



DEPARTMENT OF ADMINISTRATIVE SERVICES

PROPOSED CHANGE OF THE CONNECTICUT STATE
BUILDING CODE AND FIRE SAFETY CODE

DATE SUBMITTED: _____

CODE INFORMATION

Proposed change to: ☐ Building Code ☐ Fire Safety Code

Code section(s): _____

PROPONENT INFORMATION

Name: _____ Representing: _____

Telephone: _____ Email: _____

Address: _____
Street Address Town State Zip Code

PROPOSAL INFORMATION

Description of change and reason for change (attach additional information as needed):

Proposed text change, addition or deletion (attach additional information as needed):

Supporting data and documents (attach additional information as needed)

☐ **This Proposal is original material.** (Note: Original material is considered to be the submitter's own idea based on or as a result of his/her own experience, thought or research and, to the best of his/her knowledge, is not copied from another source.)

☐ **This Comment is not original material, its source (if known) is as follows:** (such as material / code development proposal from a prior development cycle or proposal submitted to model code committee etc.)

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Ravi Ramanathan

Proponent's Signature

Printed Name

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12/29/16

PROPOSAL INFORMATION

Description of change and reason for change (attach additional information as needed):

This code amendment proposes the deletion of kitchens, laundry, and similar areas from the requirements of 210.12(B) from the 2023 edition of the NEC. This provision of the Code requires both AFCI and GFCI protection in these areas, and the information detailed below shows that due to the prevalence of AFCI nuisance tripping and the prevailing, less-safe alternatives for resolution of this problem by homeowners, this section should be amended by the State of Connecticut.

Resetting a breaker is the first response to nuisance tripping, typically sending CT residents to the basement and creating risk of a trip and fall, especially for the 18% of CT residents over age 65. After multiple nuisance tripping events, the next typical solution involves replacing an AFCI/GFCI breaker with a standard (unprotected) breaker -- resulting in the elimination of both AFCI and GFCI protection.

By requiring AFCI protection in Kitchens, Laundry, and similar areas, 210.12(B), as currently drafted, homeowners would be forced to endure commonplace nuisance tripping, the end result of which may be a loss of proven lifesaving GFCI protection combined with an increased trip and fall hazard.

The detailed reasoning for this proposed change is presented below:

NUISANCE TRIPPING

A recent study by East Carolina University was conducted to investigate residential electricians' perceptions of arc-fault circuit interrupters (AFCIs) and "nuisance tripping", i.e., unwanted tripping. This study was conducted to examine a variety of issues surrounding the use of AFCIs and nuisance tripping, including the following:

- Frequency of nuisance tripping with AFCIs
- Troubleshooting and solutions
- And more...

The conclusions are as follows:

- Almost all respondents (93.9%) experienced problems with nuisance tripping with AFCIs on residential projects at some point in their work.
- Most respondents (87%) have replaced AFCIs with standard circuit breakers (and/or knew someone who had done so) to resolve nuisance tripping issues. This is, by far, the most common way of resolving these issues.
- And more...

Please see Attachment #4 for full detail.

Recent nuisance tripping data from the Electro Federation Canada shows there are significant issues with nuisance tripping, particularly with clothes washers, microwave ovens, refrigerators and from other unknown sources. Canadian Authorities Having Jurisdiction are permitting contractors to swap AFCI circuit breakers for standard thermo-magnetic-trip breakers where it can be demonstrated there is no other solution to the nuisance tripping.

Please see Attachment #5 for full detail.

A LACK OF EVIDENCE TO SUPPORT AFCI

As noted in proposals made during the 2023 NEC cycle, a review of comments when kitchen and laundry areas were first added, Code Making Panel 2 did not have clear substantiation of fires located in these specific areas from data used to justify that expansion. Although fire data never supported this expansion of AFCIs, these locations

were nevertheless added to the 2014 NEC. Data from both the National Fire Protection Agency (NFPA) and The United States Fire Administration (USFA) show increases in electrical related fires since AFCI was introduced in 2003.

Please see Attachments #1 and #2 for full detail.

According to the most recent NFPA data¹ [2015 – 2019], there were 2,410 fires associated with electrical branch circuits, which resulted in 20 deaths, 50 injuries and an estimated \$108 Million property damage.

The NFPA data for fires involving electrical branch circuits are as follows:

- Between 2003 and 2006 there were 1,600 reported branch-circuit fires annually
- Between 2007 and 2011 there were 2,200 reported branch-circuit fires annually
- Between 2015 and 2019 there were 2,410 reported branch-circuit fires annually

GFCI IS EFFECTIVE

The widely publicized graph depicting Electrocutions Associated with Consumer Products has been acknowledged as credibly illustrating the direct correlation between the reduction in consumer product electrocutions and the expansion of GFCI protection. For an illustration of the effectiveness of GFCI in electrocution prevention, please visit <https://www.esfi.org/program/ground-fault-circuit-interrupters> and <https://www.esfi.org/ground-fault-circuit-interrupters-preventing-electrocution-since-1973/>

PRECEDENCE ALREADY SET

States including Montana, North Dakota, and Michigan have amended AFCI requirements within their State Code.

Please see Attachment #3 for full detail.

TIME IS REQUIRED TO UPDATE AND COORDINATE PRODUCT STANDARDS

The National Electrical Manufacturer's Association (NEMA) recently commissioned review of the UL 1699 AFCI and UL 943 GFCI standards to coordinate them with appliance standards including the UL 60335 series. Work is progressing well on the UL 943 GFCI standard, but time is required to identify and implement changes to UL 1699 AFCI and UL 60335 series Appliance standards. In the meantime, effective GFCI protection with convenient point of use reset options should be maintained as defined in NEC 210.8. Note also that GFCI nuisance tripping issues are infrequent relative to AFCI issues.

SUMMARY

The prevalence of AFCI nuisance tripping, resulting in the increased elderly population trip and fall hazard and possible elimination of GFCI protection justify the pause on AFCI expansion. Please consider this 2023 amendment proposal.

Sincerely

Ravi Ramanathan

President Electrical Wiring Systems

Cited References:

¹ NFPA 4/8/2024

<https://content.nfpa.org/-/media/Project/Storefront/Catalog/Files/Research/NFPA-Research/Electrical/osHomeFiresCausedbyElectricalDistributionEquipmentSupporting.pdf?rev=d0cf9038a4e54f5281f2313c3697d7a4&hash=327E782B5DA994F0822116C368156E2C>

Proposed text change, addition or deletion (attach additional information as needed):

From NFPA 70 210.12

(B) Dwelling Units.

All 120-volt, single-phase, 10-, 15-, and 20-ampere branch circuits supplying outlets or devices installed in the following locations shall be protected by any of the means described in 210.12(A)(1) through (A)(6):

1. ~~Kitchens~~
2. Family rooms
3. Dining rooms
4. Living rooms
5. Parlors
6. Libraries
7. Dens
8. Bedrooms
9. Sunrooms
10. Recreation rooms
11. Closets
12. Hallways
13. ~~Laundry areas~~
14. ~~Similar areas~~

Exception No. 1: AFCI protection shall not be required for an individual branch circuit supplying a fire alarm system installed in accordance with 760.41(B) or 760.121(B). The branch circuit shall be installed in a metal raceway, metal auxiliary gutter, steel-armored cable, or Type MC or Type AC cable meeting the applicable requirements of 250.118, with metal boxes, conduit bodies, and enclosures.

Exception No. 2: AFCI protection shall not be required for the individual branch circuit supplying an outlet for arc welding equipment in a dwelling unit until January 1, 2025.

Informational Note No. 1: See NFPA 72-2022, *National Fire Alarm and Signaling Code*, 29.9.4(5), for information on secondary power source requirements for smoke alarms installed in dwelling units.

Informational Note No. 2: See 760.41(B) and 760.121(B) for power source requirements for fire alarm systems.

Supporting data and documents (attach additional information as needed): Please see attached documents referenced above.

Supporting data and documents (attach additional information as needed)

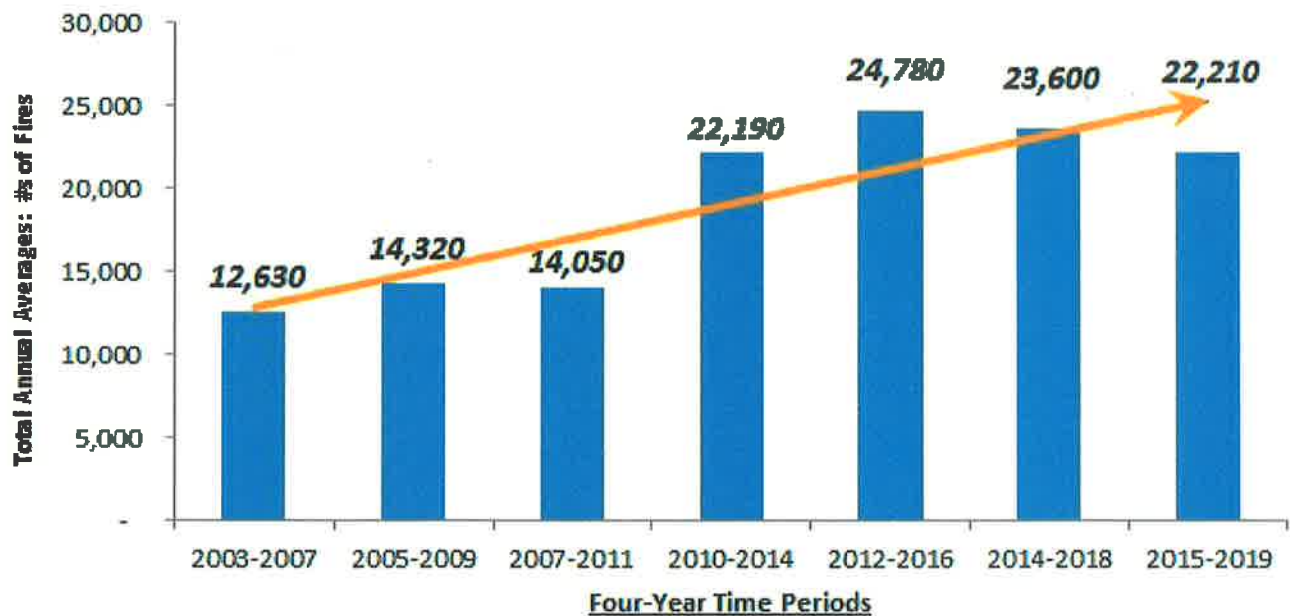
Attachment #1

NFPA Electrical Fire Data

PI 3155

NFPA Electrical Fire Data

Home Fires Involving Wiring and Related Equipment: Annual Averages



Sources: Data from NFIRS Version 5.0, NFPA Survey, NFPA Fire Experience Survey and Fire Safety in the United States since 1980

Attachment #2

USFA residential Building Electrical Malfunction Trends (2012-2021)

PI 3155

US Fire Administration

Residential Building Electrical Malfunction Fire Trends (2012-2021)

(<https://www.usfa.fema.gov/statistics/residential-fires/electrical.html>)

Residential Building Electrical Malfunction Fire Trends (2012-2021)

Fires, deaths, injuries and dollar loss

Fires Deaths Injuries \$ Loss

Residential building electrical malfunction fires

[View data in a table](#) [Download chart](#)



Residential Building Electrical Malfunction Fire Trends (2012-2021)

Overall trends

Overall trends for residential building electrical malfunction fires and losses for the 10-year period of 2012 to 2021 show the following:

↗ An 11% increase in fires.

↘ A 17% decrease in deaths.

↗ An 8% increase in injuries.

↗ A 27% increase in dollar loss.*

In 2018, there were 32 incidents with a reported dollar loss of \$1,000,000 or more, 14 in 2019, 13 in 2020 and 23 in 2021. These incidents may have contributed to the continued increase in fire dollar loss. The 2019 high-dollar-loss fires included a \$26,400,000 hotel fire in New Orleans, Louisiana.

*This overall constant dollar-loss trend takes inflation into account by adjusting each year's dollar loss to its equivalent 2021 value.

Attachment #3

State-By-State NEC Adoption

PI 3155

STATE-BY-STATE NEC ADOPTION

Overview of AFCI Requirements: 20 states and 3 major municipalities have made amendments to reduce the AFCI requirements. Below is a summary of the changes that have been made:

Montana (2017 NEC) – Removed requirements to install AFCIs in kitchens.

Idaho (2017 NEC) – AFCI protection is only required in bedrooms.

Oregon (2020 NEC) – AFCI requirements deleted from branch circuits that supply hallways, kitchen or laundry areas, as well as GFCI protected receptacles installed in dining rooms. AFCI protection shall not be required for optional, dedicated outlets that supply equipment known to cause unwanted tripping of AFCI devices and for branch circuits that serve an appliance that is not easily moved or that is fastened in place.

South Dakota (2020 NEC) – Includes an exception which would not require AFCIs on life support and similar equipment.

North Dakota (2020 NEC) – AFCI protection not required for refrigeration appliances if a single receptacle on a dedicated circuit is installed.

Iowa (2020 NEC) – AFCI requirements for branch circuit extensions or modifications in dwelling or dormitory units were deleted.

Wisconsin (2017 NEC) – AFCI requirements do not apply to kitchens.

Michigan (2018 IRC) – AFCI requirements were deleted.

Indiana (2018 IRC) – AFCI requirements were deleted for modifications or renovations of homes. New construction will require AFCIs.

Ohio (2017 NEC) – AFCI requirements were deleted for receptacles installed to serve kitchen countertops.

Vermont (2020 NEC) – AFCI requirements for branch circuit extensions or modifications were deleted where the extension of the existing conductors is used solely to hardwire single station smoke and or CO alarms in an existing dwelling or dormitory unit.

New Hampshire (2020 NEC) – AFCI requirements for dormitory unit devices and bathrooms, guest rooms and guest suites, and branch circuit extensions or modifications for dormitory units were deleted. "Protection in excess of the requirements of the 2014 National Electrical Code shall not be enforced under the state building code".

Connecticut (2015 IRC; 2017 NEC) – AFCI protection not required for replacement receptacles.

New Jersey (2017 NEC) – AFCI requirements for kitchens and laundry areas, as well as for branch circuit extensions or modifications, were deleted.

Virginia (2017 NEC) – AFCI's only required in bedrooms.

North Carolina (2020 NEC) – AFCI requirements for kitchens and laundry areas were deleted, as well as those for dormitory unit bathrooms, guest room and guest suites, and extensions or modifications.

West Virginia (2020 NEC) – AFCI requirements were reduced on modifications and extensions to any new home, except in bedrooms.

South Carolina (2018 IRC) – AFCI's will not be required in kitchens and laundry areas.

Tennessee (2017 NEC) – AFCIs are optional for bathrooms, laundry areas, garages, unfinished basements, work or similar area, and for branch circuits dedicated to supplying refrigeration equipment.

Mobile, AL (2014 NEC) – AFCI's requirements were deleted for family rooms, dining rooms, living rooms, parlors, libraries, dens, bedrooms, sunrooms, recreation rooms, closets and hallways.

Arkansas (2017 NEC) – AFCI's are not required in kitchens and laundry areas.

Kansas City and Springfield, MO (2011 NEC) – AFCI's only required in bedrooms.

Utah (2018 IRC) – AFCI requirements were deleted.

Overview of NEC adopted versions:

- **2023 NEC** – 2 States
- **2020 NEC** – 17 States
- **2017 NEC** – 17 States
- **2014 NEC** – 1 States
- **2008 NEC** – 1 States
- **Local Adoption** – 5 States:
Alabama, Arizona, Mississippi, Missouri and Nevada.
- **AFCI Requirements Controlled by International Residential Code** – 7 States

Attachment #4

AFCI and Nuisance Tripping Research Study (ECU)

PI 3155

AFCI and Nuisance Tripping Research study

Dr. Steven W. Schmidt
Dr. Xi Lin
East Carolina University

August 15, 2023



2023 Research Study Overview

The purpose of this study was to investigate residential electricians' perceptions of arc fault circuit interrupters (AFCIs) and nuisance tripping. This study was designed to build on the 2020 AFCI study.

This study was conducted to examine a variety of issues surrounding the use of AFCIs and nuisance tripping, including the following:

- Frequency of nuisance tripping, troubleshooting, and solutions
- Costs (time and money) associated with nuisance tripping
- Electricians' perceptions of AFCIs and nuisance tripping
- Customers' perceptions of nuisance tripping
- Customer safety and protection

2023 Research Study Overview (continued)

Following is a summary of steps taken in order to address the research questions:

1. An online survey was developed and sent to residential electricians
 - The survey development process, along with information on reliability and validity checks, can be found in the report summary
 - Names and email addresses of residential electricians were provided by Electrical Contractor Magazine
 - An initial invitation was emailed to 4000 residential electricians, and a follow-up reminder was sent seven days after the initial invitation
 - Respondents who completed the survey were asked to provide their email addresses if they were interested in participating in brief (10-15 minute) phone interviews
 - As an additional incentive, all respondents who completed the survey were given the option of providing their email addresses for a chance to enter a drawing for one of five \$50 Amazon gift cards

2023 Research Study Overview (continued)

2. Telephone interviews were conducted with respondents who provided their contact information
 - Nine interviews were conducted
 - Interviews were 10-15 minutes in duration
 - Each interview asked respondents to provide details on their experience dealing with AFCIs and nuisance tripping
 - Interview data was used to support and enhance data gathered in the online survey
3. Both survey and interview data were analyzed, first by each researcher individually, and then together, in order to make conclusions and recommendations

2023 Executive Summary

- Almost all respondents (93.9%) experienced problems with nuisance tripping and AFCIs on residential projects at some point in their work.
- Almost all respondents (87%) knew someone who had replaced AFCIs with standard circuit breakers to resolve a nuisance tripping issue. This percentage is about the same as that from the 2020 survey, when 83% of respondents indicated they knew someone who had done this.

2023 Executive Summary

- The major problems with nuisance tripping are as follows:
 - New construction that involves home products (appliances, lighting) that are more technologically advanced than, or do not work with, the AFCIs being installed in the home.
 - A respondent noted: “AFCI technology is not keeping up with new technology used in appliances, LED Drivers, and other loads”
 - Rewiring/rework projects on existing homes, whereby new electrical components (AFCIs) are added to existing wiring systems.
- The two major issues above may be incompatible with each other. AFCIs must be flexible enough to work with old (existing) wiring systems, but they also have to be technologically advanced to work with the latest technology found in new residential construction and new appliances.

2023 Executive Summary

- **In the past year**, respondents worked on an average of 45 residential projects
 - 34% of these projects (15 of 45) experienced AT LEAST ONE issue with nuisance tripping
 - 87% of those projects (13 of 15) required at least one call-back
 - 18% of the projects (8 of 45) experienced TWO OR MORE issues with nuisance tripping
 - 88% of those projects (7 of 8) required two or more call-backs
- Note that the 8 projects that experienced TWO OR MORE issues with nuisance tripping are counted in the 15 projects that included at least one nuisance trip.
- These percentages are virtually unchanged from the 2020 study.

2023 Executive Summary

- Most respondents (66%) address the issue of nuisance tripping by replacing the AFCI.
 - Most respondents initially replace the AFCI with a new AFCI (often a different brand of AFCI than was used originally).
 - If that doesn't work, they replace with a standard breaker
 - Many respondents know people who have replaced AFCIs with standard breakers.
 - The trying of different brands of AFCI to address nuisance tripping issues is something that is new in the 2023 study. One respondent referred to it as "AFCI roulette".
 - Respondents have preferred brands and brands they will not use. There was no consistency of preferred brand (or brand they will not use) from respondent to respondent.
- Almost all respondents agreed that safety was the main benefit of AFCIs. However, only 23% of respondents believed the benefits of AFCIs outweighed the problems associated with them.
- Overrun costs for replacing AFCIs are still a major concern for electricians.

2023 Executive Summary

- One average call back costs electricians **\$200** and takes **2 hours** to complete.
 - These figures are unchanged from the 2020 survey.
- Based on data compiled from this survey on nuisance tripping frequency, and based on data from US Market Watch on the number of new homes constructed in 2022, we can estimate that call backs related to nuisance tripping in that year cost the electrical industry at least:
 - \$128,174,500 (tools, materials, wages)
 - 1,281,744 hours (drive and work time)
- Note that this figure is based on new construction. Survey respondents consistently noted that the major problems with nuisance tripping happen on rewire/renovation projects, which are not included here.

2023 Executive Summary

- There was a much greater emphasis on proactivity and on education in this study than in the 2020 study. More respondents are educating their customers up front about the issue of nuisance tripping. They are also educating local/regional authorities in charge of codes with the purpose of changing AFCI requirements.
 - In some cases, exceptions are being made at these levels.
 - There may be opportunities to use education to promote optimal use of AFCIs and Dual Function AFCI/GFCIs that could address problems related to nuisance tripping.
- As in the 2020 study, there are a significant number of work arounds that electricians use to “get around” AFCI requirements. NEC code enforcement is not consistent from area to area. AFCIs are regularly replaced with standard breakers if nuisance tripping occurs after inspections.

2023 Executive Summary

- There is agreement that AFCI technology is improving, which is helping the issue of nuisance tripping, however, perceptions are that technology is not improving fast enough and is not keeping up with innovations in appliances and other home products that use electricity.
- There is still a perception that AFCI requirements in the NEC are driven by AFCI manufacturers to make money.

2023 Survey Overview and Findings

2023 Survey Participants

The online survey was sent to **4,000** potential participants

Responses received: **N = 141**

In order to complete the survey, respondents had to answer “yes” to the first two questions on the survey:

- Q1. Do you do residential project work?
- Q2. Do you use AFCIs and/or Dual Function AFCI/GFCIs in your residential wiring

Number of usable responses: **N = 131**

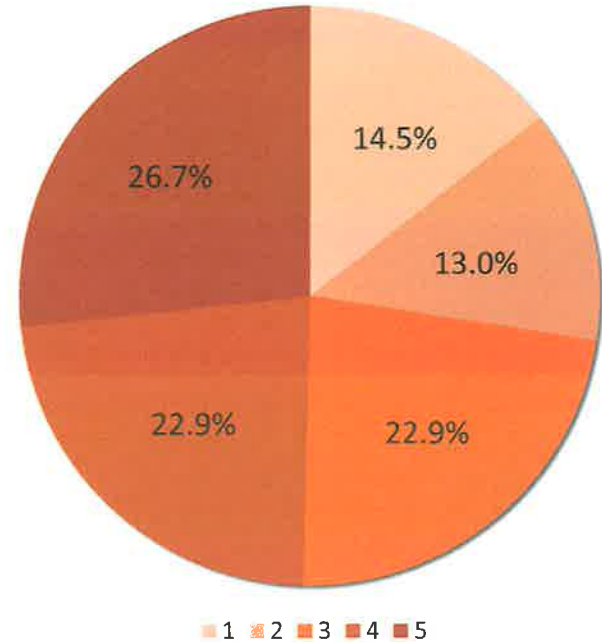
- Those who responded positively to the first two questions and completed the survey



The use of AFCIs and/or Dual Function AFCI/GFCIs is important in residential work.

Respondents were fairly evenly divided in their beliefs on this statement.

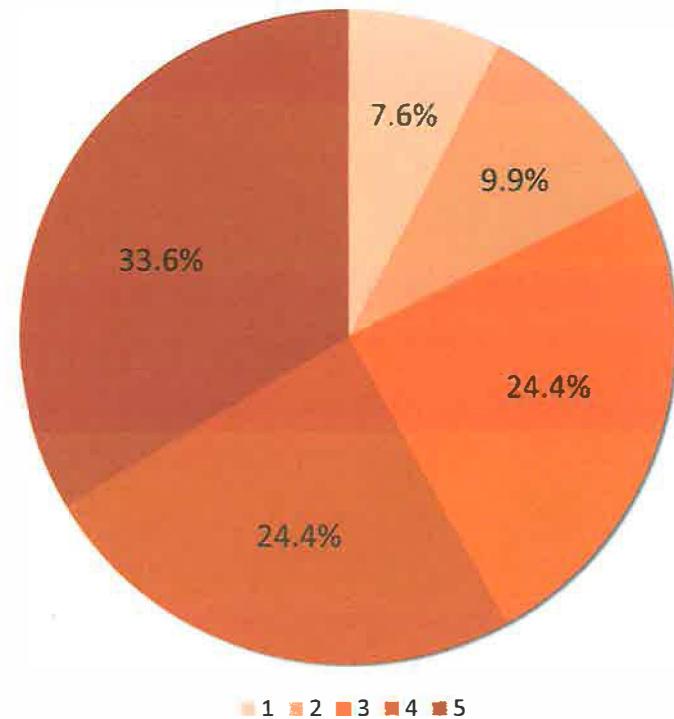
1. Strongly disagree	14.5%
2. Disagree	13.0%
3. Neither agree or disagree	22.9%
4. Agree	22.9%
5. Strongly agree	26.7%



Installing AFCIs and/or Dual Function AFCI/GFCIs makes residences safer.

58 percent of respondents agreed with this statement and 42 percent were either neutral or disagreed with this statement.

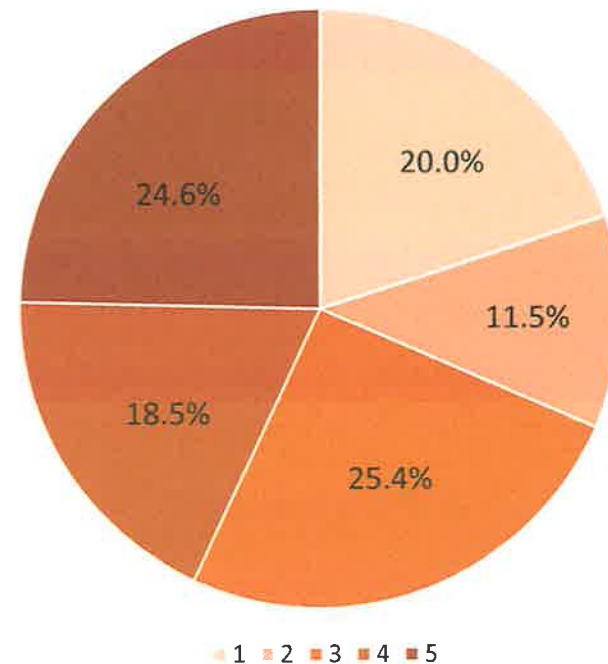
1. Strongly disagree	7.6%
2. Disagree	9.9%
3. Neither agree or disagree	24.4%
4. Agree	24.4%
5. Strongly agree	33.6%



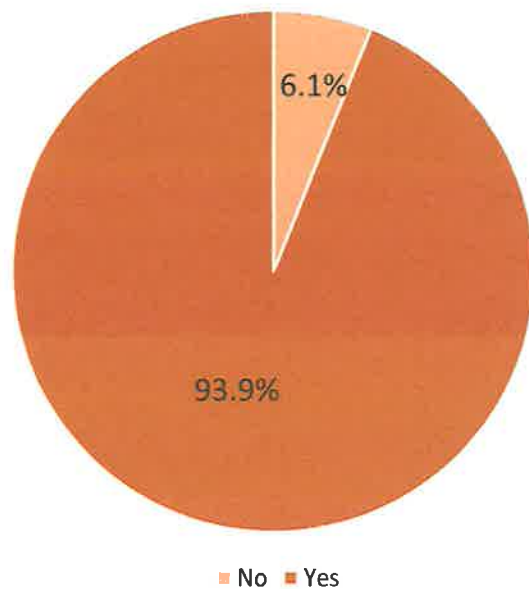
Installing AFCIs and/or Dual Function AFCI/GFCIs provides benefits to homeowners.

Respondents were fairly evenly split in their beliefs on this statement.

1. Strongly disagree	20.0%
2. Disagree	11.5%
3. Neither agree or disagree	25.4%
4. Agree	18.5%
5. Strongly agree	24.6%



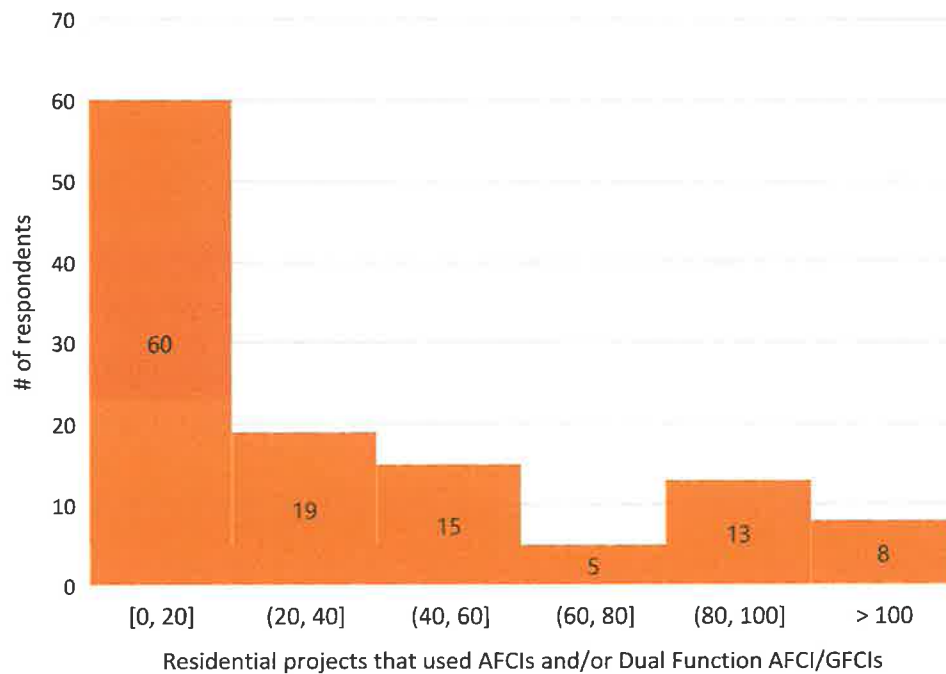
Have you ever experienced nuisance or unwanted tripping of AFCIs and/or Dual Function AFCI/GFCIs on residential projects?



Most respondents have experienced nuisance tripping.

- **Yes: 93.9%**
- No: 6.1%

Within the last year, on approximately how many separate residential projects did you use AFCIs and/or Dual Function AFCI/GFCIs?



- The average respondent used AFCIs and/or Dual Function AFCI/GFCIs on **45** separate residential projects within the past year.

Data on Nuisance Tripping and Call Backs

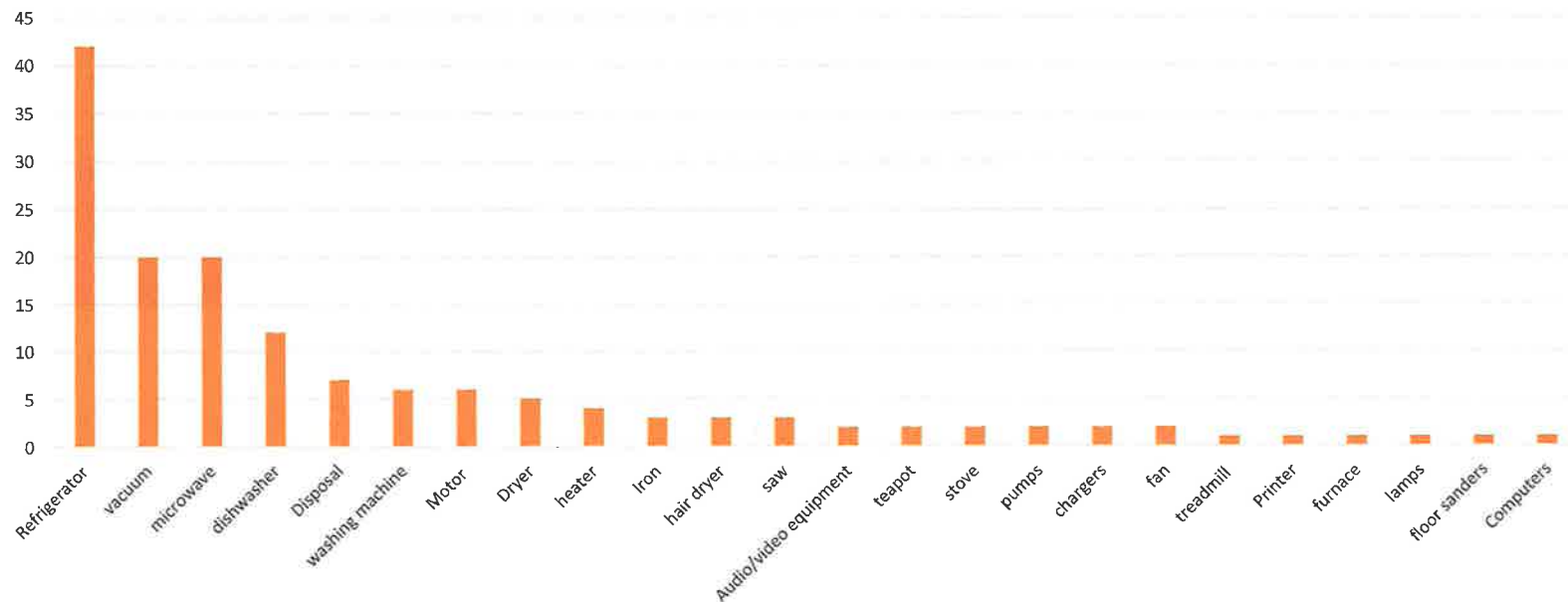
- Respondents worked on an average of 45 residences that used AFCIs within the past year.
- There was **AT LEAST ONE** issue with nuisance tripping in 15 of those 45 residences (34% of all residences experienced issues with nuisance tripping)
 - Of those 15 residences, 13 required a call back because of nuisance tripping (87%).
- There were **TWO OR MORE** issues with nuisance tripping in 8 of those 15 residences (or 18% of the total of 45 residences).
 - Of those 8 residences, 7 required two or more call backs (88%).

In your experience, what is the most common cause/origin of nuisance tripping in AFCIs and/or Dual Function AFCI/GFCIs?

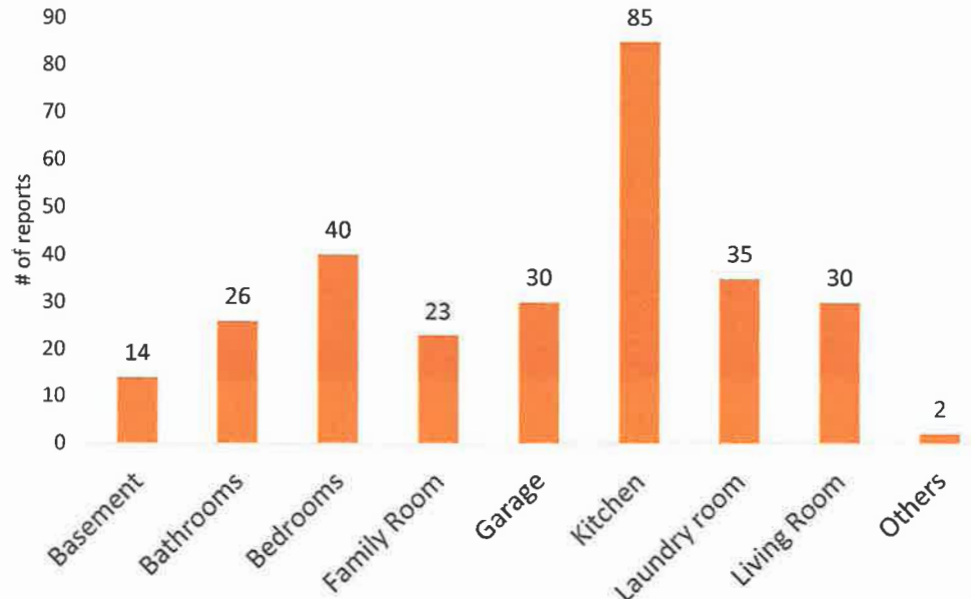
- Respondents' most common response to this question (in order) are as follows:
 - Motor/Electrical load issues (79 mentions)
 - Breaker issues (30 mentions)
 - Neutral issues (9 mentions)
 - Existing old wiring/wiring equipment (8 mentions)
- Note that many respondents listed multiple causes/origins in their responses. In these cases, we categorized each separately (so a single person's response could be represented multiple times in the list of mentions above).

In your experience, what is the most common appliance or load that causes AFCI and/or Dual Function AFCI/GFCI nuisance tripping?

Most common appliances/loads causing nuisance tripping: Refrigerator, vacuum, microwave, dishwasher.



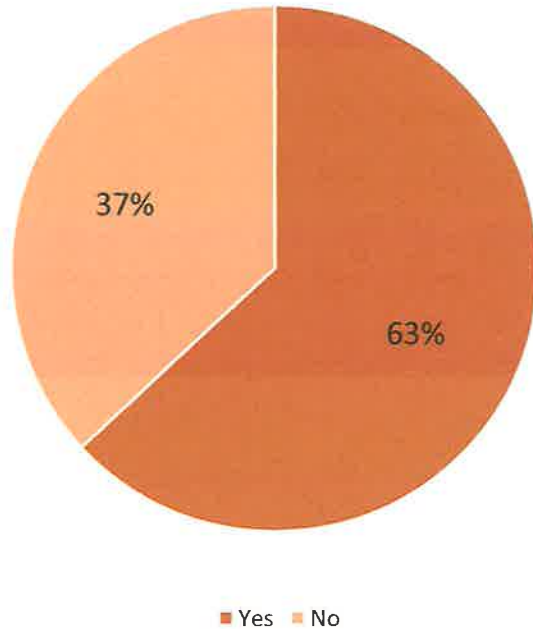
In your experience, what circuits or areas in the home experience the most AFCI and/or Dual Function AFCI/GFCI nuisance tripping?



14 reported Basement
26 reported Bathrooms
40 reported Bedrooms
23 reported Family room
30 reported Garage
85 reported Kitchen
35 reported Laundry room
30 reported Living room

NOTE: Respondents could choose as many options as they thought applied.

Have you or your customer ever reset a tripped AFCI or Dual Function AFCI/GFCI circuit breaker that resulted in a plugged-in appliance (such as a blender, food processor, stove, toaster oven, garbage disposal or power tool) immediately starting back up again?



- **Yes: 63%**

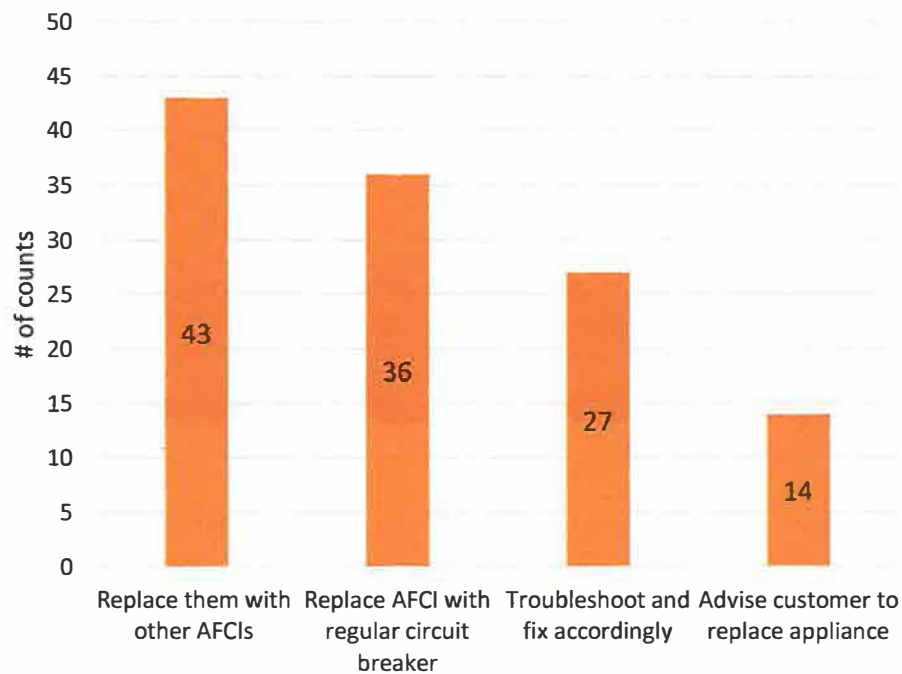
- **No: 37%**

This was a fairly common occurrence among respondents, and it may be a safety issue of concern.

Homeowner Safety and Security Questions

- As noted on the previous page, most electricians have encountered situations in which an unattended appliance restarts when an AFCI or a Dual Function AFCI/GFCI breaker is reset.
- The general consensus was that consumers call electricians before attempting to fix anything on their own.

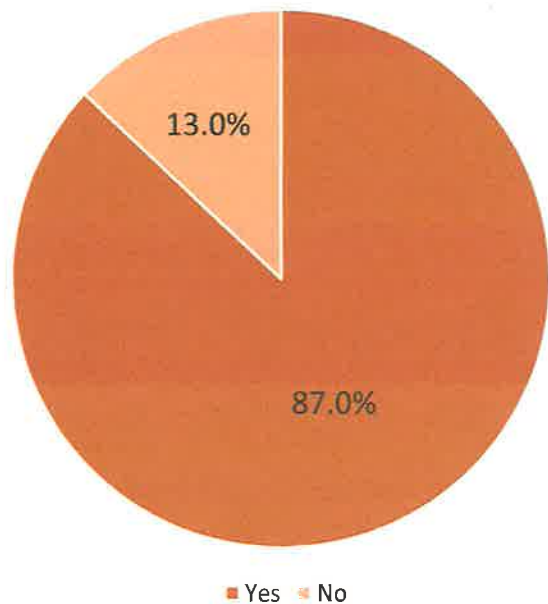
What is the most common way you resolve nuisance tripping problems?



The most common response to this question was replacing AFCIs with **other AFCIs** .

1. Replace them with other AFCIs (often a different brand)
2. Replace AFCI with regular circuit breaker
3. Troubleshoot and fix accordingly
4. Advise customer to replace appliance

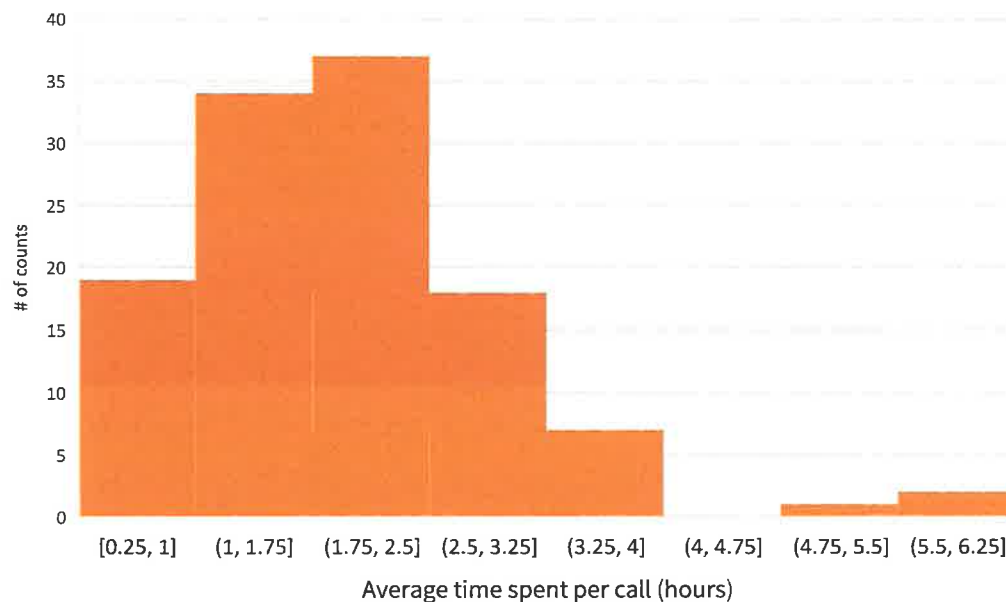
Are you aware of anyone ever replacing an AFCI or Dual Function AFCI/GFCI Breaker with a standard circuit breaker to resolve the nuisance tripping issue?



Most respondents knew someone who had replaced an AFCI breaker with a standard breaker. This percentage is consistent with that from the 2020 survey (83 percent).

- **Yes: 87%**
- **No: 13%**

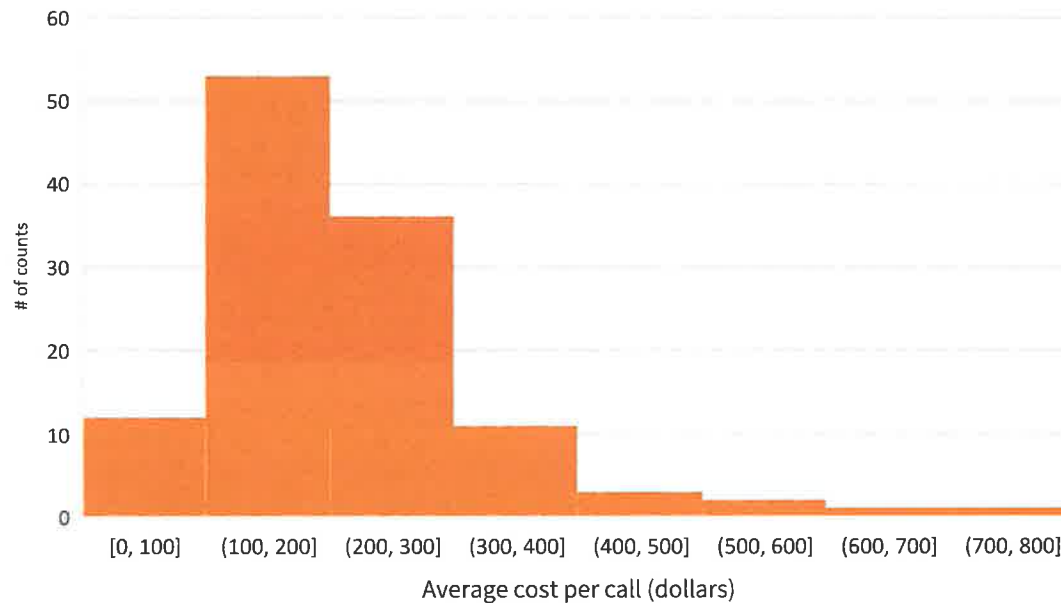
Considering drive and work time, ONE average call back takes ____ hours.



On average, respondents spent **2 hours** on a call back.

This average is the same as the 2020 average.

Considering tools, materials, supplies, and wages, ONE average call back costs _____ dollars.

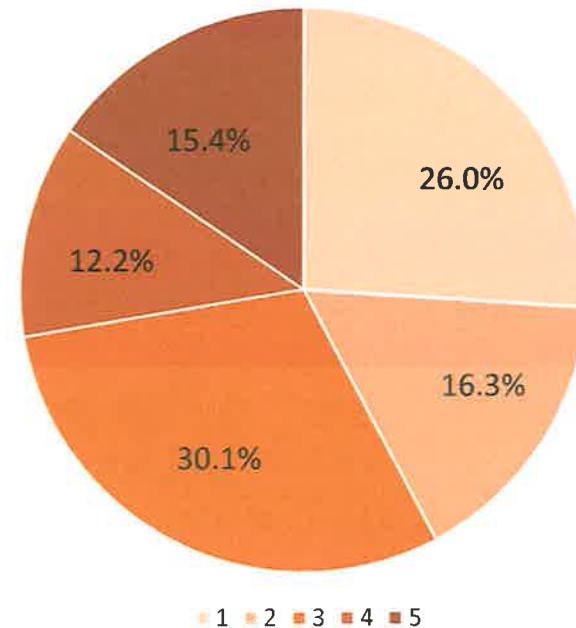
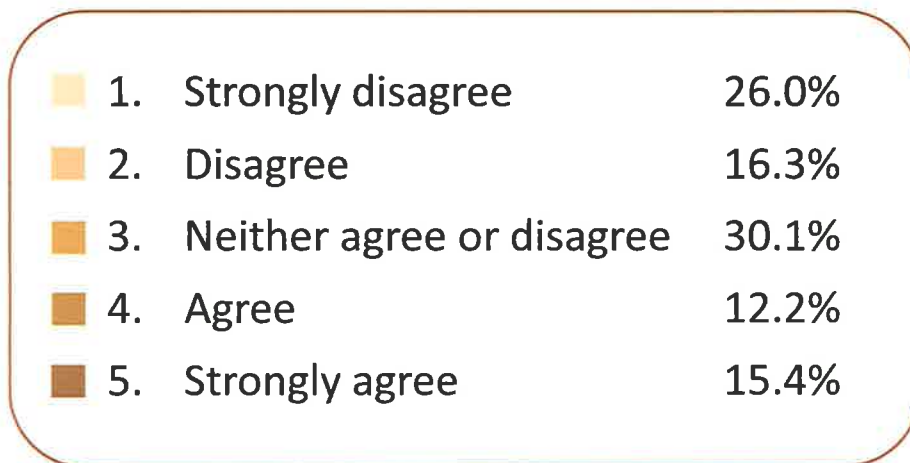


On average, respondents spent **\$200** for a call back.

This average is the same as the 2020 study average.

AFCIs or Dual Function AFCI/GFCIs should be installed in the same room, or on the same floor, as the room/floor that they serve.

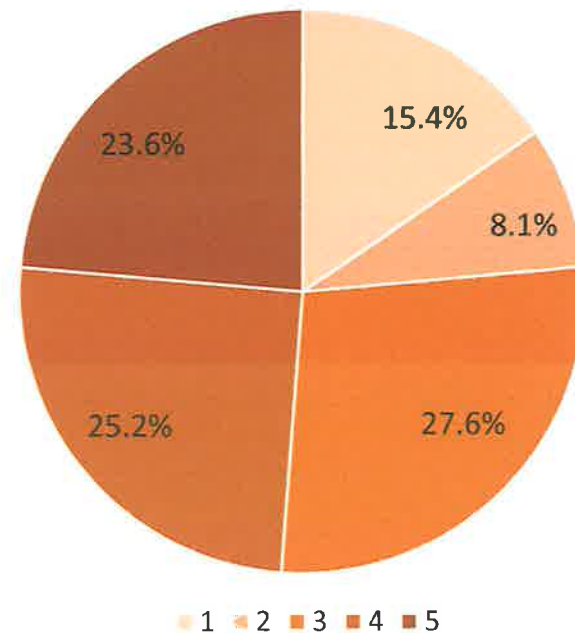
- Responses to this question were fairly evenly split. Some respondents noted this was ideal, but not often feasible.



AFCI and/or Dual Function AFCI/GFCI nuisance tripping problems have caused a decrease in my customers' satisfaction with my work.

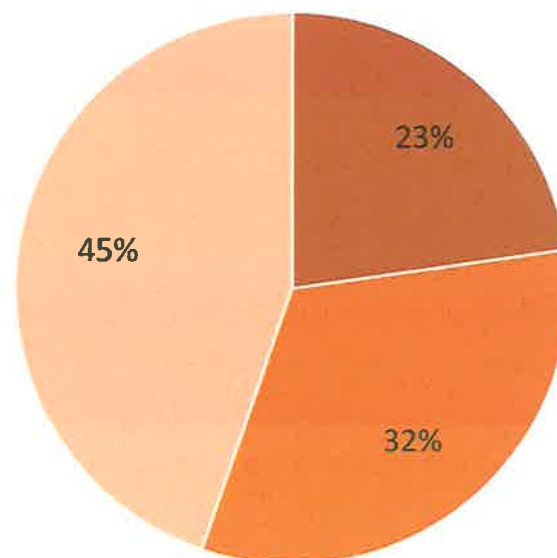
Almost half of all respondents agreed with this statement. Respondents have lost jobs/contracts because of nuisance tripping. More have started to proactively educate customers about this issue.

1. Strongly disagree	15.4%
2. Disagree	8.1%
3. Neither agree or disagree	27.6%
4. Agree	25.2%
5. Strongly agree	23.6%



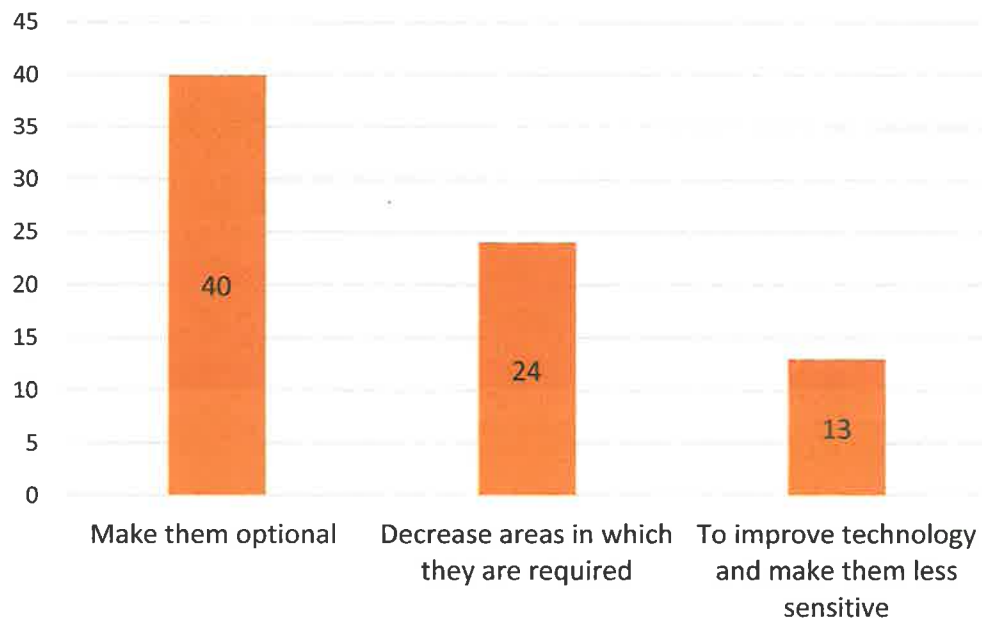
In your opinion, do the benefits of AFCIs and Dual Function AFCI/GFCIs outweigh the problems or do the problems outweigh the benefits?

- A majority of respondents (45 percent) believed that problems outweigh benefits.
- Twenty-three percent believed that benefits outweigh problems.



■ Benefits outweigh problems ■ Problems and benefits equal
■ Problems outweigh benefits

If you were writing the National Electrical Code (NEC), would you recommend any changes to the AFCI and/or Dual Function AFCI/GFCI requirements? If so, please note the changes you would recommend.



The most common responses to this question are as follows:

- Make them optional (top response by far)
- Decrease areas in which they are required
- Work with manufacturers to improve technology and make them less sensitive

Appendices

APPENDIX A: ABOUT THE RESEARCHERS

APPENDIX B: STUDY METHODOLOGY INFORMATION

About the Researchers

- Dr Steven W. Schmidt is Professor of Adult Education at East Carolina University. He also manages the Adult Education Program. He earned masters and doctoral degrees from the University of Wisconsin – Milwaukee. He has conducted many qualitative and quantitative research studies, and his work has been published in a variety of scholarly journals. He regularly presents his research at national and international conferences, and he has authored two textbooks. In addition, he is the author of the publication “The Shift to Competency-Based Education in the Electrical Trades Industry”, published by ELECTRI International.
- Dr. Xi Lin is Associate Professor of Adult Education at East Carolina University. She is a graduate of Auburn University’s doctoral program in adult education. Dr. Lin has conducted a variety of quantitative research studies, and also focuses on using technology in the research process. Her work has been published in many different journals and she has presented at conferences around the world.

Study Methodology Information

Steps taken to ensure study validity included the following:

- Subject-matter experts were employed to review the survey and interview questions to ensure content validity. The use of a standard interview guide and the pilot testing of the survey were also used to ensure overall validity.
- The use of multiple methods of data collection, along with data triangulation, was also used to ensure validity and reliability

Survey Protocol

- The survey was distributed to 4000 electricians randomly selected from a list of electricians owned by Electrical Contractor Magazine. After pilot testing, survey invitations were sent to 4000 electricians on July 6, 2023. A follow-up, or reminder message was sent to the same list on July 11, 2023. The deadline for responses was July 13, 2023.

Survey Sample Size

- In order to ensure a 90 percent confidence level and a 10 percent margin of error in our study, the number of respondents had to be over 100. That was achieved with a total usable number of responses of 131. The 90 percent confidence level aligns with the confidence level for the 2020 study. The number of responses means we can generalize results for the population of residential electricians (with a 10 percent margin of error).

Attachment #5

EFC Collected Data on AFCI Nuisance Tripping

PI 3155

From: Gurvinder Chopra
Sent: Thursday, July 6, 2023 10:21 AM
To: Hamden, Todd
Subject: RE: AFCI Tripping

PI 3155
EFC DATA

Hi Todd, I don't see a reason for not being able to share on a public Domain as there is no mention of any names of the manufacturers which would make it confidential. We have shared this data with CACES and some regulators as well.

Gurvinder Chopra | VP, Standards & Regulations
Electro-Federation Canada



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CANADA

ELECTRO FEDERATION CANADA **EFC**     

From: Hamden, Todd <...>
Sent: Thursday, July 6, 2023 10:19 AM

To: Karen Ewing
Cc: Gurvinder Chopra
Subject: RE: AFCI Tripping

Hi Karen/Gurvinder

I am wondering if the below information can be shared in a public domain (General public). Has this information been in the public domain.

Regards,



Todd Hamden

Manager, Certification and Standards

www.hubbell.ca

From: Karen Ewing <
Sent: Wednesday, July 5, 2023 9:14 AM
To: Hamden, Todd <
Cc: Gurvinder Chopra
Subject: FW: AFCI Tripping

Hi Todd,

Below is a report on appliances that have tripped with AFCIs and the # of occurrences per year. We have some unknowns due to the submitter not sending in the details but we know there was a trip.

Hope this helps 🙏

Count of Equipment Causing Tripping	Years							Grand Total
	2018	2019	2020	2021	2022	2023	(blank)	
Microwave		2	10	28	18	17	9	84
Unknown	2	20	6	12	32	1	3	76

Washing Machine		2	5	25	26	8	4	70
Television		1	5	6	6	2	3	23
Vacuum		2	8	3	5		3	21
Refrigerator		1	1	4	5	1		12
Saw		4	2	4				10
Dishwasher			1	3	4	1		9
Freezer		2		1	1	2	1	7
Dryer			1	4			1	6
Mitre saw				1	2	2		5
Lawn mower				2	1	1		4
Pump			1				2	3
Stove					3			3
Oven				1	2			3
Hair Dryer				1			2	3
Washer/Dryer						3		3
Vacuum						2		2
Printer			2					2
Blender			1				1	2
Treadmill				2				2
Pot Lights			1		1			2
Printer			1		1			2
LED Tree					2			2
Hot Water Tank		1						1
Generator			1					1
Snow blower starter engine					1			1
Inverter Charger					1			1

Vent Hood		1					1
Computer					1		1
Sewage pump						1	1
Air Compressor				1			1
Garage Door Opener						1	1
CPAP Machine or electric foot rest					1		1
Heat Gun					1		1
Dehumidifier					1		1
Hot water heater				1			1
OTR					1		1
Car Charger				1			1
Battery				1			1
Sewerage pump				1			1
Playstation						1	1
Freezer & Refrigerator				1			1
Drill Press		1					1
Gas Range						1	1
Breville Espresso Machine, Vacuum, Tea Kettle, Bar Fridge				1			1
Christmas lights					1		1
Electric fireplace					1		1
Various						1	1
Projector						1	1
Heat pad						1	1
Propane boiler				1			1
Power sofa						1	1

Electronics			1					1
Exhaust fan					1			1
(blank)								
Grand Total	2	37	47	106	118	45	32	387

Kindest regards,

Karen Ewing | Business Sections Administrator

Electro-Federation Canada

190 Attwell Drive, Suite 560,

Toronto, ON M9W 6H8

Direct: (647) 250-8341



ELECTRO
FEDERATION
CANADA

EFC



From: Hamden, Todd <THamden@hubbell.ca>

Sent: Tuesday, July 4, 2023 4:00 PM

To: Gurvinder Chopra <gchopra@electrofed.com>; Karen Ewing <kewing@electrofed.com>

Subject: AFCI Tripping

Hi Gurvinder / Karen,

I hope this e mail reaches both of you well and you are enjoying our warm weather. I have a need for a bit of information as there are some proposals at NEMA to the NEC with respect to AFCI's and I would like to know what the reported incidents we have been tracking.

I would welcome any data you can disclose with me on the number of AFCI trips reported, what type of appliance and possibly manufacture (if you can). The manufacture info may be too much but anything you can provide would be of interest.

Regards,



Todd Hamden

Manager, Certification and Standards

T: 905 837-6058

T: 416.302.6004

Email: thamden@hubbell.ca

www.hubbell.ca

EFC collected data on AFCI nuisance tripping:

Count of Equipment Causing Tripping		Years						
Row Labels	2018	2019	2020	2021	2022	2023	(blank)	Grand Total
Microwave		2	10	28	18	17	9	84
Unknown	2	20	6	12	32	1	3	76
Washing Machine		2	5	25	26	8	4	70
Television		1	5	6	6	2	3	23
Vacuum		2	8	3	5		3	21
Refrigerator		1	1	4	5	1		12
Saw		4	2	4				10
Dishwasher			1	3	4	1		9
Freezer		2		1	1	2	1	7
Dryer			1	4			1	6
Mitre saw				1	2	2		5
Lawn mower				2	1	1		4
Pump			1				2	3
Stove					3			3
Oven				1	2			3
Hair Dryer				1			2	3
Washer/Dryer						3		3
Vacuum						2		2
Printer			2					2
Blender			1				1	2
Treadmill				2				2
Pot Lights			1		1			2
Printer			1		1			2
LED Tree					2			2

Hot Water Tank		1					1
Generator			1				1
Snow blower starter engine					1		1
Inverter Charger				1			1
Vent Hood		1					1
Computer					1		1
Sewage pump						1	1
Air Compressor				1			1
Garage Door Opener						1	1
CPAP Machine or electric foot rest					1		1
Heat Gun					1		1
Dehumidifier					1		1
Hot water heater				1			1
OYR					1		1
Car Charger				1			1
Battery				1			1
Sewerage pump				1			1
Playstation						1	1
Freezer & Refrigerator				1			1
Drill Press		1					1
Gas Range						1	1
Breville Espresso Machine, Vacuum, Tea Kettle, Bar Fridge				1			1
Christmas lights					1		1
Electric fireplace					1		1
Various						1	1
Projector						1	1
Heat pad							1
Propane boiler				1			1

Power sofa						1		1
Electronics			1					1
Exhaust fan					1			1
(blank)								
Grand Total	2	37	47	106	118	45	32	387

PROPOSAL INFORMATION

Description of change and reason for change (attached additional information as needed):

This proposal adds an equivalent and practical alternative method of providing AFCI protection that is intended to reduce the number of trips up-and-down stairs to the electrical panel for the testing, operation, and troubleshooting of AFCIs, and in the process reduce death and injury exposure to Connecticut families, especially the 65-and-over adults.

AFCIs and GFCIs, as part of recommended routine safety checks and maintenance, must be tested monthly, which requires going back-and-forth between the electrical panel and the areas being protected in order to verify the electronics and switching contacts are functioning properly to turn off power when called upon. Additional trips are expected due to nuisance trips with loads such as treadmills, game consoles, kitchen appliances, mostly plug-in loads on receptacle branch circuits, as the industry continues to receive reports of nuisance trips.

Nationally, from 2017 to 2021, there was an over 25% increase in death and injuries from falls in homes, with stairs being the most dangerous location and responsible for 23% of the fatalities, according to the National Safety Council. For 2021 alone, there were 29,100 death and 3 million injuries treated in hospital emergency facilities that were attributed to falls in the homes.

Locally, as reported by Connecticut Department of Public Health, the CDC estimated that “injury-related medical, work loss, and quality of life costs in Connecticut exceeded one trillion dollars in 2020; \$2 billion from deaths, \$374 billion from hospital admissions, and \$648 billion from emergency department treatment and release.” In addition, it was noted that “In 2021, approximately 85% of fall-related deaths and 70% of fall-related hospital admissions occurred among Connecticut residents 65 years of age and older.” Connecticut’s 65-and-older population accounts for 18.3% of the overall population.

The Electrical Safety Foundation International (ESFI) recently published a survey[3] of 100 Massachusetts electrical contractors that showed over 38,000 calls associated with AFCI and GFCI breakers in 2021. According to the 2023 follow-up to the 2020 survey of contractors that responded to the East Carolina University survey, electrical contractors are still dealing with at least one nuisance tripping issue in 33% of the jobs involving AFCIs, with 18% being two or more issues requiring two or more call backs. Considering the fact that the majority of dwelling units are 2 levels or more, with the electrical panel typically installed in the basement or garage, it is not hard to conclude that more trips between the electrical panel and the areas being protected means increased likelihood of trips and falls on the stairs, often times fatal events for the senior population. In fact, of the 29,100 deaths, noted earlier, due to falls in the homes that occurred in 2021 nationally, over 25,000 were adults aged 65 and older. Overall, falls among adults aged 65 and older cost over \$50 billion annually. For Connecticut in 2020, the figures were “over 400 older adults in Connecticut died from a fall and over 37,000 were sent to the hospital for care”.

For new constructions in Connecticut, there had been and will continue to be one realistic option out of the six permitted by the current Article 210.12(A) which is 210.12(A) (1), that forces consumers to traverse stairs to their electrical panel when dealing with AFCIs. The remaining, so called, “options” are either not commercially available (such as (2), (3) and (4)) or not practical (such as (5) and (6)).

With most nuisance trips occurring with plug-in loads on receptacle branch circuit, this proposal will provide homeowners relief by first giving homeowners the flexibility to choose between multiple offerings of Outlet Branch-Circuit (OBC) AFCIs, providing local test/reset, rather than stuck with limited offering from the same electrical panel manufacturer, and second, reduce the number of times they must traverse the stairs to operate the AFCIs, and in the process decreasing the likelihood of injury and fatality from AFCI involved activities in the homes. After all, human-life saving devices shall never be the cause of human deaths and injuries.

Proposed text change, addition or deletion (attach additional information as needed):

210.12

(A) Means of Protection.

AFCI protection shall be provided by any of the following means:

- (1) A listed combination-type AFCI installed to provide protection of the entire branch circuit.
- (2) A listed branch/feeder-type AFCI installed at the origin of the branch circuit in combination with a listed outlet branch-circuit-type AFCI installed on the branch circuit at the first outlet box, which shall be marked to indicate that it is the first outlet of the branch circuit.
- (3) A listed supplemental arc protection circuit breaker installed at the origin of the branch circuit in combination with a listed outlet branch-circuit-type AFCI installed on the branch circuit at the first outlet box if all of the following conditions are met:
 - a. The branch-circuit wiring shall be continuous from the branch-circuit overcurrent device to the outlet branch-circuit AFCI.
 - b. The maximum length of the branch-circuit wiring from the branch-circuit overcurrent device to the first outlet shall not exceed 15.2 m (50 ft) for a 14 AWG conductor or 21.3 m (70 ft) for a 12 AWG conductor.
 - c. The first outlet box shall be marked to indicate that it is the first outlet of the branch circuit.
- (4) A listed outlet branch-circuit-type AFCI installed on the branch circuit at the first outlet in combination with a listed branch-circuit overcurrent protective device if all of the following conditions are met:
 - a. The branch-circuit wiring shall be continuous from the branch-circuit overcurrent device to the outlet branch-circuit AFCI.
 - b. The maximum length of the branch-circuit wiring from the branch-circuit overcurrent device to the first outlet shall not exceed 15.2 m (50 ft) for a 14 AWG conductor or 21.3 m (70 ft) for a 12 AWG conductor.
 - c. The first outlet box shall be marked to indicate that it is the first outlet of the branch circuit.
 - d. The combination of the branch-circuit overcurrent device and outlet branch-circuit AFCI shall be identified as meeting the requirements for a system combination-type AFCI and listed as such.
- (5) If metal raceway, metal wireways, metal auxiliary gutters, or Type MC or Type AC cable meeting the applicable requirements of 250.118, with metal boxes, metal conduit bodies, and metal enclosures are installed for the portion of the branch circuit between the branch-circuit overcurrent device and the first outlet, it shall be permitted to install a listed outlet branch-circuit-type AFCI at the first outlet to provide protection for the remaining portion of the branch circuit.
- (6) Where a listed metal or nonmetallic conduit or tubing or Type MC cable is encased in not less than 50 mm (2 in.) of concrete for the portion of the branch circuit between the branch-circuit overcurrent device and the first outlet, it shall be permitted to install a listed outlet branch-circuit-type AFCI at the first outlet to provide protection for the remaining portion of the branch circuit.

(7) A listed outlet branch-circuit-type AFCI installed on the branch circuit at the first outlet in combination with a listed branch-circuit overcurrent protective device if all of the following conditions are met:

- a. The branch-circuit wiring shall be continuous from the branch-circuit overcurrent device to the outlet branch-circuit AFCI.
- b. The maximum length of the branch-circuit wiring from the branch-circuit overcurrent device to the first outlet shall not exceed 15.2 m (50 ft) for a 14 AWG conductor or 21.3 m (70 ft) for a 12 AWG conductor.
- c. The first outlet box shall be marked to indicate that it is the first outlet of the branch circuit.
- d. The service equipment or enclosure housing the branch circuit overcurrent protective device is located on a different floor or level from the room being protected that reaching the branch circuit overcurrent protective device from the room being protected requires traversing stairs, steps, or ramps.
- d. The outlet branch-circuit-type AFCI is installed on the same floor or level as the room being protected.

Informational Note: See UL 1699-2011, *Standard for Arc-Fault Circuit-Interrupters*, for information on combination-type and branch/feeder-type AFCI devices. See UL Subject 1699A, *Outline of Investigation for Outlet Branch Circuit Arc-Fault Circuit-Interrupters*, for information on outlet branch-circuit type AFCI devices. See UL Subject 1699C, *Outline of Investigation for System Combination Arc-Fault Circuit Interrupters*, for information on system combination AFCIs.

Supporting data and documents (attach additional information as needed): Please see attached documents referenced above.

https://portal.ct.gov/-/media/dph/injury-and-violence-prevention/injuryfactsheets/2021-falls-fact-sheet-final_110122.pdf

<https://portal.ct.gov/DPH/Health-Education-Management--Surveillance/The-Office-of-Injury-Prevention/Falls-Prevention-Program>

<https://www.esfi.org/esfi-afci-and-gfci-performance-survey/>