

Operating rapid earth fault current limiters (REFCLs)

Effective: 6 December 2024

Policy

Purpose

This policy outlines Energy Safe Victoria's expectations about how distribution businesses should operate rapid earth fault current limiters (**REFCLs**) installed on their supply networks in Victoria and other related matters. It is intended to provide transparency about what our minimum expectations will be unless a distribution business demonstrates that an alternative approach is more appropriate for their circumstances.

Distribution businesses can expect us to have regard to this policy when reviewing and assessing their approach to operating REFCLs as outlined in their electricity safety management schemes (**ESMSs**) and bushfire mitigation plans (**BMPs**). However, we will also have regard to information and evidence provided by distribution businesses during the assessment and acceptance process. Ultimately, we will need to be satisfied that the approach set out in a distribution business' ESMS and BMP is appropriate and will minimise the hazards and risks and bushfire danger arising from its supply network as far as practicable.

Background

The *Electricity Safety Act 1998 (Vic)* (**Act**) and associated regulations establish the regulatory requirements that apply to distribution businesses, which are monitored and enforced by Energy Safe.

Part 10 of the Act establishes a general duties framework together with obligations for distribution businesses to submit ESMSs and BMPs to Energy Safe outlining how they will meet their general duties and what their proposals are for the mitigation of bushfire. The general duties require distribution businesses to design, construct, operate, maintain and decommission their supply networks to minimise hazards and risks as far as practicable. This includes hazards and risks to the safety of people, hazards and risks of property damage, and bushfire danger.

Part 10A of the Act requires distribution businesses to install technology to achieve the 'required capacity' performance standard (see definitions below) at specified zone substations. These zone substations were selected because they service high bushfire consequence areas. Modelling under worst-case conditions suggests that fire ignitions in these locations are more likely to have catastrophic impacts.

While the Act and associated regulations do not specifically refer to REFCLs, REFCLs are currently the only technology that can achieve the 'required capacity' performance standard.

A REFCL, installed in a zone substation, acts like a safety switch by rapidly detecting phase-to-earth faults on powerlines and reducing voltage to mitigate bushfire and electrocution risks. If the fault is temporary, power supply is maintained to customers. However, if the fault persists, the REFCL instructs a circuit breaker to switch off the power, cutting supply to all customers on that line until the fault is fixed.

This policy was finalised following consultation with distribution businesses and the community. Additional background and information on our consultation and consideration of issues raised by stakeholders is available here: <https://www.energysafe.vic.gov.au/refcl-operations-consultation-paper>.

Definitions

Words and phrases used in this policy have the same meaning given in the Act and associated regulations unless otherwise specified.

Table 1: Definitions

Term	Definition
Australian Fire Danger Rating System (AFDRS)	<p>The AFDRS consists of four fire danger rating levels which indicate how dangerous a bushfire could be if one started. It is a national ratings system developed in collaboration with emergency services and the Commonwealth government, forecasted by the Bureau of Meteorology.</p> <p>In terms of bushfire risk, the AFDRS levels assume the following:</p> <ul style="list-style-type: none"> • Moderate: Most fires can be controlled. • High: Fires can be dangerous. • Extreme: Fires will spread quickly and be extremely dangerous. • Catastrophic: If a fire starts and takes hold, lives are likely to be lost.
Bypass mode	<p>When a REFCL in bypass mode detects a permanent fault, it switches to traditional earthing methods (like a neutral earthing resistor or direct earth connection). This causes large fault currents to flow, enabling downstream protection devices to respond. Although bypass mode improves supply reliability, it reduces the safety benefits of REFCL protection.</p>
Distribution business	<p>A person who is the holder of a licence to distribute electricity issued under the <i>Electricity Industry Act 2000</i>.</p>
Fire Danger Period	<p>The Country Fire Authority declares a Fire Danger Period for each municipality each year which is the period when the CFA restricts the use of fire in the community to help prevent fires from starting. It varies based on factors such as the amount of rain, grassland curing rate and other local conditions and is intended to indicate the period during which fires are more likely to occur. A Fire Danger Period may be declared as early as October in some municipalities, and typically remains in place until the fire danger lessens, which could be as late as May.</p>
In-service	<p>A REFCL is switched on and actively working to mitigate bushfire risk and provide electrocution and arc flash risk reduction.</p>
Operating frequency	<p>How often a REFCL is in-service.</p>
Operating settings	<p>The level of fault detection sensitivity and how a REFCL responds when it detects a phase to earth fault.</p>
Out of service	<p>A REFCL is switched off and unable to detect or respond to faults.</p>
Prescribed REFCL	<p>A REFCL that has been installed to meet the 'required capacity' requirements prescribed by Part 10A of the Act (see background).</p>
Required capacity	<p>Means, in the event of a phase-to-ground fault on a polyphase electric line, the ability:</p> <ul style="list-style-type: none"> • to reduce the voltage on the faulted conductor in relation to the station earth when measured at the corresponding zone substation for high impedance faults to 250 volts within 2 seconds; and • to reduce the voltage on the faulted conductor in relation to the station earth when measured at the corresponding zone substation for low impedance faults to: <ul style="list-style-type: none"> – 1900 volts within 85 milliseconds; and – 750 volts within 500 milliseconds; and – 250 volts within 2 seconds; and

Total Fire Ban Day	<ul style="list-style-type: none"> • during diagnostic tests for high impedance faults, to limit: <ul style="list-style-type: none"> – fault current to 0.5 amps or less; and – the thermal energy on the electric line to a maximum I^2t value of 0.10. <p>The CFA’s Chief Officer may declare any day to be a Total Fire Ban Day. When doing so, the Chief Officer considers additional factors such as current fires in the landscape, resource commitment and increased likelihood for human and lightning induced fires. No fires are to be lit in the open air on Total Fire Ban Days unless you have a special permit.</p>
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Policy

This section outlines our general expectations about how distribution businesses should operate REFCLs installed on their supply networks in Victoria and other related matters.

Operating frequency

REFCLs should, as far as practicable, be in-service continuously throughout the year. They should only be out-of-service in limited circumstances, such as for scheduled maintenance or emergency works. Also, where possible, maintenance and emergency should occur at times that minimise risks and should be managed efficiently and effectively to minimise the time that REFCLs are out-of-service.

We expect distribution businesses to provide enforceable in-service availability commitments in their ESMSs and BMPs along with a clear outline of the circumstances in which they may take REFCLs out-of-service.

If a distribution business believes that continuous operation is not practicable in their circumstances or that a different approach will ensure that they minimise hazards and risks as far as practicable, the distribution business should provide evidence during the ESMS/BMP submission and acceptance process to enable Energy Safe to review and assess proposed alternative approaches.

Operating settings

REFCLs that have been installed to mitigate bushfire risks should be operated at high sensitivity settings at times of high bushfire risk, while lower sensitivity settings may be applied at other times subject to them still being in-service and operating to provide electrocution and arc flash risk. For prescribed REFCLs, this means aligning with the operating settings outlined in Table 2. Different settings may apply for non-prescribed REFCLs (see below).

Bypass mode should not be used by distribution businesses to address adverse supply reliability impacts due to REFCLs. We expect distribution businesses to commit and take steps, as soon as practicable, to deploy REFCL-compatible Automatic Circuit Reclosers and fault-finding devices and undertake network upgrades to address supply reliability issues directly.

In all cases, it is the responsibility of distribution businesses to assess and determine the specific settings to be applied in their circumstances to ensure that they minimise hazards and risks as far as practicable. We will expect distribution businesses to provide evidence to substantiate their settings during the ESMS/BMP submission and acceptance process to enable Energy Safe to review and assess.

Table 2: REFCL operating settings

Fire danger	REFCL operation
Declared Total Fire Ban Day	<p>Operated at the highest sensitivity settings to provide the highest practicable level of fault protection.</p> <p>In most cases we expect this to be a setting that can detect high impedance faults or fault current of 0.5 amps or more, as is the case under the ‘required capacity’ performance level.</p>

<p>Declared Fire Danger Period and Any other day when AFDRS level of the relevant area is 'High' or above</p>	<p>Operated at high sensitivity settings to provide a high level of fault protection.</p> <p>We expect this to be a setting that is able to prevent most bushfire starts (i.e., detects high impedance faults or fault current of 1.0 amps or more).</p>
<p>All other times when the AFDRS level is 'Moderate' or below</p>	<p>May be operated at lower sensitivity settings to provide a lower level of fault protection. We expect this to be a setting that is still able to prevent risks of electrocution and arcing leading to serious injury or death (i.e., detects low impedance faults or fault current of 2.0 amps or more).</p>

Operating settings for non-prescribed REFCLs

Non-prescribed REFCLs may have been installed for various reasons, including bushfire mitigation and/or to harness positive supply reliability impacts of REFCLs. We note non-prescribed REFCLs are not always designed to be able meet the 'required capacity' performance level as mandated for prescribed REFCLs.

For non-prescribed REFCLs that have been installed to mitigate bushfire risk in high bushfire risk areas, we would generally expect that they are also operated in line with Table 2. However, we acknowledge that the actual settings that can be applied will differ given non-prescribed REFCLs do not necessarily have the same performance capabilities as prescribed REFCLs. For example, rather than operating at the 'required capacity' performance level on declared Total Fire Ban Days, they will be operated at the highest practicable sensitivity setting for the given REFCL.

For non-prescribed REFCLs that have been installed at zone substations which only supply low bushfire risk areas (urban areas, for example) lower sensitivity settings may be applied year-round, even during even during declared Fire Danger Periods and on Total Fire Ban Days. That is, we do not necessarily expect that these are operated in accordance with Table 2.

We do expect, however, that these are operated in a manner that prevents risks of electrocution and arcing. In addition, we also expect distribution businesses to carefully assess the characteristics of these areas and adjust the settings as needed to mitigate associated risks. It is important to recognise that bushfire risk levels can change over time, and distribution businesses should monitor these changes and ensure, as far as practicable, that hazards and risks are minimised.

Testing and maintenance

Distribution businesses must regularly test and maintain REFCLs to ensure they are reliable and will function effectively when protection is needed, especially during high bushfire risk periods for REFCLs installed to mitigate bushfire risk.

Our baseline expectations regarding the testing and maintenance of REFCLs, whether they are prescribed REFCLs or not, are as follows:

- Distribution businesses must have detailed forward plans to regularly test all components of REFCL systems, including high-voltage equipment and computer systems. This ensures REFCLs are reliable and can provide protection when needed, especially at higher-risk times.
- All maintenance and network hardening related to REFCLs installed to mitigate bushfire risk should be completed before the declared Fire Danger Period each year. This allows time to address any issues arising from testing while bushfire risks are lower.
- Testing and maintenance of REFCLs must be done efficiently, minimising out-of-service time as much as possible.
- Robust asset and vegetation inspection programs must also be in place to reduce the likelihood of faults that could trigger REFCLs, ensuring optimal performance and minimal supply disruptions.

Distribution businesses operating prescribed REFCLs must also comply with the specific testing requirements in the Act and associated regulations (e.g., the *Electricity Safety (Bushfire Mitigation) Regulations 2023* (Vic) require distribution businesses to include in their BMPs details of testing that will be undertaken before the specified bushfire risk period each year to ensure their supply networks can operate to meet the required capacity).¹

As there are no prescriptive requirements for non-prescribed REFCLs, testing could occur at varying times, frequencies, or using different standards or methods. The distribution business will need to propose their approach in their ESMS or BMP submission

Record keeping and reporting

Appropriate monitoring and record keeping by the distribution businesses is critical to ensure REFCL operations are in line with regulatory obligations and, when necessary, to demonstrate compliance.

Distribution businesses operating prescribed REFCLs currently keep records and provide certain REFCL-related reports of information to Energy Safe, including:

- An annual compliance report under section 120P of the Act
- An annual capacity testing report under regulation 7(1)(t)(vii) of the Regulations
- Information and data relating to REFCL-protected parts of the supply network during the fire season.

More generally, distribution businesses operating REFCLs (prescribed or not) should keep records showing how they have been operated in line with accepted ESMSs and BMPs, such as:

- The amount of time each REFCL was in-service each week throughout the year.
- Dates, times, and reasons for any REFCL outages:
 - For planned outages, include the purpose aligned with the testing and maintenance schedule.
 - For unplanned outages, note the cause and actions taken to reduce the risk of recurrence.
- Settings applied to each REFCL throughout the year, mapped to the operational settings outlined in the accepted ESMS and BMP.
- Details of each network fault, including:
 - Date, time, and location of the fault.
 - Cause, and whether the fault was temporary or permanent.
 - Whether the REFCL operated during the fault, including settings applied at the time.
 - Consequences of the fault, such as fire incidents (with details on size) or any other impacts, including injury or property damage.

We expect distribution businesses to specify in their ESMS and BMP the REFCL-related records they will maintain and to confirm that these records will be made available to Energy Safe upon request.

Broadening the use of REFCLs

We expect distribution businesses to demonstrate through the ESMS and BMP submissions and acceptance process that they have considered the use of REFCLs on additional parts of their supply networks to minimise hazards and risks and bushfire danger as far as practicable in accordance with their general duties. This includes exploring opportunities for deployment of additional REFCL technology or for extending the coverage of existing REFCLs.

Document information

Document title	Operating rapid earth fault current limiters (REFCL)
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¹ *Electricity Safety (Bushfire Mitigation) Regulations 2023* (Vic) – s 7(1)(k)

Approved by	Commission
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Responsibility	General Counsel and General Manager - Legal, Governance and Regulatory Policy