Electrical Risks, Safety and Solutions for Older Homes

Presented by:

PowerCheck Electrical Safety Services

February 20, 2008

Many homes are presently insured that pose high risk of fire hazard!!

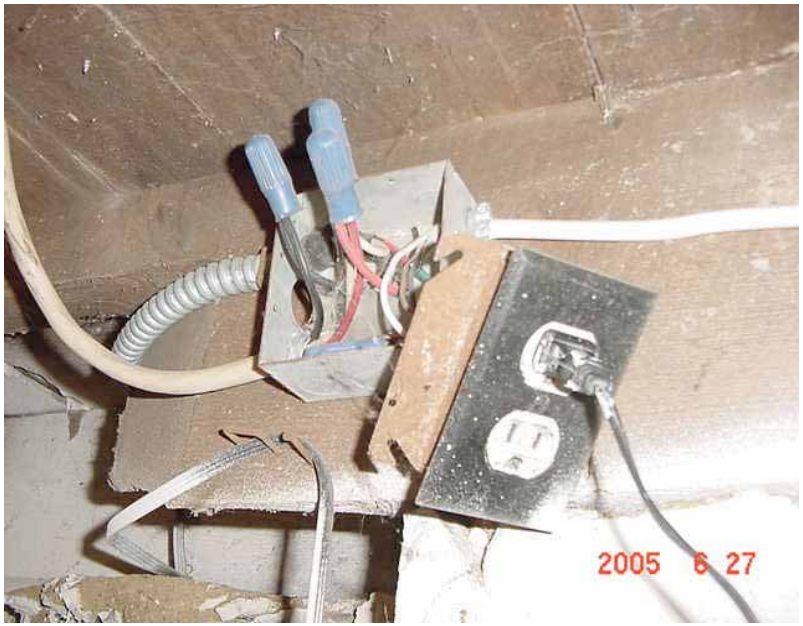
- **Reported fires due to faulty electrical period 2004 – 2007:**
  - **633**
  - **~ 1 home in 5000**
  - **$78 MM property damages**
  - **9% of total payout**
  - **4 fatalities, 20 injuries**
- These figures may be higher, as in a great number of fires the cause is undetermined.

Source: BC Fire Commissioner's Office

Residential property loss in BC accounts for about 9% of total payout

What is causing the fires?

- Vast majority of unsafe electrical systems in homes are due to tampering
- **We need to focus on the root causes of the unsafety – not the symptoms**
- Manage this by ensuring that an electrical system assessment is performed by a properly qualified person



A NOT uncommon sight. Dangers like these found in 60% of pre-1950 homes, regardless of “New service upgrade”. This type of work is what causes fires

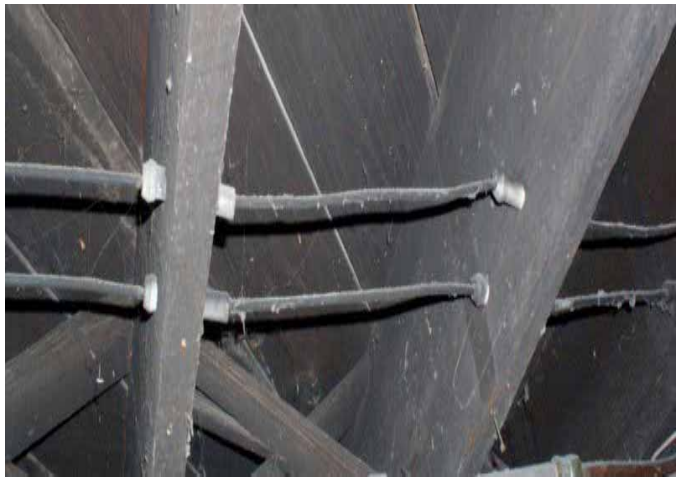
Pre-1950
Knob and tube wiring (K&T)

- Early standardized method of electrical wiring in homes
- Installed in all homes pre-1950
- Consists of
  - Two single insulated copper conductors run within wall and ceiling cavities
  - Supported by porcelain ***knob*** insulators
  - Insulated from joists and studs by porcelain ***tubes***.

Typical Knob and tube wiring in a 1930s home

Knob and tube: Qualities

- **Well engineered system**
  - Heavy gauge copper conductors (#12 AWG)
  - Minimal number of connections enroute to any receptacle
  - Solid connections: wrapped, soldered and taped
  - Conductors well spaced
  - Insulation rated for 60° C
- **Work *seldom* done by non-professionals**



Ceramic tubes protected the wire from rubbing the wood joists.

Knob and tube: Key hazards

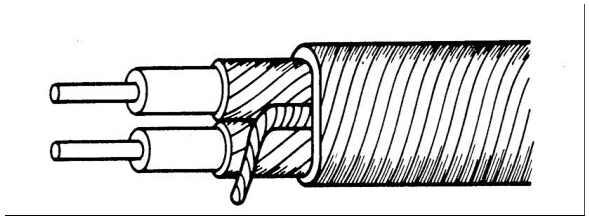
- **The hazards are not due to a deficiency of the knob and tube wiring, but due to alterations from unauthorized personnel**
- **Examples:**
  - 3-prong receptacles installed gives false impression of ground protection
  - Oversizing of fuses/breakers can lead to overloading resulting in insulation deterioration
  - Dangerous add-on circuits tapped onto the knob-and-tube conductors

3-prong receptacles are often found swapped in place of the original 2-prong receptacle, giving impression of ground protection.

1950 to 1962
Ungrounded, twin-conductor cable

1950

- **New cable introduced: NMD1**
- New, twin-conductor cable rapidly replaced knob and tube wiring due to ease of installation
  - As with K&T: Circuits not grounded
  - As with K&T: Insulation rated for 60°C



Introduced in 1950 a black, asphaltic-based twin-conductor cable. First version, NMD1, had no ground conductor. It was wired to 2-prong ungrounded outlets

Potential hazards

- As with knob-and-tube:
  - Ungrounded 3-prong receptacles
  - Insulation deterioration from overloading
  - Dangerous add-on circuits

1962 to 1984
New cables provide ground protection

1962

- **NMD3:** New cable introduced
  - with bonding conductor
  - Insulation rating still 60°C
- **NMD6:**
  - later introduced, with improved insulation rating of 75°C

Potential Hazards

- Unauthorized electrical work
  - Not for use in recessed lighting (requires wired rated at 90°C)
  - Dangerous add-on circuits

NMD3 and NMD6 used predominately 1960s to 1984. While excellent for most applications, *not* suitable for recessed lighting.

1984 to today
Modern residential cable

1984

- **NMD7**: New cable introduced
  - With temperature rating of **90°C**
  - Suitable for ceiling lighting
  - Later NMD 90 introduced with PVC jacket

Potential hazards

- Unauthorized electrical work
  - Not for outdoor, wet or underground applications
  - Dangerous add-on circuits

If not wired correctly, even modern NMD90 cable can be most dangerous

A unique period: 1965-1974 Aluminum wiring

1965 - 1974

- **Installed in vast majority of homes during this period**
  - An inexpensive solution to escalated price of copper at the time
- *"Homes wired with aluminum wire manufactured before 1972 are 55 times more likely to have one or more connections reach Fire Hazard Conditions than is a home wired with copper" (US CPSC).*

Aluminum wire, installed in the majority of houses 1965-1974

Aluminum wiring hazards

- ***"The problem with aluminum wiring is only at the connection point, the wire itself is fine" (NFPA, 2004)***
  - Poor connections at the point where aluminum meets copper can develop over time
- ***"Loose connections can potentially lead to hazardous arcs, glowing connections followed by fire" (NFPA, 2004)***

Poor connections lead to fire.

Aluminum wiring solutions

- **It is likely not necessary to rewire a home with aluminum, however it must be checked regularly for electrical safety**
- *"Each home will be different and must be assessed on it own. It is highly recommended the homeowner hire a licensed electrical contractor who is knowledgeable in the special techniques required for working with and repairing aluminum wiring" (Ontario ESA, 2004)*
- **If home has not been checked since new, it is well overdue**

Aluminum-copper connections deteriorate over time, leading to fire

GFCI ground protection

- Ground fault circuit interrupter (GFCI)
- **Providing all else is safe GFCIs provide an excellent solution for ground protection of ungrounded circuits (K&T or NMD1)**
- Available as:
  - **GFCI receptacles** or
  - **GFCI breakers**

Modern GFCI receptacle provides ground protection for ungrounded circuits

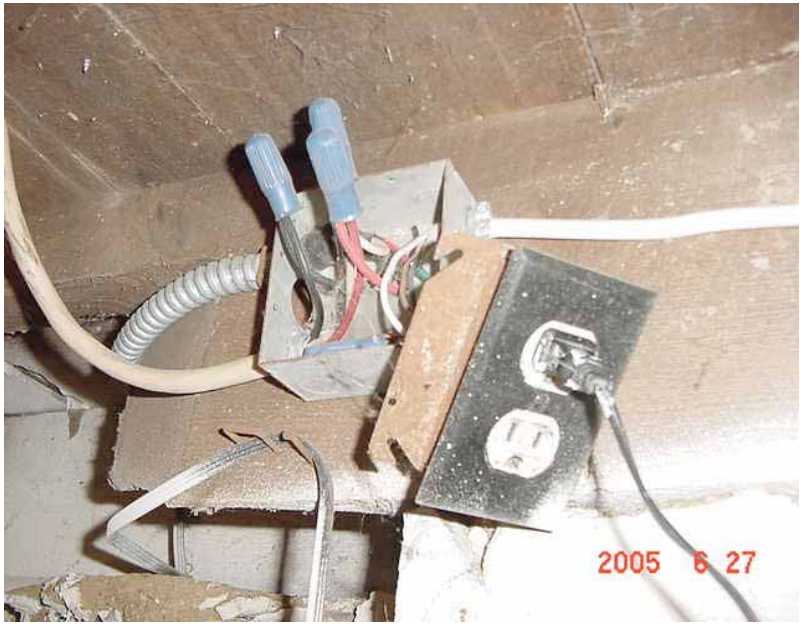
Is 60-amps adequate?

- It may be!!
- **60-Amp service is not necessarily unsafe**
- A *licensed electrical contractor* is the correct person to determine if 60 amps is adequate

Do-it-yourself 100-amp service kits are readily available from retail stores. Image source: Home Depot

Unauthorized electrical work ("Handyman tampering")

- **"Handyman tampering" is all far too common**
- The leading cause of electrical hazards
- **If handyman tampering is identified and eliminated, the number of accidental electrical fires will be greatly reduced**



A NOT uncommon sight. Dangers like these found in 60% of pre-1950 homes, regardless of "New service upgrade", or presence of knob-and-tube. This type of work is what causes fires

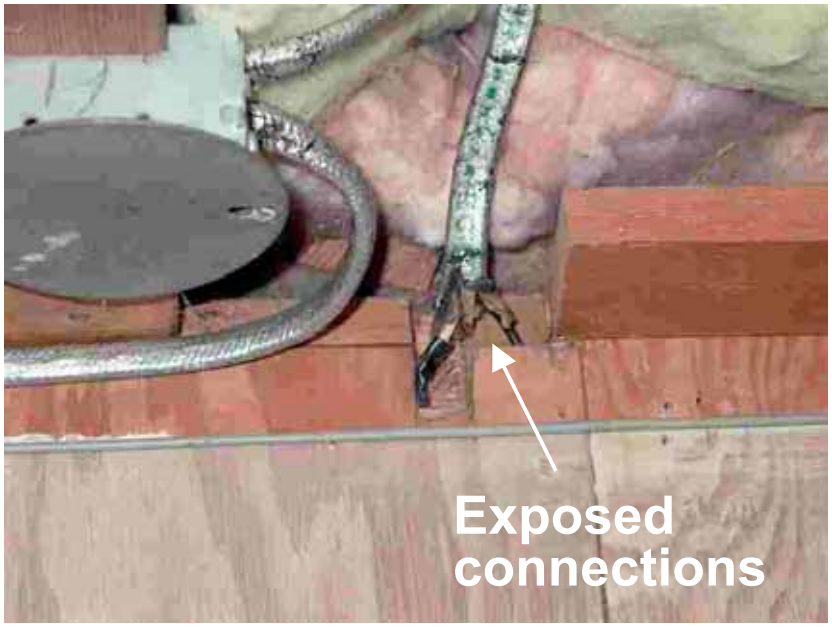
Commonly found: Over-rated breakers/fuses

- **Found in homes of all ages**
- 20 and 30 amp circuit breakers or fuse in place of original 15 amp
- Can *easily* lead to insulation breakdown, arcing, followed by fire

Oversizing of fuses and breakers can easily result in overheated conductors as shown above.

Exposed electrical connections

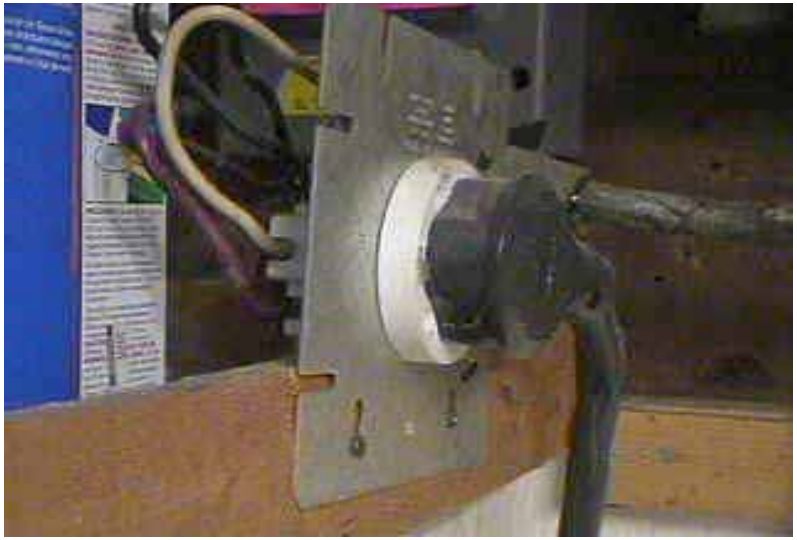
- **Found in homes of all ages**
- Exposed electrical connections, often in direct contact with wood, provide an easy opportunity for short circuits, arcing and fire



Handyman add-on supplies power to New Westminster basement suite. Connections are sandwiched between wood.

No junction box

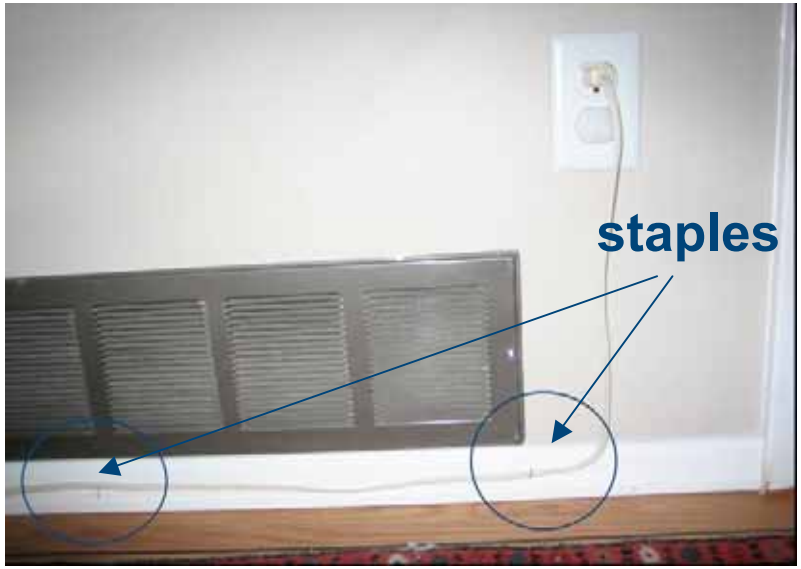
- **Found in homes of all ages**
- Particularly common with ceiling lights. The exposed connections often provide an easy opportunity for short circuits, arcing and fire



Lack of junction box is all too common in homes with add-ons wired by unauthorized individuals

Undersized extension cords

- **Found in homes of all ages**
- Extension cords are often stapled to wall. The staple provides an opportunity for a direct short, arcing and fire



Undersized extension cord used as permanent wiring. Staples provide opportunity for arcing and fire.

Baseboard heating in dangerous location

- **Found in homes of all ages**
- Baseboard heating installed
  - Under bookshelves
  - In contact with curtains
  - In vicinity of flammable material

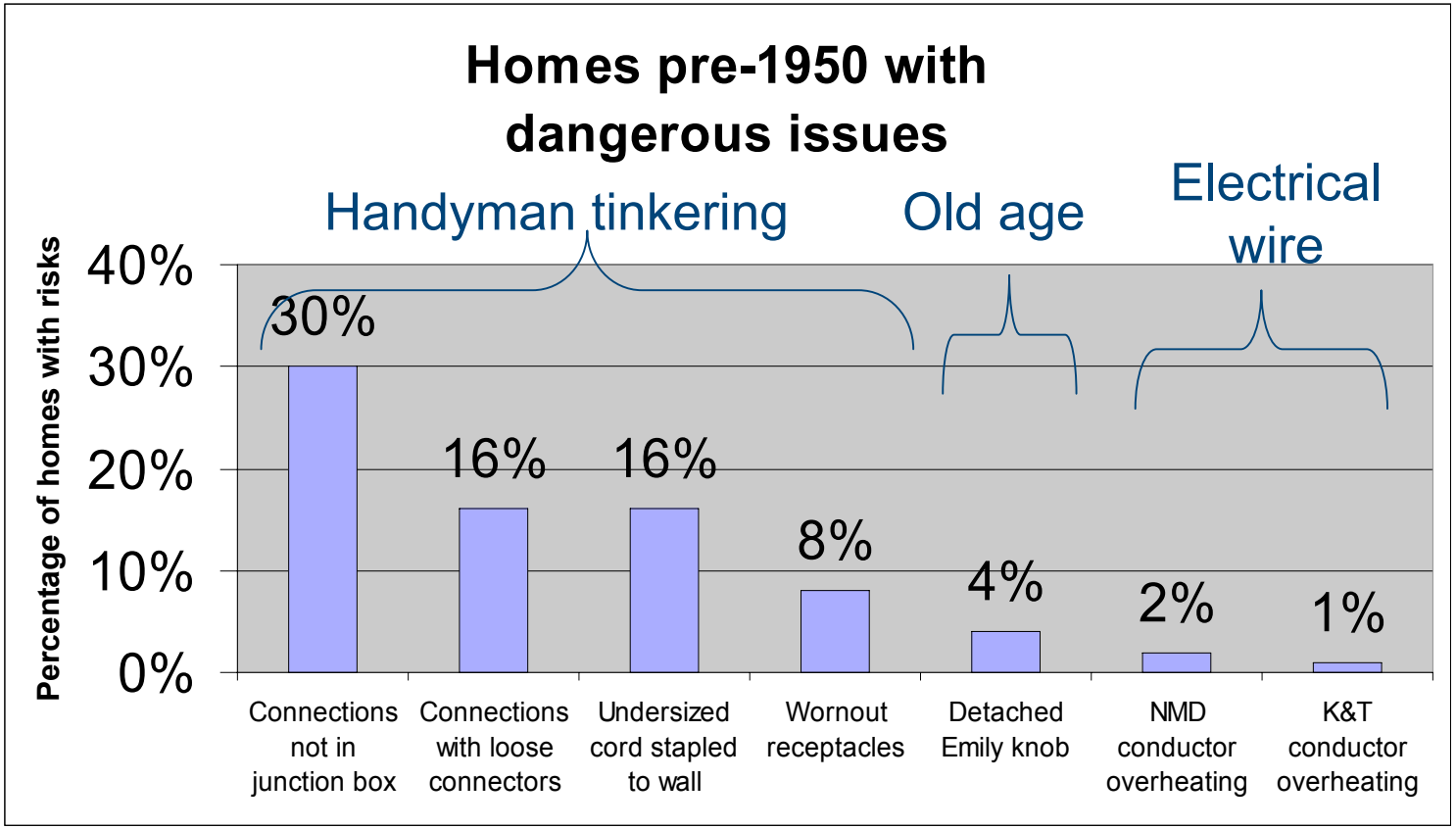
Dec 5, 2007, Akron, Ohio: “7 Firefighters said the fire began about 1 a.m. near an electric baseboard heater in the back of the house. In this house fire 3 children died, ages 6, 2 and 14 months” (source: The Plain Dealer, Cleveland News)

Deterioration with age

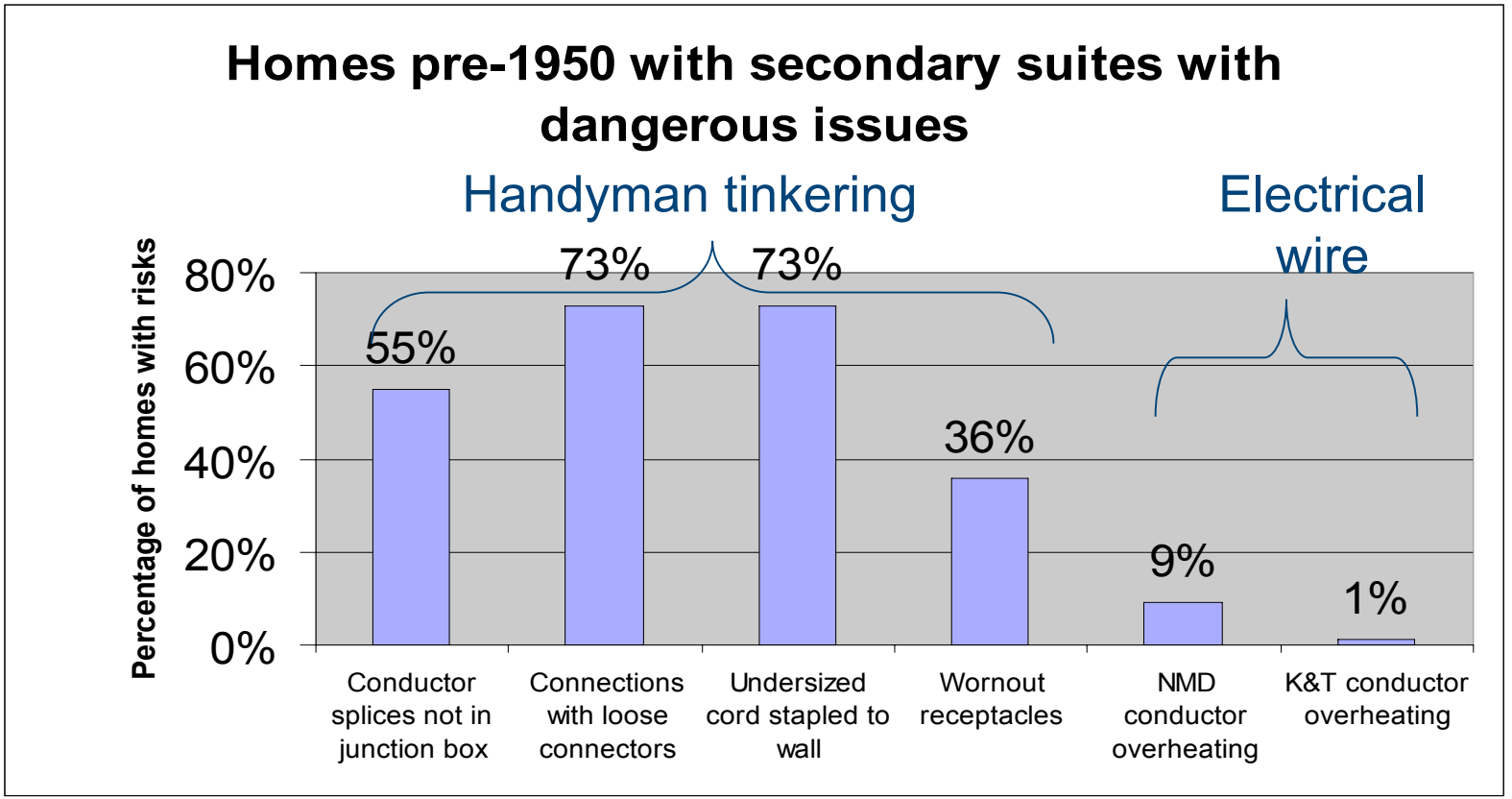
- Numerous studies conducted by the US CPSC and NFPA indicate that age of a house represents 17% of a contributing factor to the overall safety risk associated with electrical fire

Emily knob has broken free from side of house (shown left) creating a fire hazard condition

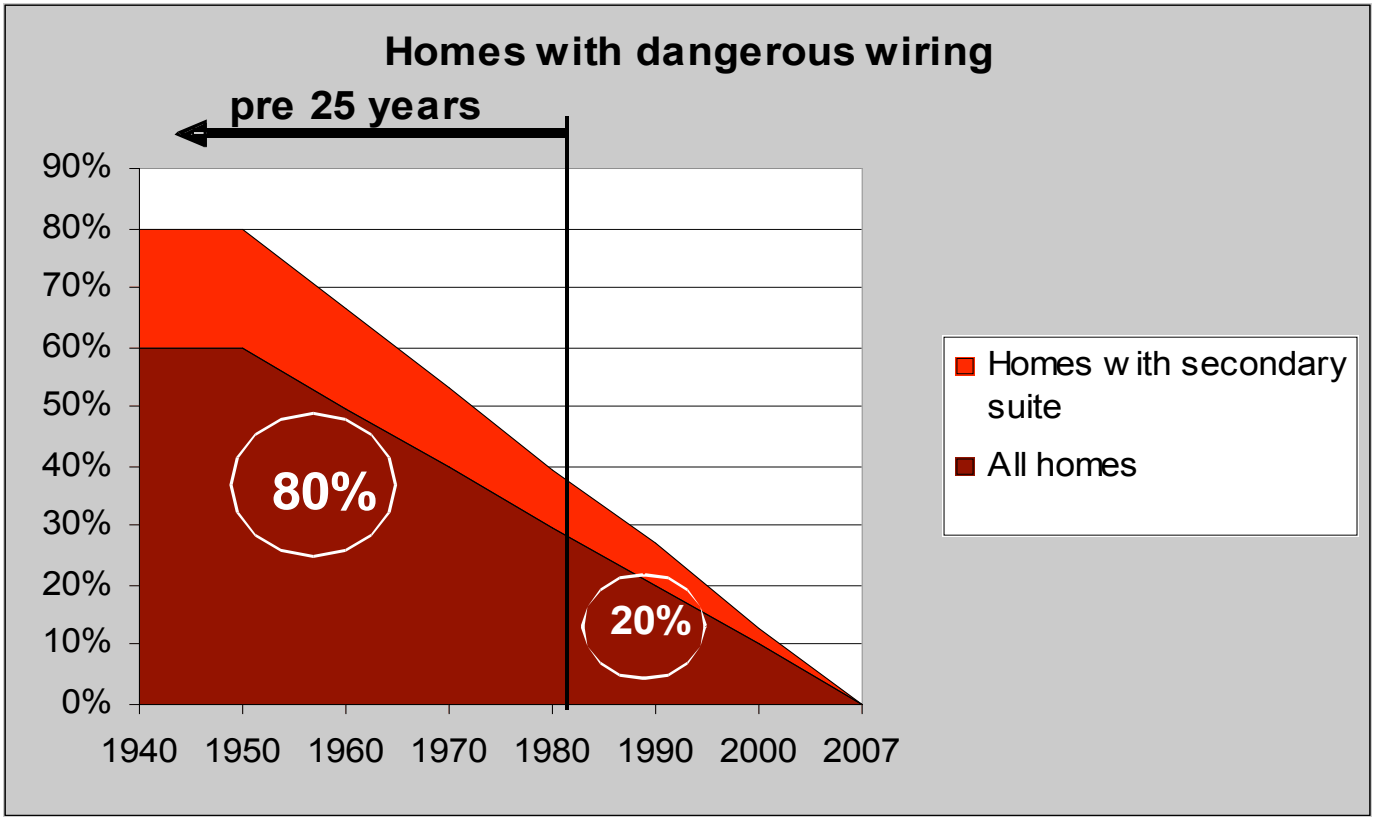
Where are we finding the hazards? Homes in general



Homes with secondary suites



Probability of risk increases with age



Risk vs. age of home

Indicators of homes with potentially high probability of risk

- **Homes with secondary suite**
  - High probability of hazardous electrical work having taken place
- **Homes with aluminum wiring (homes 1965 – 1974)**
  - High probability of risk if the homes have not been checked since new
- **Lower priced home in less affluent areas!!**
  - High probability of hazardous electrical work having taken place
- **Homes greater than 25 years of age (pre 1983)**
  - The older the home the higher the probability of risk

When should an electrical safety assessment be conducted?

- If you do not know if a licensed electrical contractor installed all electrical equipment since home was new
- When buying a previously occupied property
- If home is 25 years or older

These actions will catch the bulk of dangerous homes

Summary

- Vast majority of unsafe electrical systems in homes are due to tampering
- **We need to focus on the root causes of the unsafety – not the symptoms**
- Manage this by ensuring that an electrical system assessment is performed by a properly qualified person