

Electricity Transmission Lines

Bushfire Management
and Community Safety

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Victoria currently has over 6,500 kilometres of transmission lines, which are designed, operated and maintained in line with established safety frameworks.

Transmission line route selection aims to minimise impact to the environment. If the route passes through a high bushfire risk environment, then additional measures to reduce the risk are required.

Areas near or beneath transmission lines should be avoided in the event of a fire, as dense smoke can increase the risk of an electrical arc or flashover which can endanger life and property.

Introduction

As Victoria expands and adapts its electricity transmission network to accommodate our growing renewable generation sector, safety remains paramount.

Transmission lines, when managed and maintained properly, pose a very low risk of starting a fire. This is due to factors such as the height clearance between the transmission lines and the ground, as well as the managed vegetation beneath the lines that runs for the length of the line.

Energy Safe Victoria (ESV) ensures that those who design, construct, operate, and maintain the Victorian transmission network are aware of and understand their responsibilities and obligations to minimise the risk and impact of bushfires.

This information sheet outlines how the safety of the community is assured during the development of an electricity transmission network – from design through to decommissioning.

Throughout this information sheet the main unit of measurement used is volts. In the diagrams on pages 6-7 and 8-9, the unit of measurement used is kV (kilovolts) or a thousand volts. For example 500,000 volts = 500kV.

Background

The way electricity is generated in Victoria is changing. We are becoming less reliant on coal and gas and are more reliant on new renewable alternatives. Renewable energy sources include wind, solar and hydro, together with large scale storage facilities, such as batteries and hydro electric energy storage.

There are six key renewable energy zones in Victoria and more of our electricity will be generated at wind and solar farms located in these zones. New transmission links are being built to transport this electricity – from where it is being generated, to where it will be used in urban and regional Victoria.

The powerlines used to transport electricity from the generation source to substations (located near the users of electricity) are called “transmission lines.” Transmission lines are typically supported on tall steel towers or poles, and transport electricity at very high voltages – from 132,000 volts up to 500,000 volts. The overhead wires are called conductors.

By comparison, distribution powerlines, which transport the electricity from substations to consumers, operate at lower voltages in the range of 230 volts to 66,000 volts. Distribution power lines cover a much larger geographical area and are much closer to the ground and to trees, increasing the likelihood of fires being ignited. Transmission lines are remotely operated so that they can be shut down when required. If a fault occurs on the transmission network, the protection systems will detect and switch off the power in a very short period of time (between 80 and 120 milliseconds or 0.08 and 0.12 of a second) to prevent an electrical fire.

In Victoria, the primary Transmission Network Service Provider (TNSP) is AusNet Transmission Group Pty Ltd. TNSPs in Victoria must hold an electricity transmission licence. The licencing framework in Victoria is regulated by the Essential Services Commission.

There are five electricity distributors licensed and operating in Victoria. They are: AusNet Services Distribution, CitiPower, Jemena Electricity Networks, Powercor Australia and United Energy Distribution. Each distribution company is responsible for a separate geographic region of Victoria.

Design of Transmission Lines

Planning approvals

Before any transmission projects can be built in Victoria, the proposed project must go through a rigorous planning approval process. The project must obtain approval from the Victorian Government before construction can start.

Route selection

When TNSPs select the preferred route of the transmission line, they assess a range of criteria. The route should be in a relatively straight line and minimise environmental, social and cultural impacts. Importantly it must also consider the risk of fires in the general area of the proposed line.

If transmission lines and supporting towers are located in a high bushfire risk environment, then additional measures must be taken to reduce the risk. Measures may include more frequent condition inspections to identify potential defects and higher standards for asset maintenance or replacement to reduce faults.

Transmission Conductor Height and Easements

The overall design of the transmission line must meet certain standards, regulations and safety requirements. The AS/NZS 7000:2016 Overhead line design standard specifies the general requirements that are to be met for the design and construction of new transmission lines to ensure that the line is suitable for its intended purpose and provides acceptable levels of safety.

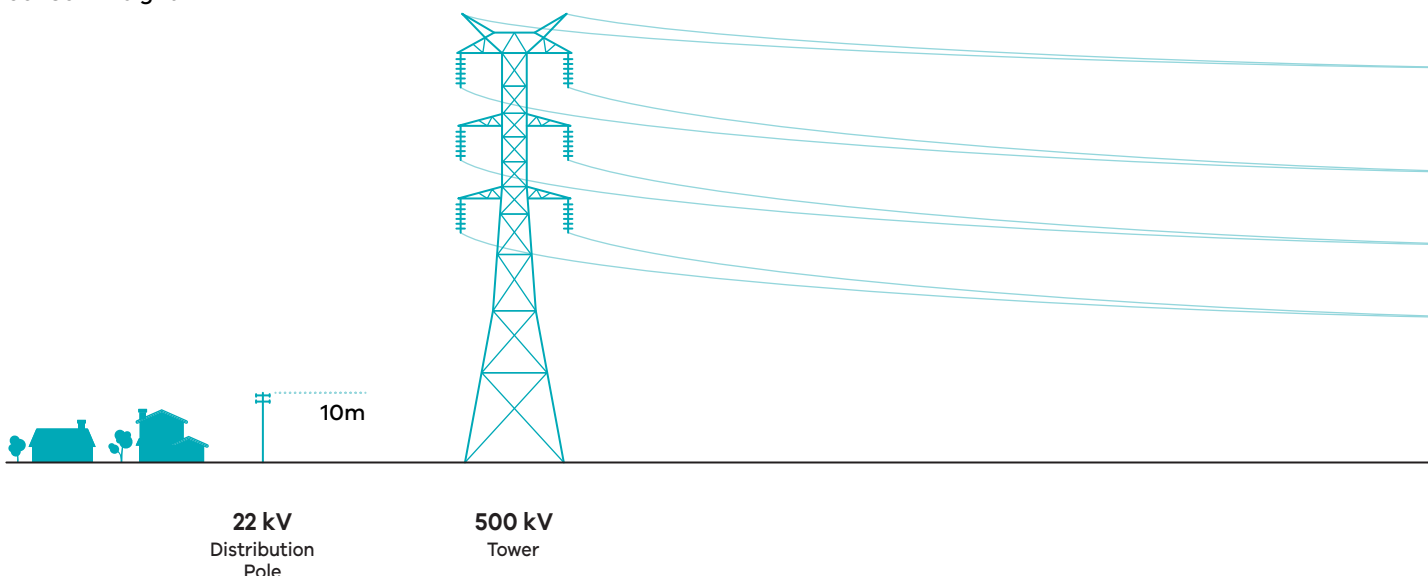
The height of each transmission tower is designed to ensure that minimum electrical safety distances are achieved:

- between each conductor,
- between each conductor and the ground,
- between each conductor and the supporting tower structure, and
- between each conductor and objects that pass on the ground underneath, such as a road or railway line, farming machinery and other vehicles and equipment that pass under.

Typical transmission tower span

Span generally within 300m to 500m

60–80m Height



The voltage of electricity being transported by the transmission lines also influences the height of towers, minimum heights of the conductors above ground, and easement widths. The tower height is designed to include an allowance for conductor sag when the conductor is operating at the maximum allowable operating temperature.

There is no prescribed maximum distance between towers. The distance outlined in the design will be based on the site topography, location of carriage ways, conductor size, type and rating and a range of other factors. A nominal span length is between 300m and 500m, but can be more if spanning across a gully.

Regulatory Framework

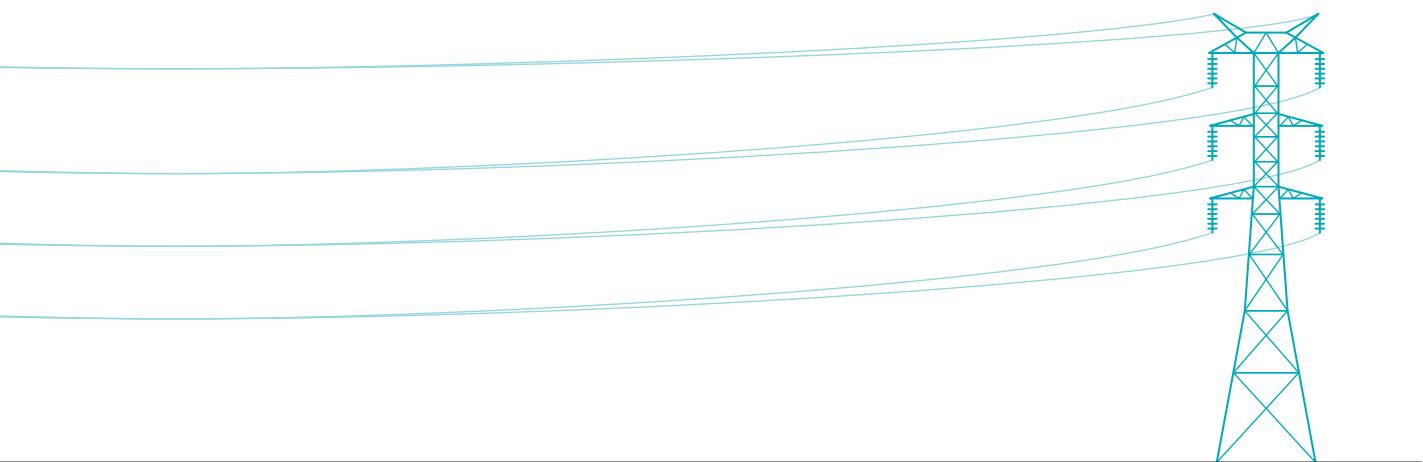
By law, electricity companies such as Transmission Network Service Providers (TNSPs) must manage and minimise fire ignition risk throughout the lifecycle of the infrastructure they are responsible for.

Section 98 of the *Electricity Safety Act 1998 (Vic)* sets out general duties of transmission companies to design, construct, operate, maintain and decommission its supply network (which includes transmission lines) to minimise as far as practicable:

- the hazards and risks to the safety of any person arising from the supply network
- the hazards and risks of damage to the property of any person arising from the supply network; and
- the bushfire danger arising from the supply network.

Energy Safe Victoria is Victoria's safety regulator responsible for electricity, gas and pipeline safety. Our role is to prevent harm by monitoring and enforcing compliance with Victoria's energy safety laws, including the *Energy Safety Act 1998 (Vic)*.

For illustrative purposes only



Easements run the length of the transmission line to provide access along the route. There may also be additional easements that provide for access to the transmission line easement – e.g. from the nearest road, across land, to the route easement. In Victoria easements cross a total area of approximately 17,500 hectares of land.

To protect the community and the transmission line infrastructure there are restrictions on the type of activities that can and can't be undertaken on or near easements. More information on these activities can be found in the relevant factsheets published by the TNSPs.

Actual easement details may vary from the typical widths indicated in the diagram below. These details are recorded on the Certificate of Title.

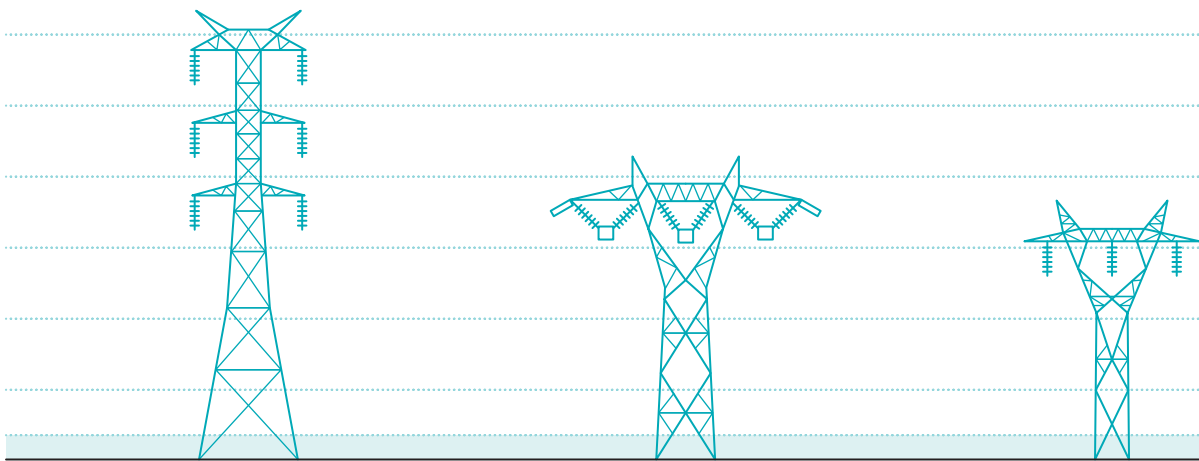
Easement widths are set out in the standard AS/NZS 7000:2016 – Overhead line design standard, (Appendix cc).

This Standard specifies the general requirements that are to be met for the design and construction of new overhead lines to ensure that the line is suitable for its intended purpose, and provides acceptable levels of safety for construction, maintenance and operation, and meets requirements for environmental considerations.

Easement widths

Height (metres)

70
60
50
40
30
20
10
3



500 kV
Double Circuit
60 metres

500 kV
Single Circuit
65 metres

330 kV
Single Circuit
58 metres

Electricity Safety Management Scheme

TNSP's that operate in Victoria must have in place an Electricity Safety Management Scheme (ESMS) that has been accepted by ESV.

The ESMS describes in detail how the TNSP will meet its duties under section 98 of the *Energy Safety Act 1998* (Vic).

An ESMS must meet the requirements of the *Electricity Safety (Management) Regulations 2019* (Vic) which includes a requirement that the TNSP's safety management system complies with the requirements of the standard: AS5577-2013 Electricity network safety management systems.

The ESMS sets out what systems, policies and practices the TNSP will use to assess and manage risk.

Section 99(2A) of the *Energy Safety Act 1998* (Vic) requires the ESMS to include a Bushfire Mitigation Plan (BMP).

As per the *Electricity Safety (Bushfire Mitigation) Regulations 2013* (Vic) the BMP sets out:

- specific preventative strategies and programs to mitigate the risk of the transmission line and network causing a fire, and
- the systems, processes and procedures to operate and maintain the network in times or zones of high bushfire risk.

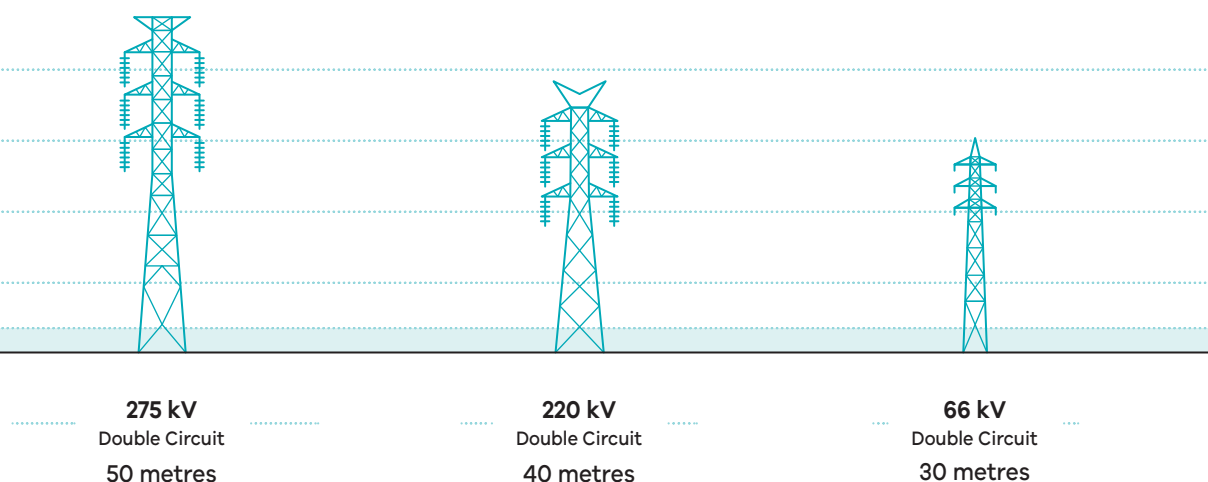
The BMP also sets out how the TNSP will conduct audits and inspections to monitor the condition of the assets to mitigate the risk of fire ignition.

The accepted ESMS (inclusive of the BMP) is an enforceable, legal commitment prepared by the TNSP.

It is the responsibility of TNSPs to ensure controls to mitigate fire risk, as detailed in the BMP, are implemented. The TNSP is required to publish specific information about their BMP on their website.

ESV holds the TNSP to account for any breaches or non-compliance with the ESMS. Penalties apply for non-compliance.

For illustrative purposes only



source: Ausnet Services, A guide to living with transmission line easements.

Construction of transmission lines

The construction of high voltage transmission lines creates risk, including fire ignition risk.

How fire risk during construction is mitigated

Fire mitigation actions during the construction of transmission lines (as detailed in the BMP) include the following:

- specific controls prescribed under the *Country Fire Authority Act 1958* (Vic), for any works undertaken during a fire danger period, must be complied with,
- restrictions on Total Fire Ban or days of high fire danger must be complied with,
- works vehicles should remain on tracks and not be driven across paddocks,
- smoking must be restricted to prescribed areas and ash and butt disposal facilities should be provided,
- firefighting equipment, such as fire extinguishers and knapsack spray pumps, must be in working order, fully charged with water (minimum 9 litre capacity), and carried in all vehicles and provided on-site, and

- dangerous goods must be stored in line with *Dangerous Goods (Storage and Handling) Regulations 2022* (Vic).

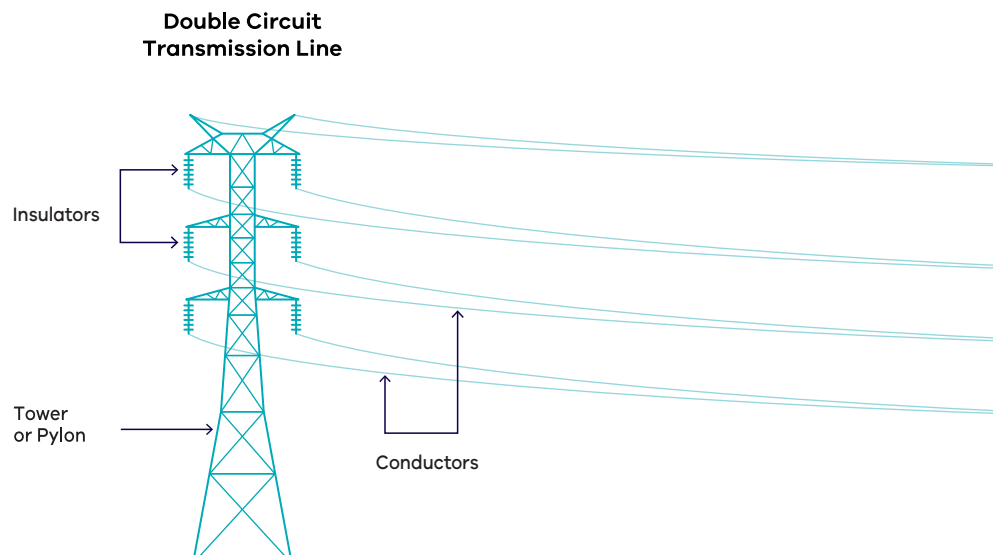
TNSP staff, and any contractors engaged by a TNSP, must be:

- trained to use the firefighting equipment,
- trained in dangerous goods storage and handling,
- trained in what their responsibilities are during emergencies,
- trained in first aid, and
- complete CFA's *Bushfire Safety for Workers* training module.

TNSP staff and any contractors engaged by a TNSP must have:

- an Emergency Management Plan in place that sets out what to do in the event of an emergency, including roles and responsibilities.

Transmission Line Components

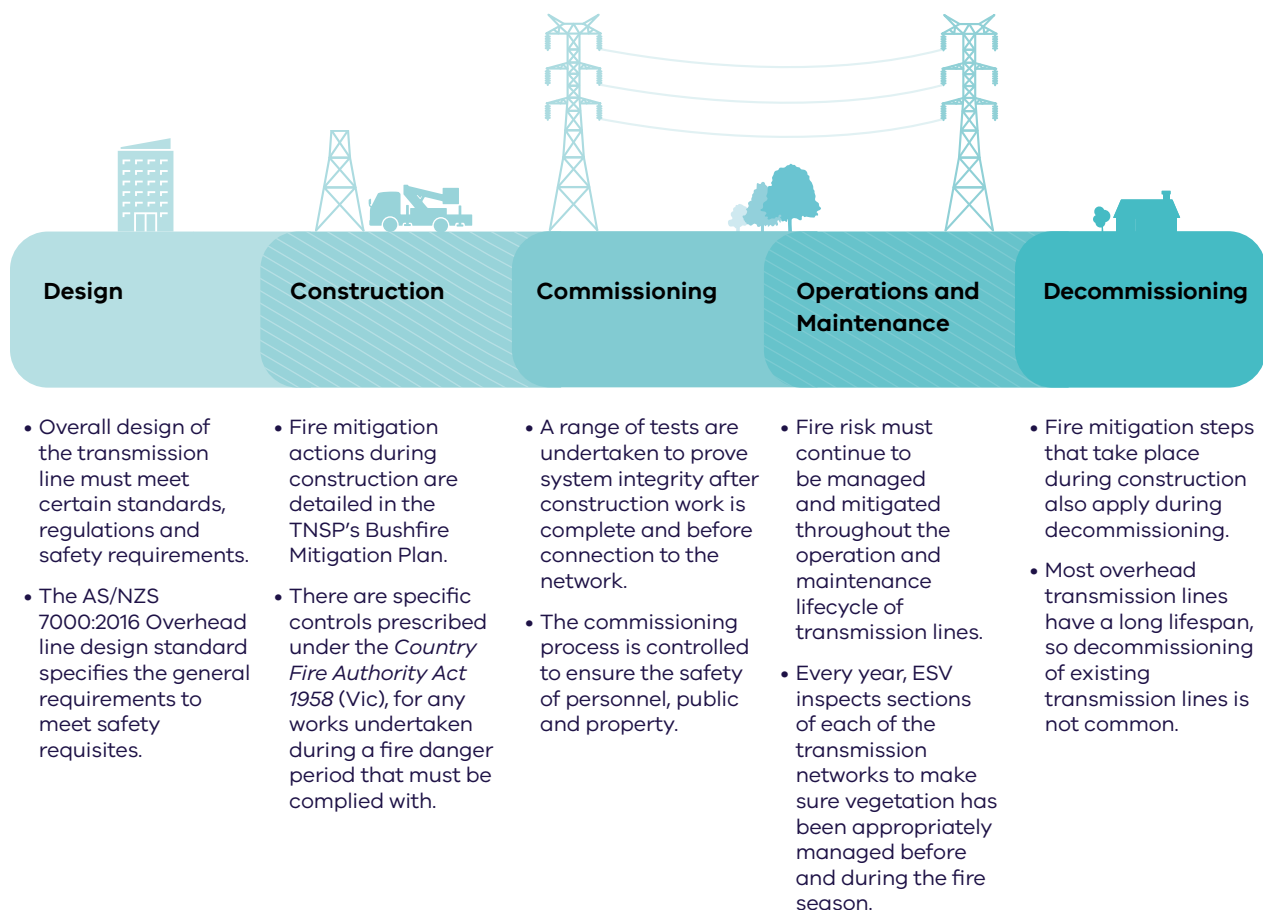


Commissioning

Once the transmission line has been completed it needs to be turned on so that electricity can be transported by the line. A range of pre-commissioning and commissioning tests are undertaken to prove system integrity after construction work is complete and before connection to the network.

The commissioning process is controlled to ensure the safety of personnel and the public.

Transmission Line Lifecycle



Operations and maintenance

Fire risk must continue to be managed and mitigated throughout the operation and maintenance lifecycle of transmission lines.

How fire risk during operations and maintenance is mitigated

Information is included in the TNSP's BMP that sets out how the risk of bushfire will be mitigated during operations and maintenance works.

Examples of what may be included in the BMP are:

- specific controls prescribed under the *Country Fire Authority Act 1958 (Vic)*, for any works undertaken during a fire danger period that must be complied with,
- work on easements on Total Fire Ban days must be suspended,
- maintenance work, such as slashing and vegetation removal, must be suspended on Total Fire Ban days, and
- hot works on Total Fire Ban days are not permitted unless the work is essential, and a permit is obtained from the relevant fire authority, detailing the specific controls that must be complied with.

Asset maintenance

The TNSP must have a system for regular preventative maintenance of its assets and detailed procedures on how the maintenance is to be carried out. This system is detailed in the BMP.

Vegetation

The TNSPs are responsible for keeping vegetation clear of the transmission lines.

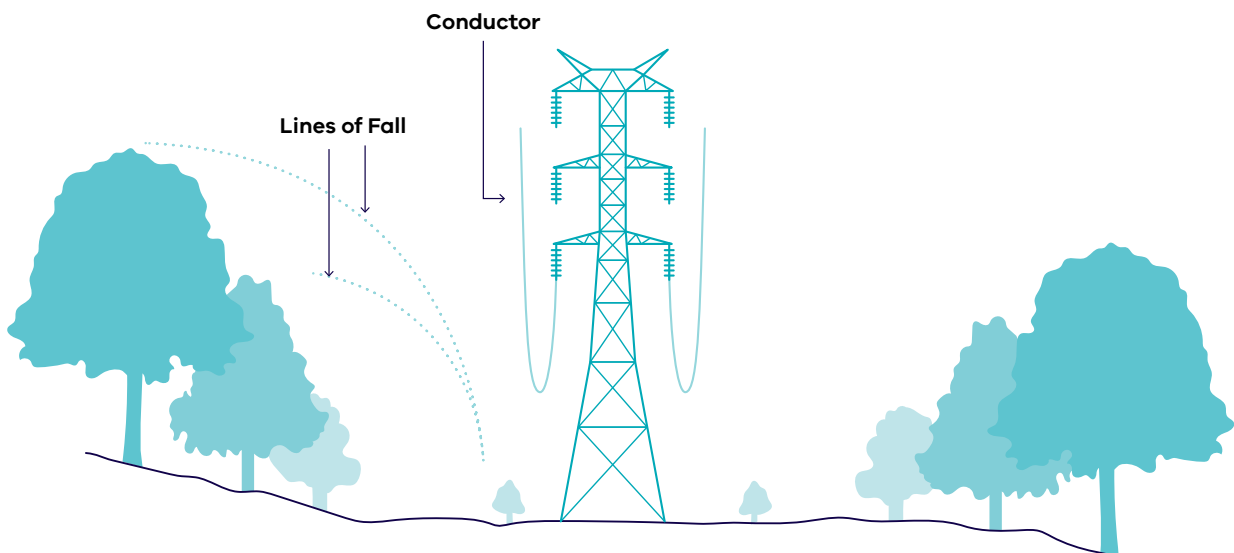
A TNSP must submit a written **Electric Line Clearance Management Plan** to ESV at least once every five years in accordance with the *Electricity Safety (Electric Line Clearance) Regulations 2020 (Vic)*. The plan must detail how they will manage vegetation and ensure minimum clearance spaces are maintained.

The minimum clearance space is set out in the Code of Practice for Electric Line Clearance - Victoria incorporated in the *Electricity Safety (Electric Line Clearance) Regulations 2020 (Vic)*. The distance varies according to voltage and distance between supporting structures.

Each year every TNSP conducts an inspection of its networks to identify any vegetation growth that is inside or approaching the minimum clearance distance.

The vegetation identified by the inspection must be cleared before the fire danger period is declared each fire season.

In addition, every year ESV inspects sections of each of the transmission networks to make sure they have been appropriately managed before and during the fire season.



Decommissioning

Decommissioning occurs when a transmission line has reached the end of its useful life and is de-energised, and typically removed. Most overhead transmission lines have a long lifespan, so decommissioning of existing transmission lines is not common but may occur if the transmission line is being replaced with a higher voltage line.

During decommissioning, the transmission line and its easement is treated in the same way as a construction site. This means the fire mitigation steps that take place during construction also apply during decommissioning. The accepted ESMS will cover the risk controls that must be in place during the decommissioning process.

Firefighting near transmission lines

Fire response

During a major fire, the Emergency Management Commissioner has an overarching role to ensure that the response and recovery is coordinated and control arrangements are in place. Those control arrangements include the appointment of State, Region and Incident Controllers and the operation of their respective control centres.

Victoria's three fire authorities — Country Fire Authority (CFA), Fire Rescue Victoria (FRV) and Forest Fire Management Victoria (FFMV) — have significant and complementary roles when it comes to bushfire management. CFA has primary responsibility for bushfire response on private land. FFMV has primary responsibility for bushfire response on public land. FRV has primary responsibility for bushfire that occurs within its geographic footprint and that includes metropolitan Melbourne and major regional centres.

All agencies work with the TNSPs to ensure the safety of the public.

Control measures

Firefighters receive training on the control measures for fighting fires near transmission lines. Victoria's fire authorities also have appropriate policies and operational procedures in place.

Aerial firefighting

TNSPs work with fire authorities to ensure aerial firefighting is possible in the vicinity of transmission lines.

The transmission towers and lines are well defined on aeronautical maps. The safe flying distance from the transmission towers is determined by regulations set by the Civil Aviation Safety Authority.

TNSPs regularly inspect their transmission networks from the air as part of their aerial inspection programs.

Community safety

Report all fires immediately

If you see a fire burning underneath or near a transmission line call Emergency Services on Triple Zero (000) immediately.



Bushfire Safety Plans

All residents living in high risk bushfire areas need a bushfire plan. Not everyone thinks clearly in an emergency. A written and well-practised plan will help you remember what needs to be done during a crisis.

Your first step in developing a plan is to understand your local risk. If you live near transmission lines, the risk of flashover and downed transmission lines must be factored into your planning.

Fires near or under transmission lines can:

- damage or destroy the conductors and insulators of the transmission line, and
- interrupt electricity supply to customers.

Smoke from fires near or under transmission lines can:

- create electrical arcs or flashovers.

Flashover or arc

A 'flashover' or 'arc' is when electricity – especially at higher voltages – jumps across a gap.

The dense smoke and hot gases caused by a fire under or near a high voltage transmission line increases the risk of a flashover.

A flashover may occur between conductors or from conductors to the ground. You may see a flash or hear an explosion or loud cracking sound.

Flashovers are potentially life threatening to someone standing nearby.

Preparing your property

If your property is near transmission lines you need to be aware of the flashover risk when preparing your property for bushfire. Don't stockpile or heap cut vegetation or other combustible material under transmission lines.

Be aware of the risk from high voltage flashover if you intend to use a transmission line easement as a break for conducting a burn-off. The smoke from your burn-off could act as a conductor and increase the chance of a flashover. Before burning off, ensure you're following regulations or laws set by CFA and your local council and register your burn-off.



Leaving Early

Leaving early is the safest option to protect yourself and your family. Leaving early means leaving the area before a fire starts – not when you can see flames or smell smoke.

The Fire Danger Rating is your trigger to act. The higher the rating, the more dangerous the situation if a fire starts. Your leaving early plan should consider:

- when you will leave,
- where you will go,
- what you will take with you,
- what route you will take, and
- alternative routes if your main route is blocked.

If the route you plan to take uses a transmission line easement, you need to consider the risk of flashover. If there is smoke in the area or a fire near the easement you should consider an alternate route. The safest option is to leave before there is a fire or smoke in the area.

Staying informed

During summer it's up to you to stay informed about fires in your area. Monitor Fire Danger Ratings and official sources for warnings by going to emergency.vic.gov.au, installing the VicEmergency app or calling the VicEmergency Hotline on 1800 226 226.

Power supply interruption

TNSPs have an obligation to provide customers with a reliable and safe electricity supply.

In the event of a supply outage during a bushfire, they work closely with State, Region and Incident Controllers and emergency management agencies to restore power as quickly as possible.

TNSPs are obliged to follow all agreed and mandatory directions given by the emergency management agencies.

References & Further Reading

Electricity Safety Act 1998 (Vic):
www.legislation.vic.gov.au

Electricity Safety (Management) Regulations 2019 (Vic): www.legislation.vic.gov.au

Electricity Safety (Electric Line Clearance) Regulations 2020 (Vic): www.legislation.vic.gov.au

Electrical Safety Management Schemes:
www.esv.vic.gov.au/industry-guidance/electrical/electrical-installations/electrical-safety-management-schemes

Country Fire Authority Act 1958 (Vic):
www.legislation.vic.gov.au

CFA - Design Guidelines and model requirements – Renewable Energy Facilities:
www.cfa.vic.gov.au/plan-prepare/building-planning-regulations/renewable-energy-fire-safety

CFA – Bushfire Safety for Workers:
www.cfa.vic.gov.au/plan-prepare/your-local-area-info-and-advice/e-learning

ESV – Electricity Hazards Safety Guide:
www.esv.vic.gov.au/about-us/our-organisation/reports/electricity-hazards-safety-guide

Dangerous Goods (Storage and Handling) Regulations 2022 (Vic): www.legislation.vic.gov.au

AS/NZS 7000: standards.org.au/standards-catalogue/sa-snz/other/el-052/as-slash-nzs--7000-colon-2016

AS5577-2013 Electricity network safety management systems: standards.org.au/standards-catalogue/sa-snz/other/en-004/as--5577-2013

Ausnet - A guide to living with transmission line easements: www.ausnetservices.com.au/search-results?q=easements

AusNet Services – Transmission Towers and Conductors: www.westernrenewableslink.com.au/resource/

Australian Energy Infrastructure Commissioner 2021 Annual Report: www.aeic.gov.au/publications/2021-annual-report

AFAC, Windfarms and Bushfires Operation v3.0: afac.com.au





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