appliance circuits, laundry circuits, sign circuits to be included with the va/sq. ft. load. The intent is to indicate they should be included in the evenly proportioned requirement. The requirements in the present text are limited to circuits covered by the second sentence. The requirement for adequate systems should not be limited to loads computed on a va/sq. ft. basis. This should apply to those computed on a va per circuit and nameplate loads. Why does the text require balanced load only for multioutlet circuits? This should apply to single outlet circuits also.

Branch-circuit overcurrent devices should only be required to be installed where circuits are installed whether there is a "connected" load or a "computed" load.

**PANEL ACTION:**

2-66 - ( 210-12 ):

**Submitter** Technical Correlating Committee National Electrical Code

**COMMENT ON PROPOSAL NUMBER:** 2-103

**RECOMMENDATION:**

It was the action of the Technical Correlating Committee that this Proposal be referred to Code-Making Panel 17 for further consideration in Article 517. This will be considered as a Public Comment.

**SUBSTANTIATION:**

This is a direction from the National Electrical Code Technical Correlating Committee in accordance with 3-4.2 and 3-4.3 of the Regulations Governing Committee Projects.

**PANEL ACTION:**

2-67 - ( 210-12 ):

**Submitter** Bernard A. Schwartz  
Schwartz Fire Specialists

**COMMENT ON PROPOSAL NUMBER:** 2-104

**RECOMMENDATION:**

After "...January 1, 2002" insert:

"or purposes of this section, the installation of an arc-fault circuit interrupter at the receptacle with all receptacles in the bedroom supplied through that protected receptacle shall be deemed compliant".

The original proposal should be accepted.

**SUBSTANTIATION:**

1. Available fire data indicate that although electrical fires do represent a significant part of the total fire problem, fires occurring along the straight run of wire from the load center to the receptacle represent only a minuscule percentage of that total. The receptacle device is designed to provide a much higher level of protection than the load center device for items that are connected to the receptacle and would therefore provide a higher level of protection and prevent the occurrence of a significantly larger amount of fires. The Underwriters Laboratories Inc. Standard for Safety for Arc Fault Circuit Interrupters (UL 1699) currently recognized four types of AFCI devices (Branch Feeder, Cord, Outlet Circuit and Portable). The NEC panel only recognizes the Branch Feeder ARC-Fault Circuit Interrupter.

2. The arc fault detection tests are listed in Table 50.2 of UL 1699. This table indicated that the branch feeder AFCI is to be subjected to:

- U.L. section # 56.2 Carbonized path arc ignition test
- 56.3 Carbonized path arc interruption test
- 56.5 Point contact arc test, unwanted tripping tests, load
- 57 Unwanted tripping tests
- 58 Operation inhibition

3. The receptacle type AFCI is tested to all of the same tests to which the branch feeder AFCI is tested plus the Carbonized path arc clearing time test (U.L. section #56.4). It is important to note that the carbonized path arc interruption test is conducted at a current rating of 5 amperes while the point contact arc test is conducted at currents that range from 75 to 300 ampere. The sensitivity of the receptacle type device to detect electrical faults in connected devices such as a television is much greater, because the impedance of (text missing).

4. Restricting the way in which the hazard may be addressed also acts as a restraint of trade and discourages new products from entering the marketplace while making the entire NFPA process appear to be a manipulative tool of a particular group of manufacturers.

**PANEL ACTION:**

2-68 - ( 210-12 ):

**Submitter** William King Jr.

U.S. Consumer Product Safety Commission

**COMMENT ON PROPOSAL NUMBER:** 2-119

**RECOMMENDATION:**

I request reconsideration of Proposal 2-119 which included a new subsection (c) to be added to Section 210-12. Arc-Fault Circuit-Interrupter Protection as follows:

(c) Lighting and Appliance Branch Circuits. Each existing 125-volt, single-phase, 15- and 20-ampere lighting and appliance branch circuit shall be individually protected by an arc-fault circuit interrupter when the service equipment is replaced.

**SUBSTANTIATION:**

In the panel statement accompanying rejection of Proposal 2-119, Panel 2 indicates that it "does not intend to expand the code to require AFCIs in existing dwellings at this time." If that statement stands, it effectively closes the door for urgently needed protection for older homes, without providing a rationale for a delay. No technical substantiation for the rejection or other reason is provided as required in Section 4-3.5.1 of the NFPA Regulations Governing Committee Projects (NFPA 2000 Directory, Part V), which states that a "reject" shall include a statement, preferably technical in nature, on the reason for the TC action. Such statement shall be sufficiently detailed so as to convey the TC's rationale for its action so that rebuttal may, if desired, be submitted during the comment period.

The availability of AFCI protection today is an outgrowth of a CPSC sponsored study by Underwriters Laboratories, Inc. entitled "Technology for Detecting and Monitoring Conditions That Could Cause Electrical Wiring System Fires", September 1995. The objective of the study was to safely permit the continued occupancy of dwellings (many of which in this country are more than 40 years old with electrical wiring system elements remaining in service beyond their original design life) without manifestation of electrical symptoms that can cause fires. According to the report, arc-fault detection is the most promising new technology especially when used in combination with conventional protection devices such as circuit breakers, fuses and GFCIs. Now that AFCIs have been thoroughly evaluated and are available in the marketplace as listed devices, existing dwellings should be among the first to receive the benefits, given the greater risk of electrical fires in older homes.

As the submitter of the proposal, and in lieu of a sustained rejection, I would accept limiting the proposal to dwelling units, and including an effective date on or before the beginning of the year for the next scheduled edition of the NEC. This would permit time for sufficient production of listed AFCIs to meet anticipated demands.

**PANEL ACTION:**

2-69 - ( 210-12 ):

**Submitter** Timothy Costigan  
Lansing, MI

**COMMENT ON PROPOSAL NUMBER:** 2-106

**RECOMMENDATION:**

Delete this code section.

**SUBSTANTIATION:**

If AFCIs have been unreliable and costly, why is this in the code? Putting products into the code before being properly tested is questionable at best. It seems that a product with a cost ten times the actual loss to society is a tremendous waste of money. Further, how many ARC faults occur in a bedroom of a dwelling? Unless an electrical cord or the wiring in the wall is pinched or exposed to conductive material, no ARC fault should occur. In the event an ARC fault did occur, it does not appear that an AFCI would actually trip in all cases.

**PANEL ACTION:**

2-70 - ( 210-12 ):

**Submitter** Don Ganiere  
Ottawa, IL

**COMMENT ON PROPOSAL NUMBER:** 2-106

**RECOMMENDATION:**

Proposal should be accepted.

**SUBSTANTIATION:**

The protection required by this section only protects the fixed branch circuit wiring. The fixed wiring accounts for less than 10% of the residential fire loss. If arc-fault protection is going to be required, then it should be of the type that provides protection for the fixed wiring, the portable wiring, and the utilization equipment.

**PANEL ACTION:**

2-71 - ( 210-12 ):

**Submitter** Robert J. Clarey  
Cutler-Hammer, Inc.

**COMMENT ON PROPOSAL NUMBER: 2-103**

**RECOMMENDATION:**

Proposal 2-103 should be accepted in part with the changes in text as indicated below:

(b) Dwelling Unit Bedrooms. All branch circuits that supply 125-volt, single phase, 15- and 20-ampere ~~receptacle~~ outlets installed in dwelling unit bedrooms shall be protected by an arc-fault circuit interrupter(s). ~~This requirement shall become effective January 1, 2002.~~

Dwelling Unit Living Areas. All branch circuits that supply 125-volt, single-phase, 15- and 20-ampere outlets installed in dwelling unit living areas shall be protected by an arc-fault circuit interrupter(s).

FPN: A dwelling unit living area is any space, that can be normally occupied, other than bedrooms, bathrooms, toilet compartments, kitchens, closets, halls, storage, garage or utility spaces.

**SUBSTANTIATION:**

Cutler-Hammer's Proposal 2-103 dealt with AFCI protection for bedroom outlets (item (b) above), for dwelling unit living areas (item (c) above), for guest-rooms and for Limited Care Facility Bedrooms. With respect to item (b), the panel accepted the deletion of the word "receptacle", and has deleted the last sentence of item (b) via, for example, the panel action on Proposal 2-116. The panel did not accept the proposed changes related to dwelling unit living areas or guest rooms, and referred the Limited Care Facility issue to Panel 17 for action.

Cutler-Hammer considers that the panel's action to expand AFCI protection to all bedroom outlets represents a significant step in consumer protection. Cutler-Hammer also understands the panel's statement "The panel continues to support the introduction of this product, based on the data received and reviewed on this subject, but believes it is prudent to limit the requirement to bedrooms to gain further experience." With our present comment, Cutler-Hammer is requesting reconsideration of section (c) of our original proposal that deals with AFCI protection for dwelling unit living areas. We consider that additional experience is available, that AFCI products are also more generally available, and that consumer awareness has increased. This substantiation therefore focuses on the experience and availability of AFCIs for enhanced branch circuit protection.

First, it must be emphasized that in this section of the code we are dealing with branch circuit protection. As such, the AFCIs must protect the branch circuit wiring from the load-center to the outlets. Logically these branch/feeder AFCIs, listed to UL 1699, must be located at the origin of the branch circuit wiring; either in or adjacent to the load-center. It must be noted however, that the protection afforded by branch feeder AFCIs extends well beyond the outlets/receptacles. In fact UL 1699 (1) requires branch/feeder performance tests with both NM-B (installed wiring) and SPT-2 (appliance cords). Thus the branch/feeder AFCIs address series and parallel arcing faults in the installed wiring. This is the origin of about 35 percent (2, 3) of residential fires associated with the electrical distribution system. In addition, the branch/feeder AFCIs detect parallel arcing faults in the appliance cords and loads beyond the outlets. They also respond to all arcs to ground. Thus, the panel, in considering expansion of AFCI protection to the dwelling unit living areas, will appreciate that, while focusing on enhanced branch circuit protection, they are also gaining considerable protection for appliance cords and loads beyond the outlets.

Second, branch/feeder AFCIs are now more generally available, with Listed product being available from four of the largest circuit breaker manufacturers. These devices are completely interchangeable with those manufacturers' conventional miniature circuit breakers (MCBs). In addition, single pole MCBs are available (4, 5) that contain both UL listed AFCI and ground-fault circuit interrupter functions. Further, the AFCI function has been incorporated into two-pole Listed circuit breakers that are also classified for mitigating the effects of arcs, and which provide protection in shared neutral circuits. Third, during the past year there has been a significant increase in operating experience. Thus Cutler-Hammer alone has more than 25,000 MCBs with AFCI protection operating in the field. The total operating time is approaching 300 million hours, and during this time there have been no reports of unwanted tripping. More importantly, there have been cases of reported fire prevention (4, 6).

Fourth, the FAA and aerospace industry (7) are actively investigating AFCI technology relative to the protection of onboard electrical wiring. During the year 2000, this has even been the subject of many newspaper articles (8). It must be noted that the aircraft AFCI will be protecting against similar types of hazards encountered in dwelling units; namely the effects of arcing faults in aging and abused wiring. In both cases, safety is enhanced by the detection and rapid interruption of hazardous arcs. In both cases there must be no unwanted tripping.

Fifth, the price of AFCIs is decreasing, and will continue to decrease with increasing volume. The present price is similar to an MCB with integrated ground fault protection. Sixth, AFCI protection has been carefully considered by Code makers in Vermont and Canada. In the state of Vermont, branch/feeder AFCIs will be mandated for all branch circuits that supply 125

Vermont and Canada. In the state of Vermont, branch/feeder AFCIs will be mandated for all branch circuits that supply 125 V, single phase, 15 and 20 ampere receptacle outlets installed in dwelling unit bedrooms and also in dwelling unit living areas. The effective date is January 1, 2001. The application of branch/feeder AFCIs to dwelling unit bedroom circuits will also be included in the Canadian Electrical Code, Part 1.

In conclusion, we understand the prudent action that the panel took in January based on the data received and reviewed at that time. However, since the time of proposal submission in November 1999, there have been significant increases in product experience and product availability. There have also been significant increases in public awareness due to papers, publications and a book-chapter on the subject, and due to consideration of AFCI protection for aircraft onboard electrical wiring. As a consequence of these increases in experience, availability, and public awareness, we are recommending that the panel extend AFCI protection to the branch circuits of dwelling unit living areas. This will reduce the electrical fire hazards associated with the fixed wiring associated with dwelling unit living areas and, as discussed in item one, will automatically reduce the electrical fire hazards associated with the appliance wires and loads connected to those living area branch circuits.

**References**

1. "Arc-Fault Circuit Interrupters", UL 1699 Standard for Safety, First Edition, February 28, 1999.
2. "What Causes Wiring Fires in Residences?", L. Smith, and D. McCoskrie, Fire Journal, pp. 19-24, January/February 1990.
3. The U.S. Home Product Report, 1992-1996, (Appliances and Equipment), K.Rohr, NFPA Fire Analysis and Research Division, February 1999.
4. "Arc-Fault Circuit Interrupters: The New Residential Electrical-Safety Technology", C. W. Kimblin, J.C. Engel and R. J. Clarey, IAEI News, pp. 26-31, July/August 2000.
5. "Overcurrents and Undercurrents: All About GFCIs and AFCIs", Chapter 16, edited by E. W. Roberts, published by Reptec, 2000.
6. "AFCIs Target Residential Electrical Fires", G. D. Gregory, NFPA Journal, pp. 69-71, March/April 2000.
7. "Arc-Fault Circuit Interrupters", J. McCormick, M.Walz, J. Engel, P. Thiesen and E. Hetzmanseder, Proceedings of the Conference on Advances in Aviation Safety, Paper 2000-1-2121, Daytona Beach, Florida, April 2000.
8. "Team of Aircraft Wiring Experts Find Frequent Flaws in Jetliners", Matthew L. Wald, New York Times, October 12, 2000.

**PANEL ACTION:**

Log # 1882  
NEC-P02

2-72 - ( 210-12 ):

**Submitter** Ronald G. Nickson, Bernard A. Schwartz  
National Multi Housing Council & Schwartz Fire Specialists

**COMMENT ON PROPOSAL NUMBER:** 2-106

**RECOMMENDATION:**

The original proposal to delete section 210-12 in its entirety should be accepted.

**SUBSTANTIATION:**

«Include NEC L1882-S-W.INC»

**PANEL ACTION:**

2-73 - ( 210-12 ):

**Submitter** Lawrence Brown

National Association of Home Builders (NAHB)

**COMMENT ON PROPOSAL NUMBER:** 2-106

**RECOMMENDATION:**

Delete Section 210-12 in its entirety.

**SUBSTANTIATION:**

The panel's actions on AFCIs, (the original acceptance of this requirement for the 1999 NEC, and the panel's rejection of Proposal 2-106 for the 2002 NEC) is clearly insupportable by the false and misleading documentation submitted by the manufacturer's of this device. Underwriters Laboratories (UL) presentation to the panel at the last ROP meeting shows that the devices will not detect all arc-faults as was insinuated by the manufacturer's during the last ROC meeting. In fact UL stated that no determination can be made of the the number of arc-faults the device will detect and in turn disconnect the power to an outlet.

This alone clearly demonstrates that the mandatory installation of these devices is not cost-effective and will be of no cost-benefit to society. The list price of these devices on October 27, 2000 is: General Electric Model THQL 1150AFP - \$170.00; Cutler-Hammer Model CH150AF - \$155.00; and Square-D Model QO115AFI - \$160.00. Claims by manufacturers that the "price will eventually come down", or that the "wholesale cost is lower", is not a practical basis for the total expense incurred by the end user of the product. With labor and profit margin by the sellers taken into consideration, the list price is a reliable basis for the total expense.

The ineffectiveness of this mandate on society can be determined. 1.667 million new dwelling units (single-family homes and multifamily units) were constructed in 1999. Additionally, 348,000 manufactured homes were built last year. Using NFPA and FEMA's U.S. Fire Administration's National Fire Incident Reporting System (NFIRS) data, the 1999 NEC requirements for bedroom receptacles, and a single device with a list price of \$155.00 installed in each dwelling, the misuse of available monies for fire and safety to a community is clear. If the devices were 100% reliable, consumers would spend \$312,325,000 to cover losses of only \$30,900,000. Well over ten (10) times the total losses. If this product would be expanded to include all circuits in a dwelling (based on 15 breakers), the public would spend over 4,684,875,000 to prevent losses of \$253,600,000. This is approximately 18.5 times the actual loss. Furthermore, this is based on the devices being 100% effective. A claim that cannot be determined by the manufacturers or UL.

The panel's lack of concern as to the effectiveness and the cost to society, as shown in the panel's statement on this Proposal, should be of great concern to the end user of the NEC. Almost all laws enacted at the Federal and state levels need to be supported by a cost-benefit analysis. The mandate of this product lacks any true benefit to the end user. To find those that will benefit, all one needs to do is follow the money. Look at all of the Proposals and Comments submitted for the 1999 and the 2002 NEC. It has been the manufacturers pushing for this product requirement in the NEC. The manufacturers stand to make billions off of society by mandating through law a product that cannot be proved reliable or effective. Just follow the money.

If the manufacturers' claims that they want to help protect society from the loss-of-life and property from fire, they should team up with the nation's fire departments and provide the devices to communities free of charge as is now the practice for smoke detectors.

I urge the panel to remove the requirements for mandatory AFCI protection. Furthermore, I encourage jurisdictions that are considering the adoption of the NEC to delete Section 210-12 by ordinance.

NOTE: Supporting material is available for review at NFPA Headquarters.

**PANEL ACTION:**

2-74 - ( 210-12 ):

**Submitter** Lawrence Brown  
National Association of Home Builders (NAHB)

**COMMENT ON PROPOSAL NUMBER:** 2-103

**RECOMMENDATION:**

Reject the revised text to the Committee Action to Accept in Principle. Do not delete the term "receptacle".

**SUBSTANTIATION:**

During an emergency situation, or nuisance tripping of the AFCI device, one would want this type of bedroom lighting to be available to rectify any problems. This is the same logic used when connecting bathroom lighting before any GFCI outlet protection. Furthermore, the submitter of the proposal did not provide any documentation showing a fire hazard exists in residential bedrooms associated with the permanently installed lighting outlet. It is more likely that accidents and the costs associated with these accidents could occur with the loss of area lighting in a bedroom under this new requirement.

**PANEL ACTION:**

Log # 14  
NEC-P02

2-75 - ( 210-12(a) ):

**Submitter** Technical Correlating Committee National Electrical Code

**COMMENT ON PROPOSAL NUMBER:** 2-107

**RECOMMENDATION:**

It was the action of the Technical Correlating Committee that this Proposal be reconsidered and correlated with the action on Proposal 3-124. This action will be considered by the Panel as a Public Comment.

**SUBSTANTIATION:**

This is a direction from the National Electrical Code Technical Correlating Committee in accordance with 3-4.2 and 3-4.3 of the Regulations Governing Committee Projects.

**PANEL ACTION:**



2-76 - ( 210-12(a) and (b) ):

**Submitter** W. Creighton Schwan  
Hayward, CA

**COMMENT ON PROPOSAL NUMBER:** 2-108

**RECOMMENDATION:**

Reconsider, and accept this proposal.

**SUBSTANTIATION:**

It is important that the type of arc fault interrupter which protects cords and other wiring beyond the outlet, be recognized. The Consumer Product Safety Commission states that over 50% of fires occur in the cord wiring beyond the outlet, and less than 20% occur on the permanent wiring between the overcurrent protection and the outlet. Lighting should not be included, because light may be needed when the device operates and cord wiring extends from receptacle outlets, not from lighting outlets.

**PANEL ACTION:**

2-77 - ( 210-12(b) ):

**Submitter** Robert A. McCullough  
Ocean County Construction Insp. Dept., NJ

**COMMENT ON PROPOSAL NUMBER:** 2-103

**RECOMMENDATION:**

Revise (b) as follows:

210-12(b) Dwelling Unit Bedrooms. All branch circuits that supply 125-volt, single-phase, 15- and 20-ampere outlets, other than those provided for smoke detectors installed in dwelling unit bedrooms shall be protected by an arc-fault circuit interrupter(s).

**SUBSTANTIATION:**

NFPA 72 as well as model building codes require the installation of smoke detectors in dwelling unit bedrooms for new construction. These are defined as outlets and would be required to be installed on the load side of an arc-fault circuit interrupter by this section. NFPA 72 at 2-3.2.4 does not allow a smoke detector to be supplied by a GFCI unless that GFCI serves all electrical circuits within the household. The same concerns that prompted this rule should be applied to AFCIs as well with regard to smoke detectors.

**PANEL ACTION:**

2-78 - ( 210-12(b) ):

**Submitter** Jack Wells

Pass & Seymour/Legrand

**COMMENT ON PROPOSAL NUMBER:** 2-108

**RECOMMENDATION:**

Accept in Principal proposal 2-108 revised as follows:

1. Reject the proposed addition to the definition in section 210-12(a).

2. Accept in Principal the proposed change to section 210-12(b) revised as follows:

(b) Dwelling Unit Bedrooms All branch circuits that supply 125-volt, single-phase, 15- and 20-ampere outlets installed in dwelling unit bedrooms shall be protected by an arc-fault circuit interrupter(s). The arc-fault circuit interrupter(s) shall be of the Branch/Feeder type installed at the origin of the branch circuit, or shall be of the Outlet Branch Circuit type installed at the first outlet in the branch circuit.

**SUBSTANTIATION:**

«include NEC L1658-S-W.INC»

**PANEL ACTION:**

2-79 - ( 210-12(b) ):

**Submitter** Howard S. Leopold  
Cooper Wiring Devices

**COMMENT ON PROPOSAL NUMBER:** 2-108

**RECOMMENDATION:**

Revise to read as follows:

210-12(b) Dwelling Unit Bedrooms. All branch circuits that supply 125-volt, single phase, 15 and 20-ampere receptacle outlets installed in dwelling unit bedrooms shall be protected by an arc-fault circuit-interrupter(s) of the Branch/Feeder type or a receptacle type recognized for protecting entire branch circuits.

**SUBSTANTIATION:**

210-12(b) presently states that all branch circuits that supply 125V, single phase, 15 and 20 ampere receptacle outlets in dwelling bedrooms be protected by an arc fault circuit interrupter(s). The problem with this wording is that it does not explicitly state the type of AFCI device and is thus likely to be interpreted to mean that only the "Branch/Feeder" type must be used. This writer has heard of the introduction of a new type of receptacle AFCI which is UL listed as suitable to protect the entire branch circuit, even though it would be installed as the first receptacle in the branch circuit, downstream of the panelboard. Revising the wording as suggested above would avoid the exclusion of this new device (by misinterpretation) as an alternate to the Branch/Feeder type. No expansion of the required areas of protection would be made by this revision.

**PANEL ACTION:**

2-80 - ( 210-12(b) ):

**Submitter** George Gregory  
Square D Company

**COMMENT ON PROPOSAL NUMBER:** 2-108

**RECOMMENDATION:**

Continue to reject Proposal 2-108.

**SUBSTANTIATION:**

The appropriate revision is in the panel action on Proposal 2-110 as recorded in the ROP.

This proposal (2-108) would allow AFCI protection by either of two alternative devices: (1) the Branch/Feeder AFCI or (2) the Outlet Circuit AFCI. Both the performance and the location in the circuit of the two devices are different. Therefore, the two devices should not be considered equivalent or alternatives for each other.

A device located at the outlet such as the Outlet Circuit AFCI or even a device with combination performance (Outlet Branch Circuit AFCI) located at the outlet would have insurmountable limitations in protecting the fixed wiring circuit against hazardous arcing. Consider these points:

- In order to open the branch circuit and protect the branch circuit wiring, the device must open the circuit at the source of the branch, not at the outlet.
- A device located at the outlet could interrupt the current flow of a series arc on its supply side. However, such a device could not clear a line-to-ground or line-neutral fault. Series faults in fixed wiring are rare in comparison to line-to-ground or line-to-neutral faults. As a series fault progresses it becomes a line-to-ground or line-to-neutral fault. Therefore, if a series fault is not isolated from the supply, it may continue as a line-to-ground or line-to neutral fault.
- A device located at the outlet and sensing back toward the supply would sense arcing not only in the branch in which it is located, it would also sense arcing in adjacent circuits, at the service and possibly on the supply side of the service.

On the other hand, a Branch/Feeder AFCI located at the source of the branch protects against arcing fire causes in fixed wiring and provides "limited" protection to extension wiring and appliances. The limit is that the B/F AFCI is not required to provide low level, series protection in 2-wire circuits such as extension cords and appliance wiring. The 2-wire protection does not seem so limited when we consider this fact from "The U.S. Home Product Report, 1992-1996 (Appliances and Equipment) by Kimberly Rohr of NFPA. On Page 7, it clarifies that "The leading cause of cord and plug fires was short circuits and ground faults, which accounted for half or more of these fires, injuries and direct property damage. Fires caused by short circuits and ground faults also accounted for 38 percent of civilian fire deaths." The Branch/Feeder AFCIs are intended and tested for detecting these arcing short circuits and ground faults. That degree of protection extends to cords and plugs and appliances.

**PANEL ACTION:**

2-81 - ( 210-12(b) ):

**Submitter** George Gregory  
Square D Company

**COMMENT ON PROPOSAL NUMBER:** 2-109

**RECOMMENDATION:**

Continue to reject Proposal 2-109.

**SUBSTANTIATION:**

The appropriate revision is in the panel action on Proposal 2-110 as recorded in the ROP.

This comment supports the addition of the AFCI at the branch to provide protection to the fixed wiring and protection to extension and appliance wiring. UL 1699, The Standard for Safety for Arc-Fault Circuit Interrupters, notes that the Branch/Feeder AFCI provides protection against the unwanted effects of arcing in branch circuits and limited protection to branch circuit extension wiring. The limited protection is that the B/F AFCI is not required to provide low level, series protection in 2-wire circuits such as extension cords and appliance wiring. This 2-wire protection does not seem so limited when we consider this fact from "The U.S. Home Product Report, 1992-1996 (Appliances and Equipment) by Kimberly Rohr of NFPA. On Page 7, it clarifies that "The leading cause of cord and plug fires was short circuits and ground faults, which accounted for half or more of these fires, injuries in direct property damage. Fires caused by short circuits and ground faults also accounted for 38 percent of civilian fire deaths." The Branch/Feeder AFCIs are intended and tested for detecting these arcing short circuits and ground faults. That degree of protection extends to cords and plugs and appliances.

The addition of an Outlet Circuit AFCI at the receptacle location would add the lower level, series protection for 2-wire circuits. It would enhance the protection brought by the Branch/Feeder AFCI.

Care must be taken when considering a combination AFCI. A combination AFCI located at the source of the branch would provide protection of the Branch/Feeder and Outlet Circuit AFCI all in one location. However, a combination performance AFCI (Outlet Branch Circuit AFCI) located at the outlet would have insurmountable limitations in protecting the fixed wiring circuit against hazardous arcing. Consider these points:

- In order to open the branch circuit and protect the branch circuit wiring, the device must open the circuit at the source of the branch, not at the outlet.
- A device located at the outlet could interrupt the current flow of a series arc on its supply side. However, such a device could not clear a line-to-ground or line-to-neutral fault. Series faults in fixed wiring are rare in comparison to line-to-ground or line-to-neutral faults. As a series fault progresses, it becomes a line-to-ground or line-to-neutral fault. Therefore, if a series fault is not isolated from the supply, it may continue as a line-to-ground or line-to neutral fault.
- A device located at the outlet and sensing back toward the supply would sense arcing not only in the branch in which it is located, it would also sense arcing in adjacent circuits, at the service and possibly on the supply side of the service.

**PANEL ACTION:**

2-82 - ( 210-12(b) ):

**Submitter** George Gregory  
Square D Company

**COMMENT ON PROPOSAL NUMBER:** 2-110

**RECOMMENDATION:**

Continue to accept the proposal as modified by Panel 2 according to the ROP.

**SUBSTANTIATION:**

The addition of AFCI protection for the branch circuit will reduce the advent of fires from arcing causes. Since this protection will protect fixed wiring, it makes good sense to incorporate protection for all outlets in bedrooms and not limit protection to receptacle outlets. Also, since the Branch/Feeder AFCI that is applied at the branch provides arcing short-circuit and arcing ground-fault protection for appliance and extension wiring, a significant degree of protection is provided beyond the fixed wiring system.

As is also noted in Proposal 2-111, an additional degree of protection would be added for extension and appliance wiring by additionally requiring Outlet Circuit AFCIs (receptacle type) at the receptacle. The added protection is series arc detection at the 5-ampere level, which can be important especially in 2-wire cords. The panel should carefully consider this added protection in future revision cycles, as the devices become available.

There are several points made by Mr. Brown in Proposal 2-106 and explanation of his vote on it for this same section that deserve comment. He is probably correct that the percentage of losses from electrical arcing fires is small compared to all residential property losses including natural disasters such as floods, earthquakes, wind and hail that contractors must consider. It is even relatively small when compared to all fire causes including arson, smoking, cooking and other causes. These comparisons do not make arcing-fault related losses insignificant. The panel has the ability to act on reducing arcing-fault causes.

As Mr. Brown points out, the preponderance of fires from arcing causes are in older homes. However, as the 1987 report "Residential Electrical Distribution System Fires?" by Smith and McCoskrie of CPSC points out, the majority of these fires are related to improper installation or modification and improper use of electricity. An AFCI installed on such circuits would do much to reduce arcing related fires. We must remember that not all systems are installed or modified by trained and qualified contractors.

The Standard for Safety for Arc-Fault Circuit Interrupters, UL 1699, is a comprehensive standard. Mr. Brown notes that instead of the 14 tests that he counted in the 1994 CPSC report evaluating a variety of devices that may help reduce electrical fires in residences, he counted only four tests in UL 1699. During development of UL 1699, it was determined that two basic forms of arcing occur in residences: point-contact and carbonized-path arcing. These two forms envelop a variety of methods of applying arcs. They do not ignore any of the tests reported on in the CPSC report. UL 1699 has 10 tests for arc fault detection and another 14 for detection under conditions that would inhibit the arc from detection. There are also 33 tests for unwanted tripping (nuisance avoidance). Beyond these basic detection tests are a number of tests including abnormal operation, overvoltage, dielectric, voltage surge, environmental sequence, leakage current, humidity conditioning and others that are required for Listing.

Regarding price, Mr. Brown is correct that some of the early units were purchased for \$85 or possibly even more. This price is one indication of the value of this newly available technology. However, that early price is no indication of the price that will exist in the marketplace as the product becomes more common, competition becomes stronger and manufactured volumes increase. Already there have also been units purchased for considerably less than half the price indicated by Mr. Brown. Those lower prices are probably a closer indicator of the direction that price will go.

**PANEL ACTION:**