

**LOG OF MEETING
DIRECTORATE FOR ENGINEERING SCIENCES**

SUBJECT: CPSC Electrical Wiring Activities

DATE OF MEETING: August 7, 2003

PLACE OF MEETING: Hilton Knoxville Airport
Alcoa, Tennessee

LOG ENTRY SOURCE: Doug Lee, ESEE

DATE OF LOG ENTRY: August 19, 2003

COMMISSION ATTENDEES:

Doug Lee, ESEE

NON-COMMISSION ATTENDEES:

Michael Callanan- International Brotherhood of Electrical Workers (IBEW)

James Dollard- IBEW

Joseph Sheehan- National Fire Protection Association

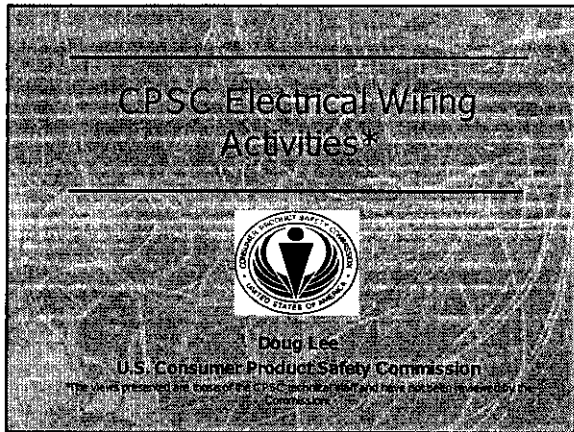
Michael Johnston- International Association of Electrical Inspectors

About 40 IBEW *National Electrical Code* code panel members (principals and alternates)

SUMMARY OF MEETING:

Mr. Lee met with the IBEW code panel members to present and discuss CPSC electrical wiring activities. Attached is the CPSC staff presentation.

6 (b) CLEARED: 8-20-03
_____☒ No Mfrs Identified
_____☐ Excepted
_____☐ Mfrs Notified
_____☐ Comments Processed



OUTLINE

- About the U.S. Consumer Product Safety Commission (CPSC)
- Electrical Wiring Activities
- Electrical Codes and Standards

2

About CPSC - Background

- Independent Federal regulatory agency, established in 1973 under the Consumer Product Safety Act
- Jurisdictional Authority under 5 Acts
 - Consumer Product Safety Act (CPSA)
 - Federal Hazardous Substances Act (FHSA)
 - Flammable Fabrics Act (FFA)
 - Poison Prevention Packaging Act of 1970 (PPPA)
 - Refrigerator Safety Act (RSA)
- 3 Commissioners, appointed by the President and approved by the Senate

3

CPSC - Budget/Staffing

- Total Budget - \$56 million in FY 2003
- About 470 staff
 - Headquarters (Bethesda, MD)
 - Field (throughout US)
 - Laboratory (Gaithersburg, MD)

4

CPSC - Jurisdiction

15,000 types of consumer products

- | | |
|---|--|
| ▪ Electrical Appliances  | ▪ Children's Toys and Furniture  |
| ▪ Combustion Appliances  | ▪ Home Wiring  |
| ▪ Furniture and Home Accessories  | ▪ Fabrics, Materials and Accessories  |
| ▪ Sports and Recreational Equipment  | ▪ Powered Equipment and Tools  |
|  | ▪ And more...  |

5

CPSC - Jurisdiction

Exceptions:

- | | |
|---|--|
| ▪ Tobacco products | ▪ Aircraft  |
| ▪ Medical devices | ▪ Firearms |
| ▪ Food and drugs | ▪ Pesticides |
| ▪ Automobiles | ▪ Cosmetics |
| ▪ Boats  | ▪ Workplace products |

6

CPSC Functions

- Collect & Analyze Data
- Perform Applied Research
- Encourage Voluntary Standards
- Require Performance Safety Standards
- Require Safety Labeling
- Require Special Packaging
- Enforce regulations
- Recall Defective Products
- Ban Hazardous Products
- Inform Consumers

7

CPSC Data Sources

- National Electronic Injury Surveillance System
- Death Certificates
- In-Depth Investigation Reports
- Injury/Potential Injury File
 - Hotline/website reports
 - Newspaper accounts
 - Other sources
- National Fire Incident Reporting System (NFIRS)

8

CPSC Fire Loss Estimates

CPSC Epidemiology staff provides annual estimates of consumer product-related residential fire losses

- National Fire Protection Association (NFPA) conducts an annual survey of fire departments and, from this, estimates national residential structure fire losses
 - Does not include details on causes of fire ignition or product involvement

9

CPSC Fire Loss Estimates

- U.S. Fire Administration's National Fire Incident Reporting System (NFIRS) compiles reports completed by participating fire departments
 - Reports include coding that describes fire cause and product involvement
- CPSC staff applies the proportions of the product-related fires from NFIRS against the NFPA national fire estimates to estimate total product-related fire losses.

10

CPSC Use of Data

- Define size of problem
 - set priorities, project decisions
- Characterize problem
 - design effective intervention
- Justify regulatory action
- Support recalls

11

Major Causes of Home Fires

- (1) Cooking Equipment - 27.7 %
- (2) Heating Equipment - 14.3%
- (3) Arson - 11.4%
- (4) Electrical Distribution - 10.8 %
- (5) Open flame - 8.4%

- Source: National estimates based on NFIRS and NFPA survey, 1999 NFPA National Fire Escape Survey

12

Major Causes of Home Fire Deaths - 1999

- Careless Smoking - 25.7%
- Arson - 18.6%
- Heating Equipment - 13.3%
- Cooking Equipment - 13.2%
- Electrical Distribution - 7.9%
- Open Flame - 6.1%

Source: National estimates based on NFIRS and NFPA survey, 1999 NFPA National Fire Escape Survey

13

Projects

- | | |
|--|--|
| <ul style="list-style-type: none"> ▪ Arc Fault Circuit Interrupters (AFCI) ▪ Countertop Cooking Appliances ▪ Clothes Dryers ▪ Transient Voltage Surge Suppressors ▪ Smoke Alarms <ul style="list-style-type: none"> • Wireless Interconnect • Sound Effectiveness • Survey (alarms, sprinklers, fire extinguishers) | <ul style="list-style-type: none"> ▪ Heaters <ul style="list-style-type: none"> • Portable • Fixed ▪ Panelboards ▪ Range Cooking Fires ▪ Mattresses/Bedding (open flame) ▪ Gas Water Heaters ▪ Upholstered Furniture ▪ Candles |
|--|--|

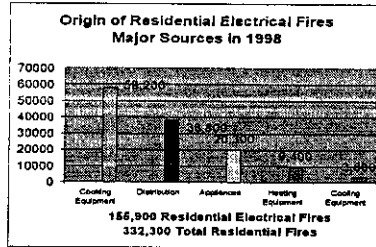
14

Electrical Wiring Activities Outline

- Fire Incident Data
- Inspection/Correction
- Outreach
- New Technologies

15

Residential Fire Losses

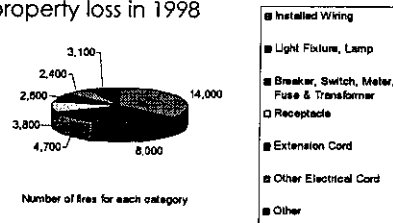


Source: 1998 Residential Fire Loss Estimates, U.S. Consumer Product Safety Commission - does not include arson related fires and all sources are not shown

16

Residential Electrical Distribution Fire Losses

38,800 Fires, 280 civilian deaths, 1,230 civilian injuries and \$680 million in property loss in 1998



Source: 1998 Residential Fire Loss Estimates, U.S. Consumer Product Safety Commission

17

CPSC History of Addressing Wiring Fires

Progressive effort since the Agency's inception

- In the late 70's, CPSC staff investigated problems with aluminum branch circuit wiring
 - Issued *Repairing Aluminum Wiring* pamphlet to advise consumers
- In 1987, CPSC staff conducted a special study of electrical wiring fires (149 in-depth cases)
 - Fires occurred at highest rate in older homes
 - Improper modifications/installations also key factors

18

CPSC History of Addressing Wiring Fires

- Home Wiring Project focused on older homes
 - Push for re-inspection of electrical systems in existing residences
 - Adoption of NFPA 73 *Electrical Inspection Code for Existing Dwellings*
 - Produced videotape demonstrations of incremental wiring repairs
 - Affordable steps to remove gross hazards
 - In 1994, sponsored study of technology for detecting and monitoring conditions that could cause electrical wiring fires (UL contract)

19

CPSC History of Addressing Wiring Fires

- UL study found that arc fault detection appeared to be very promising, especially when added to an existing circuit protection device, e.g., a circuit breaker.
 - This can be further improved if combined with ground fault detection technology
- CPSC staff has had a longstanding involvement with the *National Electrical Code®*
 - including membership on Code-making panel 20 (now CMP-17)
 - membership on Code-making panel 2 since 2000

20

Arc Fault Circuit Interrupters (AFCIs)

- By 1997, residential circuit breakers with arc fault were becoming commercially available

Figure 2.



21

AFCIs

- CPSC staff submitted comment supporting proposals for 1999 *NEC* to require AFCIs for all branch circuits
- Compromise position was requirement for circuits supplying power to bedroom receptacles to have AFCI protection; delayed effective date of Jan 2002
 - Adopted in 1999 *NEC*
- All bedroom outlets required to have AFCIs in 2002 *NEC*

22

Future

- Continue to support upgrades to the *NEC* through proposals for the 2005 Code
- Support AFCI technology for older homes
- Assess technology for distribution system components that could further reduce electrical wiring fires

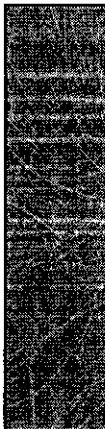
23

Data

- Dwelling fires related to electrical wiring systems from 1994-1998:
 - Annual averages - fairly level
 - Slight decrease in deaths and injuries
- Older homes at greater risk; new homes not immune.

Source: 1998 Residential Fire Loss Estimates, U.S. Consumer Product Safety Commission

24



Plan to Obtain Better Data

- Fire Protection Research Foundation (FPRF) proposal on wiring
 - Evaluation of wiring systems in existing homes
 - Improving fire reports
 - Lab testing of old components

FPRF is a not-profit research foundation of the National Fire Protection Association (NFPA)

25



Wire Safety Issues

- Aging, environmental stress
- Improper wiring practices
- Appliance/equipment load exceeds system design capacity

26



Potential Wire Safety Issues

- Environmental Stress - Chafing, embrittlement, and corrosion
- Improper installation
- Mishandling of wiring during maintenance
- Accumulated damage as wire ages

27

Current Practices

- Conformance with existing regulations, codes, and standards and revisions to them
- Training of inspectors and electricians
- Inspection, assessment, and maintenance of wire
- Engineering improvements
- Safety investigations
- Analysis of wire system data
- Exchange of technical information

28

Current Technology Initiatives

- **Diagnostics:** non-destructive evaluation (NDE) techniques, inspection and detection technologies, and monitoring sensors for identifying wire system defects.
- **Failure Mechanisms:** causes and models of wire system failure and analysis of maintenance data.
- **Interconnection Technologies:** improved connectors, such as at terminations and splices in wire systems, training, management tools, and advanced distribution technologies, such as modular wiring, fiber optics, and wireless technologies.
- **New Materials:** new materials for wire system components, such as conductors and insulation, and novel approaches for wire systems such as the application of microelectronic technology.

29

Common Issues

- Faulty wiring poses a risk to public health and safety; it may lead to failure of essential functions and even to smoke and fire.
- Managing aging wire systems is expensive and time-consuming.
- Inspection, testing, and maintenance of wire systems is a technical challenge.
- Most diagnostic procedures can detect only "hard failures" that result in serious deterioration of electrical integrity.
- Our knowledge about how wire systems age and how they fail is limited.

30

Common Issues

- There are limitations to our electrical codes and standards.
- Wire systems are becoming more complex with increasing computerization of operations and of information about those operations.
- Wire system maintenance is very expensive and it is difficult to get funding to address wiring issues before a system break down.
- Current practices flow from – and are limited by – the current state-of-the-art of wire systems technology in terms of design, installation, diagnosis and maintenance.

31

CPSC Actions

- CPSC-sponsored electrical distribution system fire investigations in the 1980s conclude older homes at greatest risk
- CPSC priority project in early 1990s develops strategies:
 - inspection code for existing residences
 - application of new technology to older residences
 - demonstrate practical safety improvements
- CPSC joins National Science and Technology Council "Wire System Safety Interagency Working Group" in 2000, a joint agency effort to look at aging and deterioration of wiring systems

32

Wire System Safety Interagency Working Group

Consumer Product Safety Commission	National Aeronautics and Space Administration
Department of Commerce	National Science Foundation
Department of Defense	Nuclear Regulatory Commission
Office of the Secretary of Defense	In addition, the following organizations are represented on the WSSIWG:
United States Air Force	Defense Nuclear Facilities Safety Board
United States Navy	Office of Management and Budget
United States Army	Office of Science and Technology Policy
Department of Energy	National Partnership for Reinventing Government
Department of Transportation	National Transportation Safety Board (observer)
Federal Aviation Administration	
Federal Railroad Administration	
Federal Transit Administration	
US Coast Guard	
Food and Drug Administration	

33

Inspection Code for Existing Homes

- NFPA 73
- Complements the *National Electrical Code* (NFPA 70)
- Principal members include CPSC, UL, IEEE, NAHB, IAEI, NECA, NEMA, EEI
- New proposals are now being accepted, due early January

34

CPSC Demonstrations

- Four old homes inspected and improved (Washington, DC area, Atlanta, St. Louis and Redlands, CA)
- TV-quality videos produced
- CPSC Guide Booklet "Home Wiring Hazards"
- Nationwide distribution of over 1000 sets of materials to state and local fire and electrical officials

USFA

35

Current CPSC Activities Funded by USFA*

- Research Project on Residential Electrical System Aging - a cooperative effort with The Fire Protection Research Foundation of NFPA
- Government-owned housing: addressing older wiring with AFCIs
- Outreach efforts via media (publications, video tapes, presentations)
- Continuing efforts via codes and standards
 - NFPA 70 proposals for additional AFCI protection
 - NFPA 73, evaluation criteria for installed systems

*These activities are partially funded by the U.S. Fire Administration (USFA)

36

Codes and Standards

Voluntary Standards Organizations

- Non-Voting members
 - ASTM
 - ANSI
 - UL
 - NEC

37

Codes and Standards

- UL- STPs
 - AFCIs
 - GFCIs
 - Smoke Alarms
 - Leakage Current Protection Devices
 - Cord Sets and Power Supply Cords
 - Transient Voltage Surge Suppressors (TVSS)
 - Relocatable Power Taps
 - Circuit Breakers/Panelboards
 - Many appliances

38

AFCIs

- CPSC Staff Evaluations
 - Efficacy
 - Nuisance Tripping
 - Consumer Usability
 - Cost vs. Benefit
 - Older Construction -Benefits 2:1 for homes 20 years or older
 - New Construction
 - 30 years life - benefits equal cost
 - 40 years life - benefits greater than cost
 - cost will decline

39

NEC Proposals - AFCIs

- Existing Homes - CPSC Staff Priority area
 - Install AFCIs on all single phase 125V, 15A and 20A outlet circuits when service equipment is replaced (CPSC 2-124)
 - Minimally should accept, single phase, 125V, 15A and 20A bedroom outlets (IBEW 2-171)
- New Construction - Support
 - Bedroom outlets
 - Single phase, 125V, 15A and 20 A outlets AFCI protected (E-CH, AmeriTel Consulting)
 - Living areas - living and dining (NASFM)
- Against AFCIs in new construction - NAHB

40

NEC Proposals - AFCIs

- Type of AFCI
 - Combination devices - new (SD)
 - Branch/Feeder - have field experience (other breaker manufacturers)
- Smoke Detectors/ Alarms on AFCIs
 - No technical reason to exclude
 - Exclude smoke detectors (IBEW 2-147)
 - Allowed but not required

41

NEC Proposals - AFCIs

- CMP 2 proposal 2-134a
 - A. Definition of AFCI, remains in Art. 210
 - B. Bedroom outlets, single phase, 125V, 15A and 20A, Combination type
 - Installed at origin of branch circuit except
 - Within 6 ft. of overcurrent protection, and
 - Installed within metal raceway or metallic sheath

42

Staff Summary on AFCIs-NEC Proposals

- Priority in older homes when replacing service equipment on all single phase, 125V, 15A and 20A outlets
- New Construction
 - Support on all, single phase, 125V, 15A and 20A outlets
 - Installed at origin of branch circuit except
 - Within 6 ft. of overcurrent protection

43

GFCIs

- Efficacy
- Nuisance Tripping
 - Early design design problem - fixed
- Consumer Usability
- Cost vs. Benefit
 - GFCIs are inexpensive
 - Benefits almost 2:1 over cost

44

GFCI Field Failures

- 2001 NEMA study
 - ~10% Inoperable
 - Power but no shock protection
 - Miswired receptacles
 - Component failures
 - Surges
 - Few failed safely - no power

45

CPSC Objectives - GFCIs

- Improve level of safety w/ GFCIs
 - Add "fail safe" or power lockout
 - Less likely to be incorrectly wired
 - Less dependency on consumer for monthly testing
 - More tolerant of electrical surges
 - More resistant to effects of humidity

46

Consumer Perception of Lockout Technology

- Would consumers not use or test?
 - Consumer Testing is independent of perceived outcome of test
 - Consumers may test when visible
 - Consumers may test when reminded
- Consumers want device to fail safely and not provide unprotected power
 - Supported by IAEE comments, American Institutes for Research study (2000), CPSC Human Factors staff

47

NEC Proposals - GFCIs

- CPSC proposal 2-47 - Add GFCI protection for unprotected dwelling unit receptacles
 - Sinks (IAEE)
 - Boat hoists
- CPSC proposal 2-70 - Add GFCI protection for receptacles in areas frequented by the public
 - CMP 2 accepted outdoor areas accessible to the public
- CPSC proposal 17-6 Add GFCI protection for vending machines
 - Receptacles
 - Installed in plug

48

Staff Summary on GFCIs-NEC Proposals

- Add GFCI protection for unprotected dwelling unit receptacles, boat hoists, vending machines
- Add GFCI protection for receptacles in areas frequented by the public - both indoors and outdoors

49

Transient Voltage Surge Suppressor Incidents

- Incidents with metal-oxide varistors (MOVs)
- Related to IBEW concern for safety on multiwire branch circuits
- An open neutral can cause an overvoltage on products with MOVs
- Creates potential for fire hazard

50

Panelboards and Circuit Breakers

Data

- Electrical distribution system fires include those caused by panelboards and circuit breakers
- Review of incident data indicates panelboard fires likely occur when connections overheat between a circuit breaker and the panelboard's bus bar.

Technical Approach

- Obtain current/better field incident data by working with local fire investigators.
- Document designs of residential panelboards.
- Stress circuit breakers with thermal cycling to obtain failure mode data.
- Develop guidelines for investigators.

51

Typical Panelboard Fire Incident
Chevy Chase, MD - March, 2002

- Single Family, Ranch Style, Finished Basement
- No prior electrical problems
- Fire occurred at approx. 4 a.m.
- 80 and 86 year olds escaped without injury
- Estimated property loss in excess of \$80,000

52

To report unsafe products:

www.cpsc.gov

1-800-638-2772

Electrical codes and standards

Doug Lee

dlee@cpsc.gov

301-504-7569