

ELECTRICITY NETWORK FIRES

Electricity networks start fires. Operating a network currently generates arcs and sparks. These high energy events may result in a small network fire or may result in a fire that impacts a wider area. Sometimes these fires have catastrophic consequences, such as the Black Saturday fires in Victoria in February 2009 or the fires in California in September 2017. While bushfires ignited by electricity networks represent only close to 3% of all bushfires, networks are over represented as the source of bushfires on extreme weather days (high wind speeds and temperature) (Miller et al., 2017).

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Bushfires ignited by networks, are second only after lightning, for the area burnt. This is because network ignited bushfires occur in remote or rural (low populations) area and tend to be well alight before being spotted.

IGNITION CAUSE	% OF BUSHFIRES	% AREA BURNT
Electrical	2.68	14
Lightning	16.04	46
Arson	6.43	13
Escape	27.40	5
Accidental	29.65	10
Unknown	17.81	11

After C. Miller et al. *Landscape and Urban Planning* (2017)

Bushfires started by electricity networks result in fines, litigations and damage to network reputations, as well as resulting in costly repairs.

IT'S GOING TO GET HARDER

Our changing climate means that managing the fire risk posed by operating an electricity network on an extreme fire weather day is becoming more challenging. Research indicates that the Forest Fire Danger Index (FFDI) in Australia will more than double by 2050 and the fire season is now longer than it was in the 1970s. The costs and impact of bushfires are increasing, and fires are becoming harder to manage as communities expand beyond the urban fringe, into bush. Not only does this place property in an environment where fire is a significant risk, but these properties require power, meaning that network infrastructure is built in treed environments.

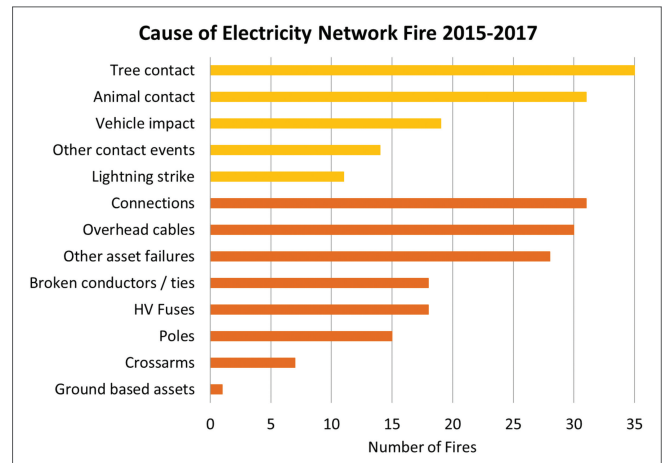


Figure 1 The combined Victorian network fire data for 2015-2017

WHAT CAUSES FIRES?

Since the Black Saturday fires and the resultant Royal Commission, Victoria's electricity networks have operated within a regulated scheme to reduce the number of network-related fires. This scheme also means that there is excellent data available from Energy Safe Victoria for the causes of network fires (<https://www.esv.vic.gov.au/news/2017-safety-performance-report-on-victorian-electricity-networks/>).

Broadly, there are two types of network fire – those caused by an asset failure and those caused by a contact event. Asset failures represent over 57 % of fire starts, with contact events representing 43 % of network fires in Victoria and it is important to note that not every network fire represents a bushfire, merely the potential for a wider fire.

The failure of assets is something that the network can manage, and significant work has occurred in Victoria to replace wooden cross-arms with metal cross-arms. Contact events are harder to predict and manage, but intelligent and automated self-healing protection schemes can help to mitigate the impact of contact events on customers and limit the number of fires.

IMPACT OF TREES

Victorian data indicates that trees contacting wires are an issue in Australia and trees interacting with Pacific Gas and Electric Company's (PG&E) wires have been implicated in 12 of the 2017 California fires, with more results to come from current investigations. These 12 fires resulted in the burning of 274364 acres, the loss of nearly 3000 buildings and the loss of 18 lives.

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Most of the Black Saturday fires were the result of downed conductors, which are very difficult to detect, as windblown debris and trees break the lines. Cable splices and cable clashing can also be an issue on windy days.

Managing trees is complicated, difficult and expensive. And trees not only represent a fire hazard, but also result in a significant number of outages during storms. Even when trees are trimmed back away from poles and wires to maintain a clearance zone, and even if trees are removed so that if a tree fell it would miss the line, branches snap off and become mobile in strong winds. Predicting which trees will fail and at what wind speed is challenging and often networks have no control over what tree is planted where.

NO ELECTRICITY, NO SPARKS, NO FIRES

One option to reduce the risk of a network igniting a fire is to pre-emptively cut the power running through a high-risk area like a forest. This has been done in South Australia and San Diego Gas and Electric Company (SDG&E) also pre-emptively cut power to some locations during the 2017 "Fire Siege" in California. It's an approach PG&E are considering for the future. Adding to networks' litigation woes, the California PUC is investigating whether de-energising significant areas of California's backcountry by SDG&E was appropriate. Without power rural customers are unable to pump water, either for their own use, animals' use or to fight fires. They also had difficulties with mobile phone access. Communications during a bushfire are vital, allowing rural communities to know where any fire is, keep informed and to receive an order to evacuate.

HEAT KILLS

The loss of electricity has other impacts. Weather systems that bring extreme fire danger also bring extreme heat. The system that brought Black Saturday resulted in temperatures of over 46°C in Melbourne, with record higher temperatures elsewhere in Victoria, for consecutive days. Extreme heat (high temperatures) kills more people in Australia than all other natural hazards combined, including bushfires. While 173 people lost their lives in the bushfires, double that number, 389, lost their lives due to high temperatures. Medical research shows that customers are 77 % more likely to survive an extreme heat event if there is a working air conditioner at home and no electricity, means no air conditioner.

70-YEAR-OLD TECHNOLOGY

Electricity networks rely on reclosers. Automatic reclosers are a great way to improve restoration times, as over 80 % of overhead line faults are transient, that is, a branch contacting lines results in a fault, but that branch then falls to the ground. A standard fuse would operate and then require a line-crew to search out the

operated fuse and replace. A recloser operates (opens and then after a pre-determined delay, closes. If the fault has resolved (branch falls to the ground), power is restored.

However, in the case of a permanent fault on a high fire danger day, and without changes to the protection settings to reduce reclose attempts to zero, the recloser is opening and closing on to the fault, creating sparks at the fault, which may ignite a bushfire. This is why reclosers are set to open and not attempt to reclose at the start of and for the duration the fire season, essentially acting like a standard fuse. But with fire seasons lengthening due to climate change this means every single fault on a line is permanent, requiring the attendance of a crew. And most networks have a movement ban on high fire danger days to keep their crews safe, meaning that customers could be without power for extended periods when they need it the most.

NEW SUITE OF SOLUTIONS

Fires are the symptom of the real problem, which is the dangerously spark intensive nature of current network protection approaches. There are spark-less solutions that reduce the fire risk posed by networks. Spark-less fuses that comply with the AS 1033 Class A spark-less standard, absorb arcs on opening and reduce the ejecta. There are reclosers that are sparkfree, using a vacuum bottle at the device and there are entirely new approaches that use less than 5% of the energy to test for a fault when compared to traditional reclosers. This new "PulseClosing®" approach allows for significant reduction in sparks and is ideal for bushfire mitigation applications.

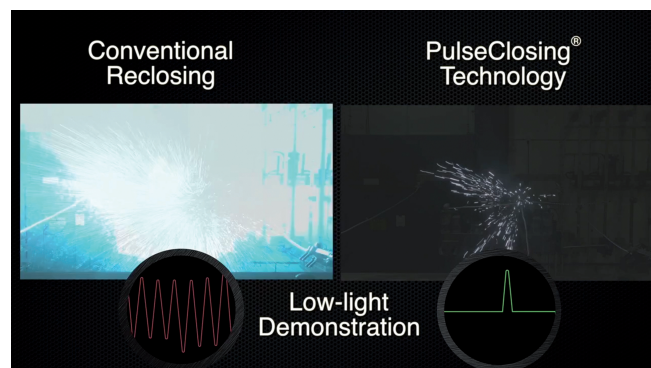


Figure 2 Comparison of sparks due to conventional reclosing with reduced sparks using PulseClosing®

The addition of communications to reclosers allows protection settings to be changed remotely, only when absolutely needed, such as on a high fire danger day, allowing customers to have the benefit of reclosing and fault clearance when it is safe to do so.

So, while current protection strategies are spark intensive, there are new ways to operate electricity networks to reduce sparks and the risk of starting a fire in an increasingly challenging environment. These new approaches also keep crew and customers safe and customers connected for longer, so that they can survive heat and fires.

For more information please contact S&C on SalesAustralia@sandc.com or visit sandc.com



S&C ELECTRIC COMPANY

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