



Guardian

A revolution in electrical safety

The Dangers of Broken Neutrals and Stray Voltages



WHAT ARE THE DANGERS OF A BROKEN NEUTRAL?

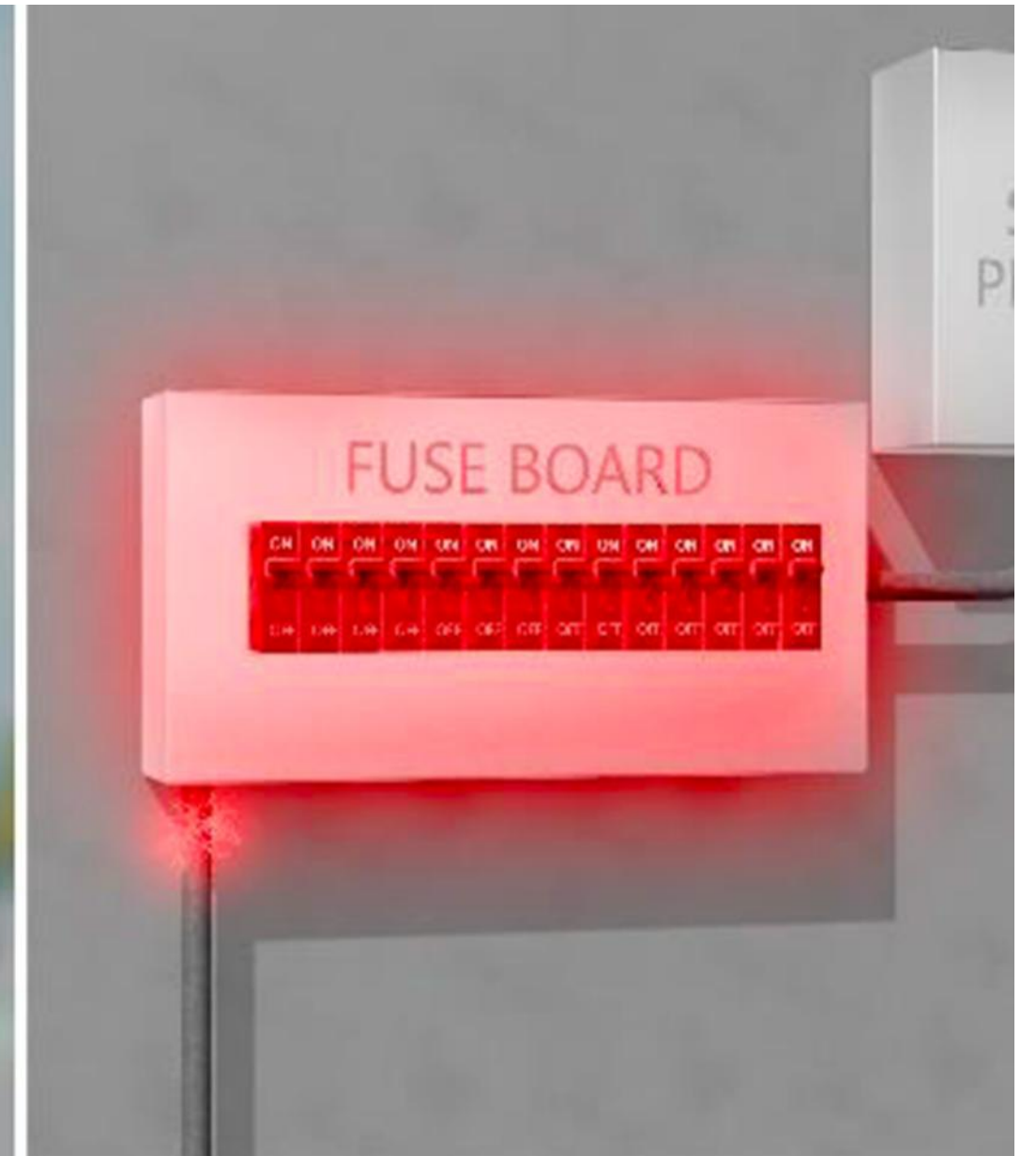


Bad connections or breakages in the Neutral conductor can cause excessive voltages in the electricity supply which can lead to

HIGH AND LOW LINE TO NEUTRAL VOLTAGES



FLOOR 1:	240V
FLOOR 2:	240V
FLOOR 3:	240V
FLOOR 4:	240V
FLOOR 5:	400V
FLOOR 6:	240V
FLOOR 7:	240V
FLOOR 8:	240V
FLOOR 9:	240V



The hairdryer moment



- **OVERHEATING YOUR ELECTRICAL INSTALLATION AND APPLIANCES.**
- **CAUSING SERIOUS DAMAGE OR DESTRUCTION TO CONNECTED LOADS**
- **RESULTING IN PREMATURE EQUIPMENT FAILURE**
- **CREATING A POTENTIAL FIRE HAZARD**



BUILDING FIRES



Broken Neutrals on the supplier's network or internally on sub supplies cause a real risk of electric shock.

Standard RCDs and MCBs **WILL NOT** detect the fault.

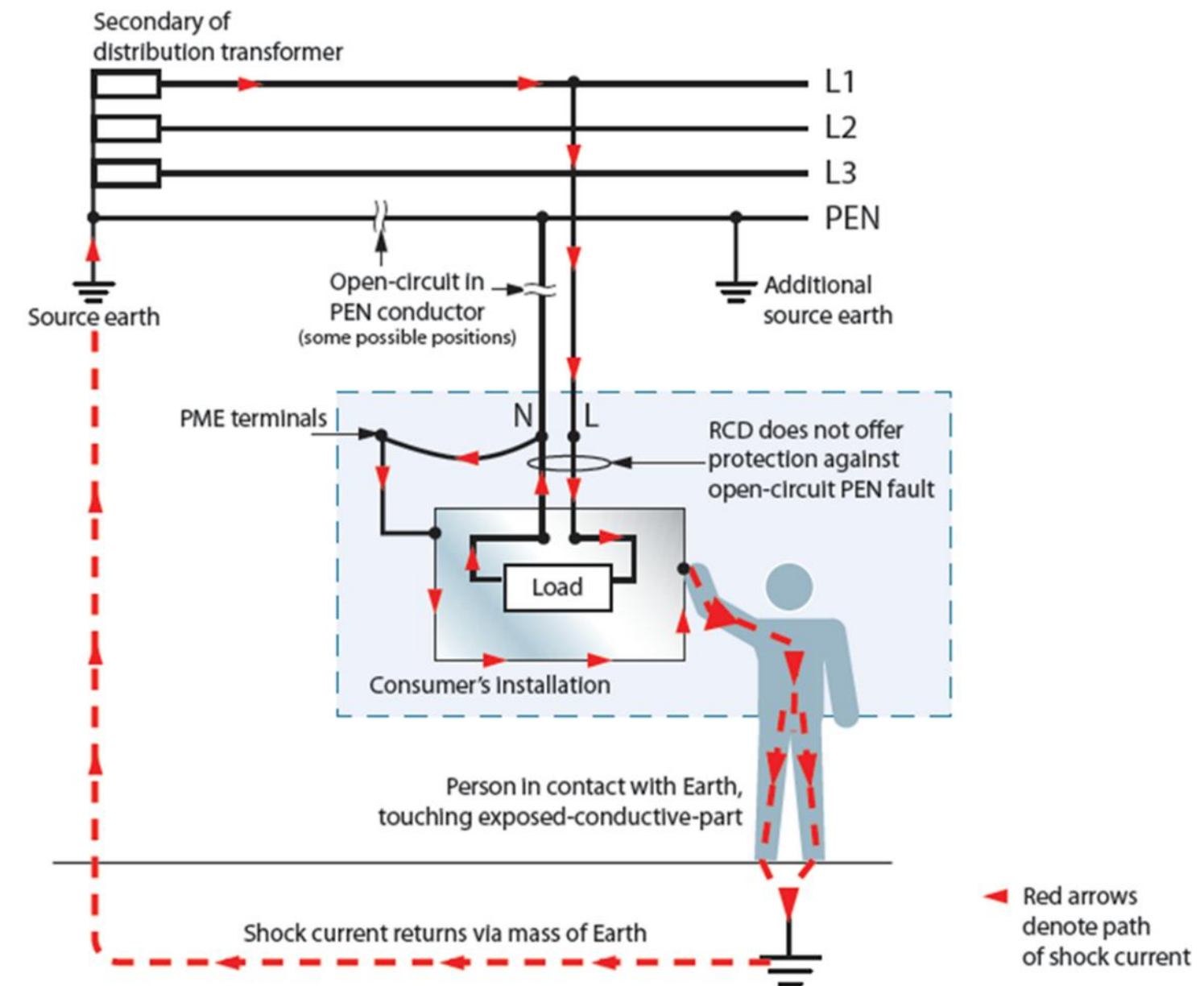


Fig 3 Electric shock risk due to open-circuit fault in the supply neutral PEN conductor

Neutral current diversion (NCD) – industry research update

Last year, the IET set out to gain information on ‘neutral current diversion’, working with industry partners NICEIC, ECA, Electrical Safety First, NAPIT, and SELECT and asked electrical installers and inspectors to answer a series of questions upon discovery of ‘neutral current diversion’.

One respondent reported they were first alerted to the possibility of current diversion due to sparks on the gas service installation pipework when verifying the continuity of conductors with the installation isolated.

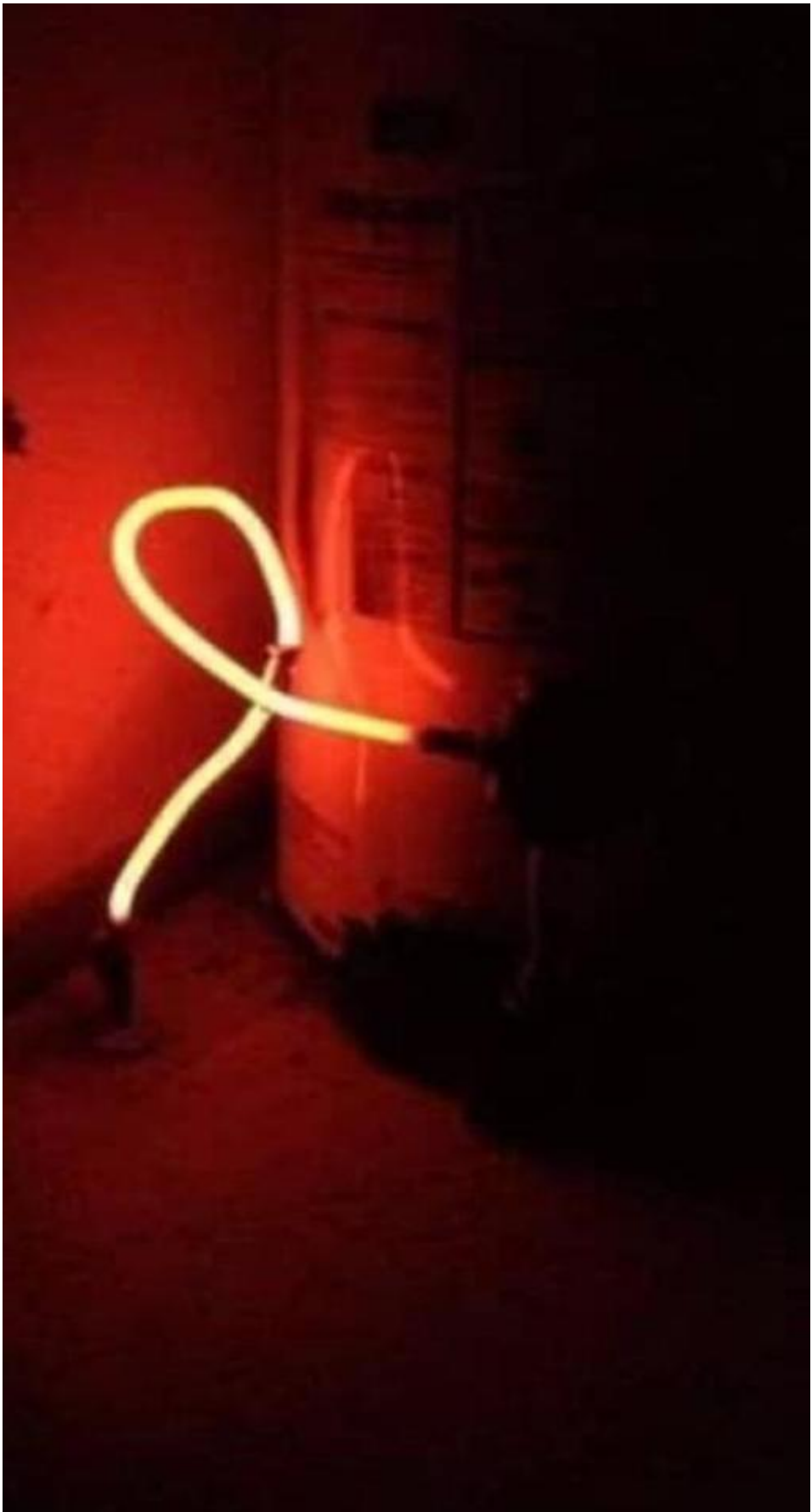
Within older electrical installations, extraneous-conductive-parts often take the form of metallic water and gas installation pipework. In the case of an open PEN conductor, the path the current takes is effectively determined by the load and impedance on the network. Metallic gas and water pipe work offer low impedance paths for neutral current to flow, potentially resulting in a significant heat build-up that can lead to fires and gas explosions.

Another respondent reported that the current recorded at the installation they were working at was subsequently found to have originated from an adjoining installation. This is a general theme of the comments and highlights that NCD can affect multiple installations at a time.

In 67 % of cases, respondents found an unexpected voltage that first highlighted NCD. The average current measured through the earthing conductor and/or extraneous-conductive-parts was 12 A, while the highest current recorded was **67A!**

It should be remembered that NCD can cause hazardous touch voltages to appear on the extraneous-conductive-parts and exposed-conductive-parts of the installation, as well as fire, explosion and damage to electrical equipment. Therefore, the IET and our industry partners strongly advise anyone who suspects NCD is present to report without delay to their local DNO.

Real life examples of diverted neutral currents causing water and gas pipe work to glow causing a real potential fire risk.



Global Evidence of the Dangers from a Broken Neutral





The residents of Grenfell Tower were alarmed to discover smoke pouring from their electrical appliances in May 2013. Laptops, televisions, washing machines and fridges were damaged by an unexplained series of power surges that prompted the frightened occupants of the 24-storey tower in west London to descend on their estate office, demanding action and answers.

Grenfell Tower

Flat Sub-Main Rising and Lateral Supplies Report, 29th May 2013.

The tenants above floor ten were reporting smoke issues, lights and power failing intermittently. On testing the incoming supplies sub-main cable voltages were shown as unusually high as indicated below: -

- 400v across Live and neutral terminals of supply
- 210v recorded across earth and neutral with main earth disconnected from met bar.
- 213v across all earths and extraneous conductive parts.

We isolated various flat consumer units whilst further testing and investigatory works were carried out. On testing the Ryfield Sub-Main distribution fuse board serving various flats located on the 15th floor to show additional test results as indicated below: -

- | | |
|--------------------|------|
| • L1 to Neutral | 399V |
| • Neutral to Earth | 236V |
| • L2 to Neutral | 400V |
| • Neutral to Earth | 334V |
| • L3 to Neutral | 399V |
| • Neutral to Earth | 234V |

We approached UK Power Networks to establish and confirm there supplies and cables had not been damaged as there are significant building works ongoing all around the perimeter of the block. On there arrival we assisted in locating the correct sub-main service heads which serve the flats, there's 2no.

The UK power network engineer carried out tests and confirmed that both service heads were intact and no abnormal voltages were recorded.

Further investigation found badly damaged enclosure and service cable in the lower ground floor riser cupboard where there is evidence of severe burn and arcing damage

This is concurrent with a Damaged/Broken cable on the sub-main supply side neutral. Connected to incoming service mains for Flats.

On inspection we found loose connections and the neutral cable had melted away from the clamp connections and could have caused a fire within the riser, please see attached photos on the following sheets.



RBKC Briefing

Electrical power surges to Grenfell Tower

- On 29 May there was a power surge at Grenfell Tower, localised to approximately 40 properties on the higher floors.
- The power was turned off for a couple of hours on 29 May to investigate and undertake repairs.
- The problem has been identified and the building made safe.
- **Temporary repairs were completed on 29 May to ensure resident safety. Further work will be required to fix the problem permanently** and we will advise residents of timing once we have confirmed arrangements.

Fixing the problem

Due to its age, Grenfell Tower has a more complex electrical wiring system than used in more modern buildings. This type of fault can develop at any time and would be difficult to identify during routine inspections.

The TMO carries out Periodic Electrical Inspections and tests to the communal electrics every five years as required. The last check was done three years ago and the system was reported to be in full safe working condition.

As a result of our findings we intend to install new rising main supply from the main service head with new terminations. We will also install power surge protection equipment to the main electrical supply for future safety and this will be done in conjunction with permanent repairs to electrical cabling.

To improve our Periodic Electrical Inspections we will introduce a thermal imaging test which will potentially identify any weak spots to the electrical connections on the main supply.

ELECTROCUTION FROM TOUCHING OUTSIDE WATER TAPS.

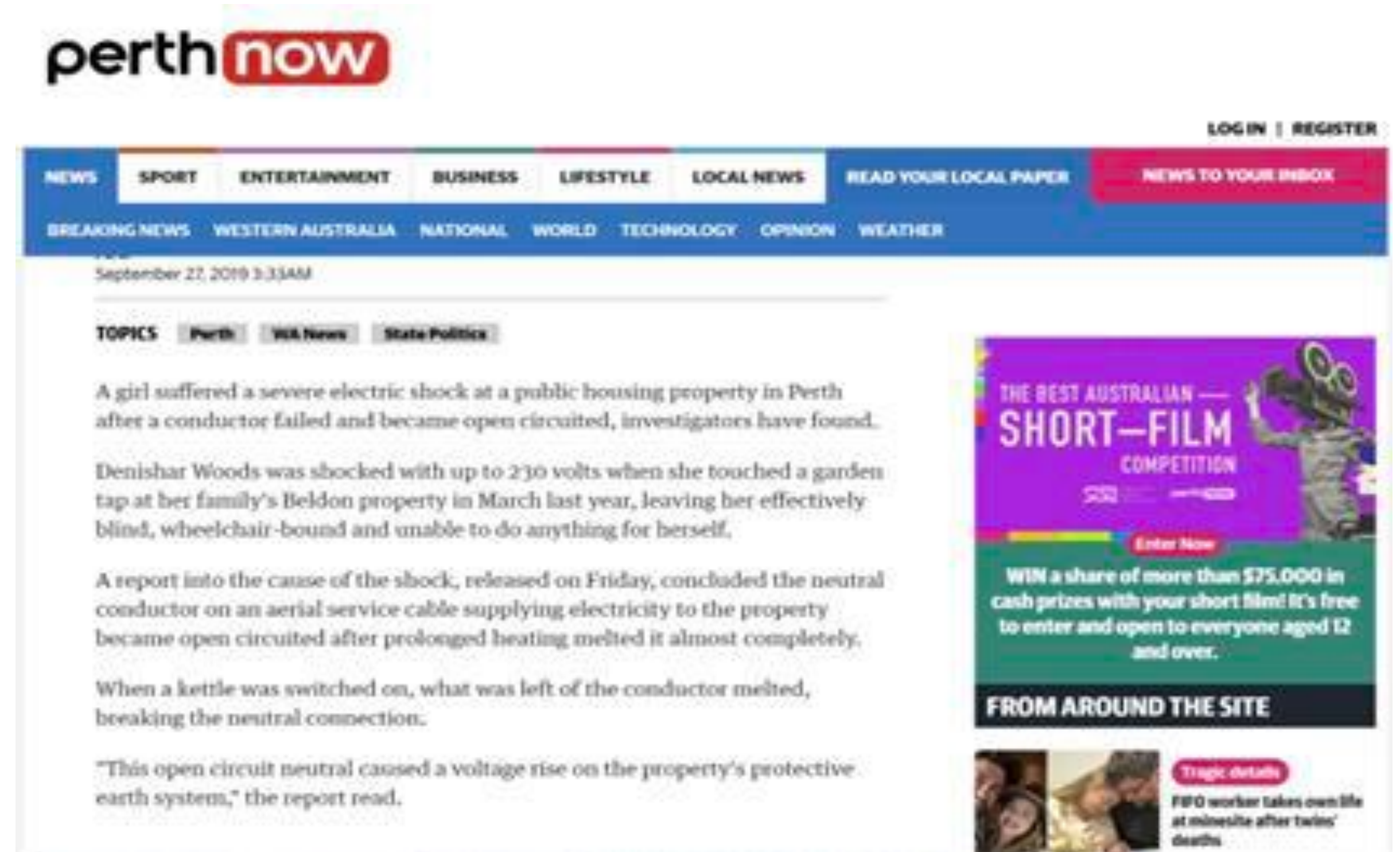
Western Australia's electrical safety regulator has concluded its investigation into the electrical accident that seriously injured a 12-year-old girl at a property in Beldon in March 2018.

In a report released today, Building and Energy (formerly EnergySafety) outlined the findings of its investigation into the cause of the accident. The investigation included on-site inspections and testing at the house and at nearby properties. It also included independent expert assessments of the earthing at the property and equipment involved in the accident.

The report found:

- the accident resulted from the failure of a neutral conductor that formed part of the aerial service cable which supplies electricity to the property;
- the 'open circuit neutral' fault occurred inside the mains connection box (MCB) attached to the roof of the property;
- the failure of the neutral conductor caused metallic parts connected to the electrical earthing system, including the garden tap, at the property to become electrically live, up to 230 volts; and
- the neutral conductor of the aerial service cable failed after it was subjected to prolonged heating.

Due to the damaged condition of the MCB, the investigation could not determine the cause of the heating and whether it started on the aerial service side or the consumer side of the MCB.



The screenshot shows a news article on the Perth Now website. The article is dated September 27, 2019, at 3:33AM. The main headline reads: "A girl suffered a severe electric shock at a public housing property in Perth after a conductor failed and became open circuited, investigators have found." The sub-headline states: "Denishar Woods was shocked with up to 230 volts when she touched a garden tap at her family's Beldon property in March last year, leaving her effectively blind, wheelchair-bound and unable to do anything for herself." The article text continues: "A report into the cause of the shock, released on Friday, concluded the neutral conductor on an aerial service cable supplying electricity to the property became open circuited after prolonged heating melted it almost completely. When a kettle was switched on, what was left of the conductor melted, breaking the neutral connection. 'This open circuit neutral caused a voltage rise on the property's protective earth system,' the report read." The article also features a sidebar with a "TOPICS" section listing "Perth", "WA News", and "State Politics". On the right side, there is a promotional banner for "THE BEST AUSTRALIAN SHORT-FILM COMPETITION" with a "Enter Now" button and text stating "WIN a share of more than \$75,000 in cash prizes with your short film! It's free to enter and open to everyone aged 12 and over." Below the banner is a section titled "FROM AROUND THE SITE" with a small image and a link to "Tragic details: FIFO worker takes own life at minesite after twins' deaths".

Boy killed by stray voltage




Melquan Robinson, 12, climbed a fence to get a ball and was fatally electrocuted (WSYX/WTTE)

Augusta, Ga (WSYX/WTTE) — A Georgia community is mourning the death of a boy after he was electrocuted by an apparent live wire on a park fence.

ELECTROCUTION THROUGH STRAY VOLTAGES ON METAL STREET FURNITURE

Woman Killed by Electric Shock on Street

 Share full article



By Sabrina Tavernise and Colin Moynihan

Jan. 17, 2004

A Manhattan woman died last night while walking her two dogs in the East Village in a bizarre accident that a Fire Department



LAW FIRMS OFFERING ADVICE



If you or someone close to you has suffered an injury due to a stray voltage incident, you need to reach out to an experienced personal injury attorney immediately. Your legal counsel can evaluate the extent of your injuries and enlighten you about your possible legal options to recover damages.

The Impact of Stray Voltage

Here are some common effects of stray voltage:

- Stray voltage can cause electrical shocks and injuries.
- Stray voltage can cause fires.
- Stray voltage can work its way to the water.
- Repeated exposure to electrical shocks can cause serious physiological and behavioral problems.

Every year, many properties are destroyed and individuals are injured or killed by electrical incidents in the United States. According to statistics from the Electrical Safety Foundation International (ESFI), electricity causes over 140,000 fires each year in the country, resulting in 4,000 non-fatal injuries, 400 fatalities, and \$1.6 billion in property damage.

Electrical incidents, such as stray voltage, often occur when an electrical current flows into a conductive item, including water pipes, concrete floors, or steel structures. If you or someone you know has suffered an injury due to a stray voltage incident, you may be eligible to seek compensation by filing a claim.

At The Fostel Law Firm, I have the resources and experience to guide, support, and represent victims of stray voltage incidents in their injury cases. As an experienced Texas personal injury attorney, I can evaluate the surrounding circumstances of your personal situation and explore your available legal options to seek damages.

ACCIDENTAL ELECTROCUTION CAUSED THE DEATH OF TWO RACEHORSES

Marching Song, trained by Andy Turnell and the Jonjo O'Neill trained **Fenix Two** both collapsed and died after suffering an **electric shock in the parade ring** before the first race.

Post mortem results from the horses, returned today (Thursday 17 February), show sudden **cardiac arrest** as the cause of death for both horses.

Investigations show an electrical discharge in the area killed the horses.

“The Authority has been officially informed that there was leakage of electricity from a cable under the parade ring in the area where the incident occurred,” said Professor Tim Morris, director of equine science and welfare at the British Horseracing Authority (BHA).

Sub station Neutral faults causing widescale damage to properties

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GRIMSBY NEUTRAL FAULT: CUSTOMER UPDATE

Posted: 24/03/2023

On Wednesday 22 March 2023, a neutral fault occurred on our network that impacted around 500 homes in Grimsby. We have reconnected all homes but, due to the nature of the damage, some homes require further repairs to their internal electrics and electrical appliances. We remain on site providing support to our customers and we are working to repair and replace damaged appliances.

The fault occurred at 02:40 on 22 March 2023 and impacted homes across 20 streets in Grimsby. The fault caused irregular voltages in customer homes, which meant that up to 415 Volts, rather than the typical 240 Volts, was supplied to power outlets causing damage to internal electrics and appliances. All customers were reconnected to the network within the day but, in some cases, repairs are required in customer's homes.

Andy Bilclough, Northern Powergrid's Operations Director said, "Neutral faults occur infrequently but we understand that they can be alarming to those affected when they do occur. However, our teams were onsite quickly to support our customers and we are working alongside our partner (GES) to repair or replace what has been damaged. For our customers whose boilers were affected, we have either sought to repair the boiler or provided temporary heating arrangements."

Louise Lowes, Northern Powergrid's Head of Customer Services said: "We have a team of people on site helping customers and are providing food, warm drinks and mobile phone charging facilities as well as handling claims. We have contacted all customers affected to make them aware we are here to offer support and we are closely monitoring our most vulnerable customers affected and offering appropriate support. We will continue to provide this support throughout the day.

"If any customer requires additional support or has a claim to raise, please call 105.





Please right click on the image below and open the link to watch our short product video and see how the Guardian can help detect and protect your building from faults that may occur on the electrical infrastructure



<https://www.youtube.com/watch?v=Mxo5VVx7C1g>

THE GUARDIAN, POWER AND PROTECTIVE CONDUCTOR MONITORING.



Installing Guardian to monitor the incoming mains supply and at each sub distribution board will help limit the risks caused by broken neutrals and help detect stray voltages on bonded services.



Helping to detect faults and safely isolate or warn the building owner of any potential fault before catastrophic failure occurs.

Guardian can detect stray voltages on any conductive services and surfaces, gas pipe work, metal fences etc. That should not normally be live.



REMOTE MONITORING

The Guardian can connect to the cloud-based portal or the customers own building management system where each device can be viewed remotely.



Guardian

DEVICE LIST

status	Enabled	Name ↑	Last Update Time
ALARM	YES	Guardian 1	24/04/2023,11:31:24
ON	YES	Guardian 2	24/04/2023,11:31:24
ON	YES	Guardian 3	24/04/2023,11:31:24

Guardian 1

L1-N VOLTAGE
230.85 volts

L2-N VOLTAGE
230.29 volts

L3-N VOLTAGE
231.44 volts

N-VN VOLTAGE
0.78 volts

Frequency out of Range

E-VN VOLTAGE
0.64 v

FREQUENCY
68.01 Hz

ELECTRICAL NETWORK TYPE
3 Phase - 4 Wire

Guardian v0.2

EARLY WARNING ALARMS

Alarms can be sent to help alert the building user or maintenance company of a detected fault before catastrophic failure occurs.



TARGET MARKETS

The Guardian provides safe, resilient, and cost-efficient power and protective conductor monitoring solutions, applicable in all buildings with a 3-phase supply, including but not limited to:

- Power utilities
- Data centers
- Commercial Buildings
- Schools
- Hospitals
- Rail Network
- Smart buildings
- Supermarkets
- E-mobility
- Energy storage
- Renewable energy
- Hotels
- Hospitality Industry
- Highrise apartments
- Care homes
- Marinas and swimming pools

an ideal solution for fire alarm designers, consultants, and facility management companies.

AWARDS AND TESTIMONIALS

“The Guardian is excellent; it’s got legs is the phrase. I can see this absolutely being at every single commercial and industrial installation in the future. The unit really does have legs!”

Quoted on FIX Radio The Electrical Show, 11th January 2024.

Paul Meenan



Radio Co-Presenter - The Electrical Show



c2c Head of M&E



Chairman - Workplace Safety
Electrical Safety Roundtable



Thank you.
**We look forward to answering
any questions you may have.**

