REFCL Compliance Maintained Planning Report Lilydale (LDL) Zone Substation

AMS – Electricity Distribution Network

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Contents

1 Project overview

The Electricity Safety (Bushfire Mitigation) Amendment Regulations 2016 came into effect on 1 May 2016 amending the *Electricity Safety (Bushfire Mitigation) Regulations 2013* (the **Regulations**). These Regulations specify the Required Capacity for Rapid Earth Fault Current Limiter performance. The Regulations also specify the 22 zone substations on AusNet Services' network that must comply with the Regulations.

The *Electricity Safety Amendment (Bushfire Mitigation Civil Penalties Scheme) Act 2017* (the **Act**) sets out the significant financial penalties enforceable for non-compliance. Refer to Appendix A for further information.

Lilydale (**LDL**) zone substation (**ZSS**) is included in Tranche 2 of the AusNet Services REFCL Program with compliance required to be achieved by 1 May 2021. This report investigates and seeks funding for the most prudent and efficient approach to maintain compliance with the Regulations at LDL during the 2022-26 regulatory control period.

By the Tranche 2 compliance deadline of 1 May 2021, LDL will have two standard Arc Suppression Coils (**ASCs**) installed which, for planning purpose, are assumed to have a combined capacitive current limit of 185 Amperes (**A**) (Bus 1 has an approximate limit of 65A and Bus 2 has an approximate limit of 120A), beyond which it may not be able to achieve the Required Capacity. The zone substation demand is within the zone substation rating and the zone substation assets are in good condition. Hence, the increasing capacitive current is driving the need to invest in LDL to ensure AusNet Services can maintain compliance with the Regulations.

This report reviews various options considered by AusNet Services to manage the capacitance growth. The preferred option, which is the option found to be the most economically efficient and technically feasible, recommends the following:

- Installation of one 7.5MVA isolation transformer on LDL11 past switch LD727;
- Undergrounding 350m of overhead HV ABC and associated assets;
- Network load to be assessed after summer and transfers from Bus 2 to Bus 1 to be implemented to move approximately 10A of capacitance from Bus 2 to Bus 1.

The estimated cost for this solution and associated works is $4.3 million.

2 Background

2.1 Purpose of this report

This report investigates any constraints that are forecast to occur at LDL, identifies and assesses potential options, and seeks funding for the preferred option. LDL is included in Schedule 1 of the *Electricity Safety (Bushfire Mitigation) Regulations 2013*, and must meet the Required Capacity defined in the Regulations.

The constraints investigated include:

- Forecast demand;
- Network constraints; and
- Capacitive current and compliance with the Regulations.

The following sections of this report describe the compliance obligations, the technologies available to achieve those obligations, constraints at the zone substation and options to mitigate any issues.

2.2 Compliance obligations

The Victorian Government has mandated, through the Regulations, that electricity distribution companies increase safety standards on specific components of their networks to reduce bushfire risk. The Regulations set challenging performance standards (the **Required Capacity**) for 22 of AusNet Services' zone substations. The dates for compliance are separated into three tranches based on a prioritising points system, and occur on 1 May 2019, 1 May 2021 and 1 May 2023. In addition, the Victorian Government has enforced timely compliance of the Regulations by introducing significant financial penalties though the *Electricity Safety Amendment (Bushfire Mitigation Civil Penalties Scheme) Act 2017* (**the Act**).

Distribution businesses have found that the Required Capacity can only be met by installing Rapid Earth Fault Current Limiters (**REFCLs**) in zone substations. In addition, the Victorian Government's Powerline Bushfire Safety Program also identified REFCLs as the preferred solution for meeting the Required Capacity[1].

The Act provides for the Governor-in Council to grant exemptions and for a Major Electricity Company to request the modification of due dates and periods.

Details of the Act, the Regulations and the penalties are in Appendix A.

2.3 REFCL technology

There are various types of technology that fall under the REFCL umbrella, however the only type of REFCL currently considered suitable by the Victorian Electric Supply Industry (VESI) for bushfire safety is known as the Ground Fault Neutraliser (GFN), a proprietary product by Swedish Neutral. Presently, the GFN is the only device that can meet the performance criteria of the Regulations. All references to REFCLs in the remainder of this document are referring to the GFN type.

REFCLs are comprised of the following key components:

- Arc Suppression Coil (**ASC**) – which is a large inductor that compensates for the capacitive current during an earth fault.

[1] REFCL fact sheet 2016 111216, Introducing best knowledge and technology, Powerline Bushfire Safety program, Dec 2016

- Residual Current Compensator (**RCC**) – also referred to as the inverter, which is located in the zone substation control building or switchroom. It is used to reduce fault current by compensating for the active current during an earth fault
- Control Panels and software, which control the equipment.

2.4 REFCL constraints

The REFCL's ability to successfully detect, manage and locate phase to earth (also referred to as ground) faults on the 22kV network[2] is dependent on a complex combination of network conditions which, when correctly managed, allow continued operation of the REFCL protection in compliance with the Required Capacity.

The following network conditions and physical constraints impact the continued correct operation of the REFCL and its ability to continue meeting the Required Capacity:

Network damping factor

The network damping factor is defined as the ratio of the resistive current losses to the capacitive current (I_R/I_C) measured across the zero-sequence network. A higher damping factor is undesirable as it limits the ability of the REFCL to detect a high impedance fault, and thus operate in the time required to comply with the Required Capacity. The higher the damping factor the lower the capacitive current limit of the ASC.

Network topology

Most modern residential developments are constructed using underground cables which have a higher capacitance than overhead lines. As the 22kV network grows due to increased demand, new customer connections and overhead conductor to underground cable conversions, the additional cable installations will increase the total capacitive current on the network. If the network capacitive current exceeds the capacitive current limit of the ASC, network investment is required to maintain compliance with the Regulations.

Capacitive current limit of the ASC

There are two capacitive current limits:

- **Per ASC:** The typical configuration for REFCLs is one ASC per supply transformer and therefore per bus. The limit of an ASC is dependent on the damping characteristics of the network. Currently, the actual damping characteristics specific to the network can only be measured once a GFN is operating. At locations where a GFN is not yet operational, an ASC planning limit of 100A is assumed to determine indicative, but conservative, augmentation timing. At LDL, it has been determined that Bus 1 has an approximate limit of 65A and Bus 2 has an approximate limit of 120A. This is to be further confirmed by ongoing tests that AusNet Services is carrying out. For the purpose of this report, 65A and 120A have been respectively assumed for Bus 1 and Bus 2.
- **Per feeder:** To enable differentiation of the feeder experiencing a fault, the maximum capacitive current that is allowable per individual feeder is 80A.

Software limitations

Currently Swedish Neutral (manufacturer of the GFN) has not deployed a software solution that will allow the use of three GFNs at one zone substation.

[2] SWER, which operates at 12.7kV, is excluded from the Required Capacity and is subject to its own requirements.

2.5 Prudent and efficient investment

AusNet Services has taken the approach of incremental funding requests to maintain compliance with the Regulation to ensure minimal long term cost to customers. This is prudent and efficient as it enables:

- Minimum works to be carried out just in time to maintain compliance with the Regulation until 2026.
- Planning to be based on the most up-to-date network growth and capacitive current information and
- Application of the latest development in REFCL technology in this rapidly developing field. For example, should Swedish Neutral deploy a software solution that to enables the use of three REFCLs at a zone substation, it may enable deferral of a new zone substation.

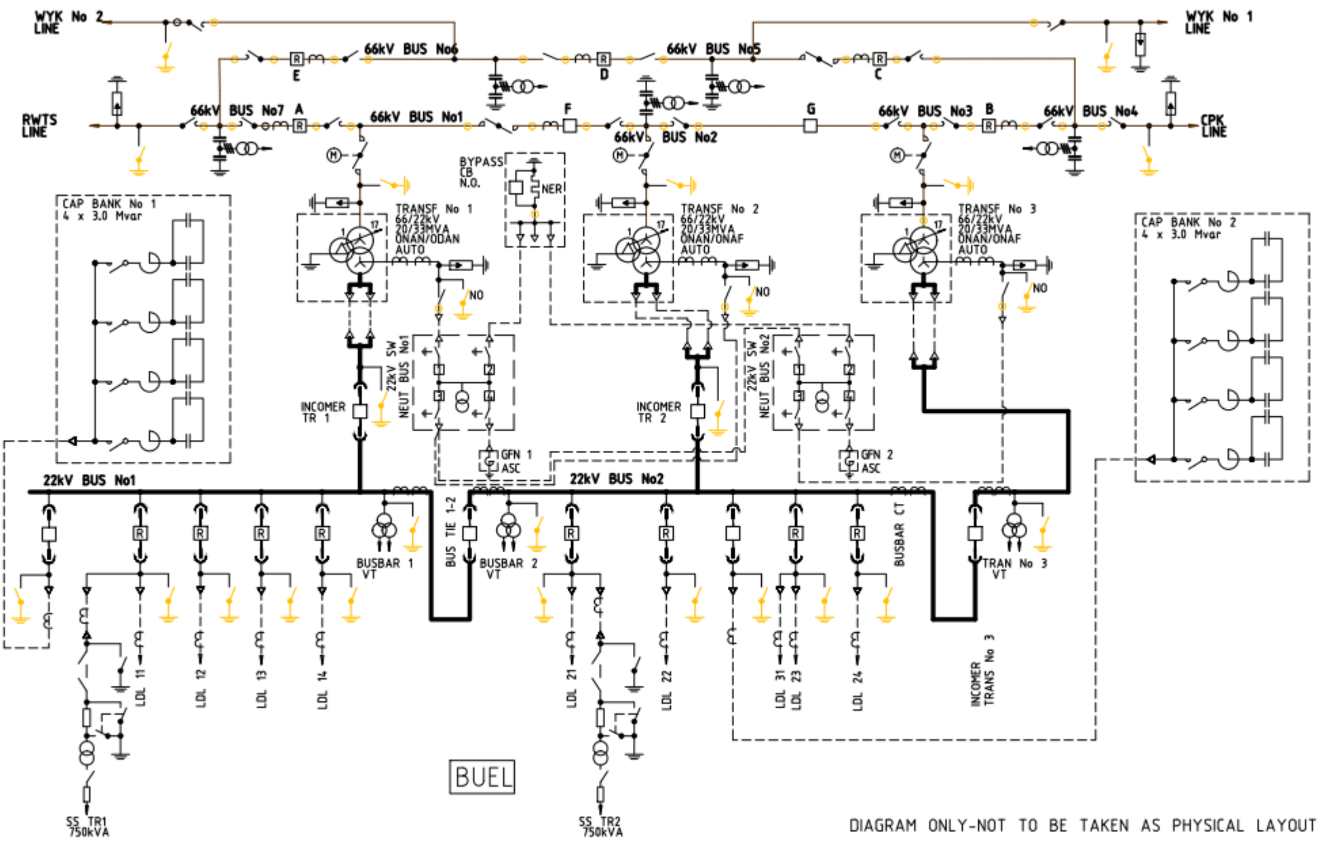
3 LDL zone substation overview

Lilydale (**LDL**) zone substation (**ZSS**) is located in the suburb of Lilydale approximately 35km east of Melbourne. It is included in Tranche 2 of the AusNet Services REFCL Program.

Originally constructed in the late 1950s with three 10/13 MVA transformers, LDL has been progressively upgraded and now consists of three 20/33 MVA transformers which are all in good conditions and less than 20 years old.

The future (post-REFCL) Single Line Diagram (**SLD**), showing the two REFCLs, is presented in Figure 3.1. Two REFCLs will be commissioned at LDL zone substation by 31 May 2021 as part of Tranche 2 of the AusNet Services REFCL Program to achieve compliance with the Regulations.

Figure 3.1 LDL ZSS Single Line Diagram



Source: AusNet Services

An aerial view of the 22kV feeders originating from LDL is shown in Figure 3.2. The distribution areas include both residential and commercial suburban areas around Lilydale as well as semi-urban areas that are heavily tree-covered, steep and have limited access between the suburbs and townships Mooroolbark, Mount Evelyn, Yarra Glen, Healesville and Silvan.

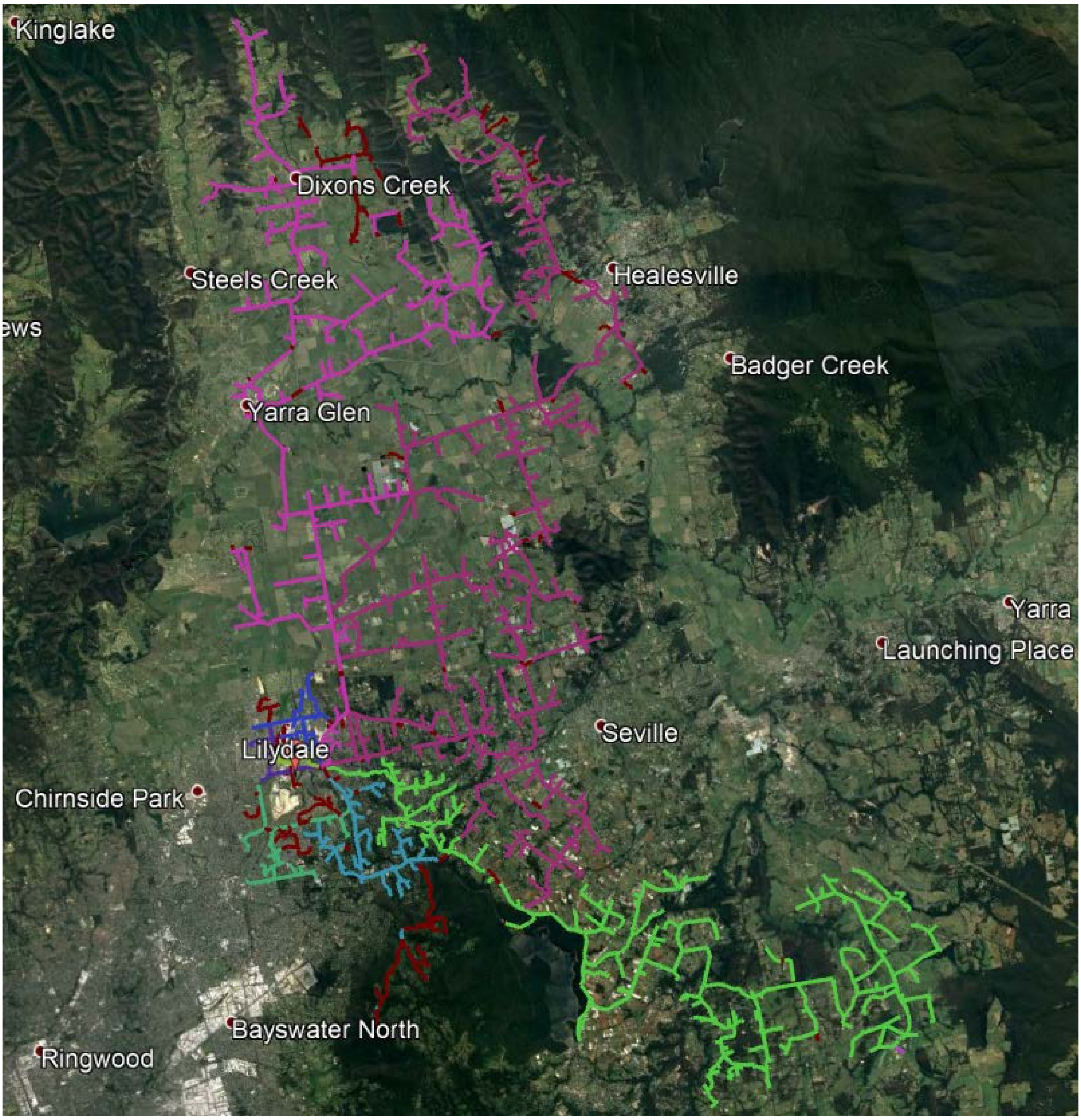
The feeders are predominately overhead. Table 3.1 shows the breakdown of overhead conductor and underground cables per feeder. Overhead feeders contribute a lower amount of capacitive current compared to underground cables.

The Mount Dandenong feeder, LDL11, has a notably higher amount of underground cable. Currently, approximately 40% of LDL11 is underground. LDL23 and LDL24 also have high amounts of cable. This was a result of the Powerline Replacement Fund (**PRF**) Bushfire Safety Program which focused on converting overhead conductor to underground cable in high bushfire risk areas.

Table 3.1 Overhead and underground conductor lengths

Bus	Old Feeder Name	New Feeder Name	Overhead (km)	Underground (km)	Total length (km)
Bus 1	LDL21	LDL11	24.6	15.1	39.8
Bus 1	LDL12	LDL12	3.6	0.6	4.2
Bus 1	LDL13	LDL13	87.5	1.2	88.7
Bus 1	LDL14	LDL14	98.8	4.6	103.4
Bus 2	LDL11	LDL21	6.0	2.1	8.0
Bus 2	LDL22	LDL22	10.8	4.2	15.1
Bus 2	LDL23	LDL23	184.1	10.7	194.8
Bus 2	LDL24	LDL24	14.4	10.6	25.0
		Grand Total	**429.9**	**49.1**	**479.0**

Figure 3.2 LDL ZSS Aerial Layout (underground conductor shown in dark maroon)



3.1 Network forecast

This section provides a discussion on the demand and capacitive current forecasts to identify if either attribute is exceeding the capacity of the substation and when it is expected to occur. This will identify the need and drive the type and timing of any intervention or investment that may be required.

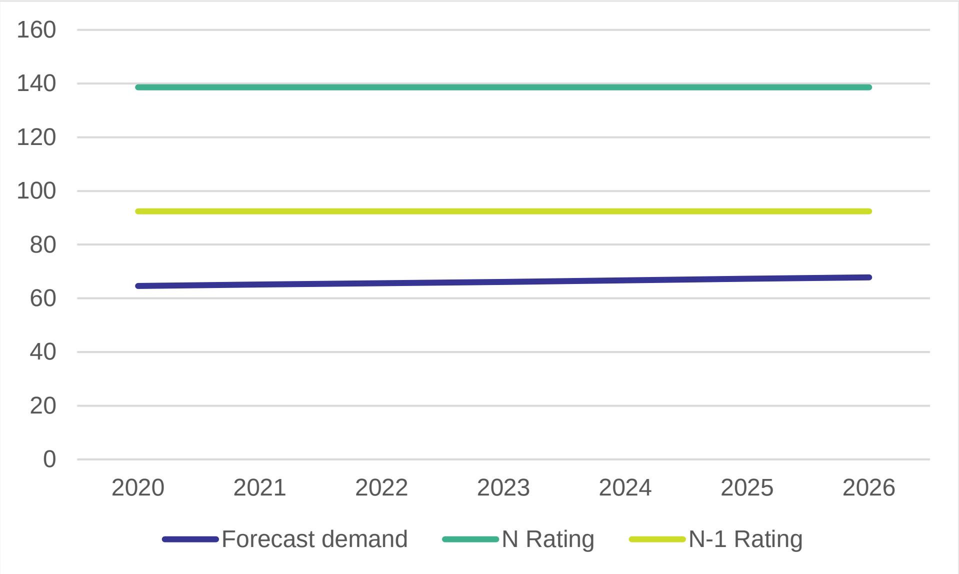
3.1.1 Demand forecast

The table below shows the LDL maximum demand forecast in MVA between 2020 and 2026. By 2026, the Summer (consolidated) demand is expected to increase by approximately 3.2MVA. However, as shown in Figure 3.3, the forecast demand will not exceed the N-1 cyclic rating of the substation within the 2022-2026 regulatory control period. In addition, these supply transformers are considered to be in good condition as discussed above, hence the probability weighted value of energy at risk does not warrant capacity augmentation to be undertaken.

Table 3.2 Maximum Demand (MVA) Forecast for LDL – 2020 to 2026

	2020	2021	2022	2023	2024	2025	2026
LDL Winter (50POE)	53.3	53.0	52.7	52.3	51.9	51.5	51.1
LDL Summer (50POE)	63.5	64.0	64.5	65.0	65.5	66.1	66.6
LDL Winter (10POE)	57.2	57.0	56.7	56.3	55.9	55.5	55.1
LDL Summer (10POE)	67.2	67.7	68.2	68.8	69.4	70.0	70.6
LDL Consolidated Forecast[3]	64.6	65.1	65.6	66.1	66.7	67.3	67.8

Figure 3.3 Demand forecast



3.1.2 Capacitance forecast

The network capacitive forecast was developed based on the characteristics of each zone substation supply area, the standard topology of cables installed for underground residential developments (**URDs**) and other known network augmentation.

Since the growth in capacitance is strongly related to the growth of URD, the forecast was made in 5 year increments as the timing of growth on an annual basis is not certain. The growth is expected to be a step function of new URDs that are being established, rather than a smooth and gradual increase each year. However, the capacitive current growth has been extrapolated to create an indicative annual trend, as shown below, to provide a view on the timing of when intervention is likely to be required.

As stated in section 2.4, the ASC limit is dependent on the damping characteristics of the network that individual zone substation supplies, including the effect of earth resistivity in the zone substation supply area and pollution (salt) on insulators. AusNet Services has attempted to model network damping to forecast ASC limits. The models were based on Tranche 1 zone substations so the outputs could be compared to measured data to test accuracy. The models developed to date have not accurately calculated the damping as measured in Tranche 1 and investigations

[3] The forecast is the weighted sum of the summer forecasts, calculated as 30% of the 10POE summer forecast plus 70% of the 50POE summer forecast.

are continuing. As a result, the actual damping characteristics specific to each network can only be measured once a REFCL installation is operating.

The ASC limit of 100A that is used for planning purposes is based on learnings from the Tranche 1 installations and consideration of differences with the Tranche 2 zone substation network supply areas. At LDL, it has been determined that Bus 1 has an approximate limit of 65A and Bus 2 has an approximate limit of 120A. This is to be further confirmed by ongoing tests that AusNet Services is carrying out. For the purpose of this report, 65A and 120A have been respectively assumed for Bus 1 and Bus 2.

AusNet Services is acting prudently to address the network capacitive limits at each Tranche 2 zone substation by deferring investment until the network damping can be accurately measured when the REFCL is brought online whilst working on refining network damping modelling. In the event the capacitance is identified to be greater than the ASC limit and compliance with the Regulatory obligations cannot be met, AusNet Services will utilise the time extension provisions in the Regulations to implement solutions to achieve the Required Capacity.

LDL will have two standard ASCs installed by 31 May 2021, which, for planning purposes, is assumed to have a combined capacitive current limit of 185A. The table and chart below demonstrate that the capacitive current limit is forecast to be exceeded by 2021 and will continue to increase.

Table 3.3 LDL capacitive current forecast

	2020	2021	2022	2023	2024	2025	2026
LDL capacitive current	212	216	220	223	227	231	235
ASC Limit	N/A	185	185	185	185	185	185
Excess capacitive current		31	35	38	42	46	50

Figure 3.4 Capacitive Current Forecast for LDL – 2020 to 2026

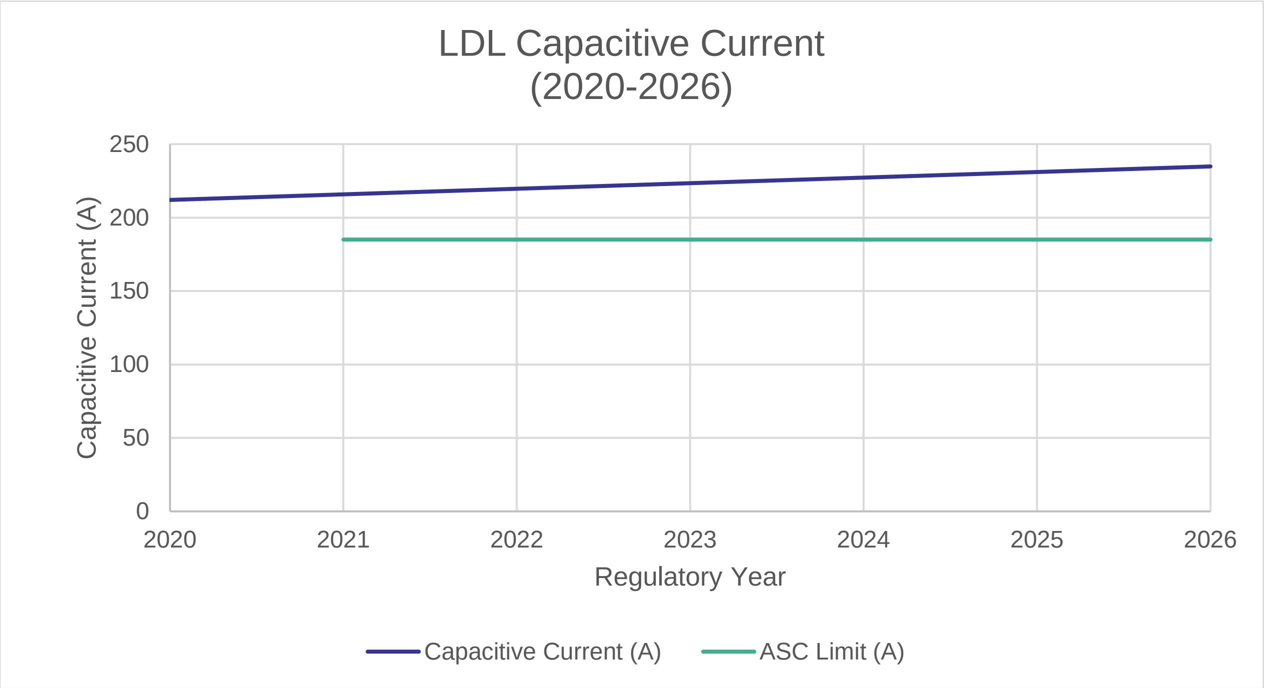


Table 3.4 presents estimates of the capacitive current (I_{CO}) per feeder. Importantly, the table shows:

- The I_{CO} at LDL will be greater than the planning limit of the combined two REFCLs;

- LDL11 and LDL23N feeders have the highest amount of capacitive current, and therefore these feeders are considered in more detail in section 4.
- The capacitive current is not split evenly between the buses, with Bus 1 having 105A and Bus 2 having 132A in 2026. The individual limit has been exceeded on both buses.

Possible mitigation measures to address this are discussed in section 4.

Table 3.4 Estimated Capacitive Current contribution per feeder

Old Feeder Name	New Feeder Name	Forecast I_{CO} (A) 2026
LDL21	LDL11	64
LDL12	LDL12	3
LDL13	LDL13	22
LDL14	LDL14	16
	Total Bus 1	**105**
LDL11	LDL21	6
LDL22	LDL22	11
LDL23E	LDL23E	22
LDL23N	LDL23N	50
LDL24	LDL24	41
	Total Bus 2	**130**
	Grand Total	**235**

3.2 Identified need

As shown in section 3.1, due to expected growth in AusNet Services network, additional works will be required to maintain compliance with the Required Capacity in the Regulations during the 2022-2026 regulatory control period.

The forecast continued residential growth, network augmentation in the LDL supply area, particularly URDs which increase the capacitive current on the network, means that the capacitive current capacity of the REFCLs at LDL is forecast to exceed the capacitive current limit at LDL in 2021. The following key issues arise:

- The zone substation is forecast to exceed its planning limit of 185A (two REFCLs installed);
- The capacitive current is not split evenly between the buses, with Bus 1 having 105A and Bus 2 having 130A in 2026. The individual limit has been exceeded on both buses.

As the demand growth is not identified to be a constraint for the zone substation, AusNet Services needs to identify the most economic option to address the capacitive current constraint that will affect the REFCLs.

4 Options analysis

The options identified below are based on the best knowledge currently available on the network, including ASC limit and forecast capacitive current growth.

AusNet Services has identified six options that could maintain compliance with the Regulations. These are summarised in Table 4.1.

Initial assessment of the six options found that four were non-credible. The reasons for this assessment are set out in in Table 4.1.

Two of these options (option 3 and 6) were assessed as credible options and are discussed further in section 4.1 and 4.2.

Table 4.1 Options Reviewed

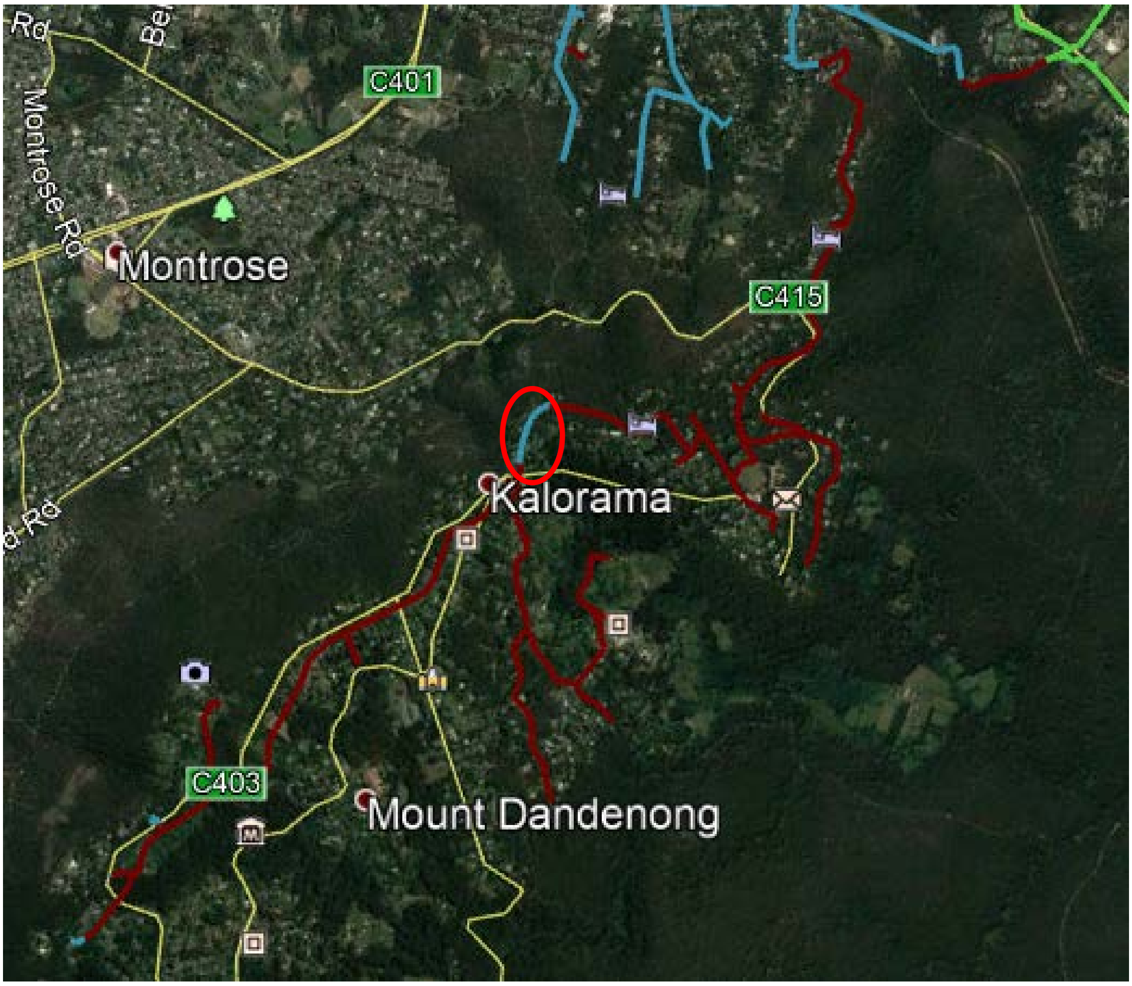
Option	Discussion	Credible
Option 1 - Business as Usual	The Business as Usual option maintains the status quo at LDL which will entail no additional investment at LDL to manage the impact of the capacitive current. With an increasing capacitive current forecast, LDL may become non-compliant with the Regulations, the community served by the LDL zone substation would be exposed to increased risk of fire starts from 22kV phase-to-earth faults, and AusNet Services will be subject to penalties under the Act. On this basis, Option 1 is not a credible option.	N
Option 2 - Capacitance/Load Transfer	Investigation of the network found that there are no options to transfer load away from LDL to adjacent substations that would provide sufficient reduction of capacitive current. Hence, this option is not technically feasible and therefore a non-credible option.	N
Option 3 - Install isolation transformer and network augmentation	This option proposed to install an isolation transformer to reduce the capacitive current at LDL by isolating the Mount Dandenong 22kV network Feeder LDL11 past switch LD727. This will also require undergrounding 350m of overhead line and network augmentation. This is a credible option and is discussed further in section 4.1	Y
Option 4 – Remote REFCL	The remote REFCL solution is currently under development by AusNet Services. It isolates part of a feeder and protects that isolated section with its own REFCL. The remote REFCL can be located no closer than 100m to the zone substation due to earthing issues. The following is required for this option: • remote REFCL requires at least 22m x 11m land size in a developed urban area which will be difficult and expensive to acquire • remote REFCL would be required on a Bus 1 or Bus 2 feeder, followed by load transfer, to ensure capacitance on both buses is below the limits. LDL11 is the feeder with the most capacitance forecast, hence, is the likely target. This is a viable option and is discussed further in section 4.2.	Y
Option 5 - Install third REFCL	Third REFCL is technically feasible however requires extensive zone substation modification and because more cost effective, easily deployed options exist, this is considered non-credible.	N
Option 6 - New Zone Substation	Installing a new zone substation is a technically viable option. However, it is a high cost solution and there would be significant negative social impact due to the land area required to accommodate a new zone substation and increased overhead network for feeder exits. Given that this is an established area, it is likely to be difficult to find available land for the ZSS. Therefore, whilst establishing a new zone substation would address the technical issues, it is not further considered as there are more cost effective alternatives that maintains compliance at LDL.	N

4.1 Option 3– Install isolation transformer and network augmentation

This option proposes to install an isolation transformer at LDL to reduce the capacitive current that LDL is subjected. The requirement for this approach is that all conductors downstream of the isolation transformer are underground cables.

In section 3, LDL11 feeder was identified as having high capacitive current. The Mount Dandenong 22kV network (Feeder LDL11 past switch LD727) is almost entirely underground. The last major overhead section (Figure 4.1), which is approximately 350m in length of HV ABC, is installed along a narrow road that is cut into rock. Undergrounding this remaining overhead section, if HV ABC is not be exempt, and the installation of a 7.5MVA isolation transformer will provide an expected reduction of 45A of capacitive current.

Figure 4.1 LDL11 Mount Dandenong, circled section is HV ABC



Recent measurements indicated that LDL14 is likely to be a source of high damping. Therefore, it is recommended to install a 300kVA isolation transformer on pole 1007369. This is expected to reduce the capacitance on LDL14 by 6A and potentially improve damping.

The revised capacitance current for 2026 is summarised in Table 4.2.

Table 4.2 Revised capacitive current contribution per feeder

New Feeder Name	Forecast I_{CO} (A) 2026	Capacitance Reduction	Revised Forecast I_{CO} (A) 2026
LDL11	64	-45	19
LDL12	3	0	3
LDL13	22	0	22
LDL14	16	-6	10
Total Bus 1	**105**	**-51**	**54**
LDL21	6	0	6
LDL22	11	0	11
LDL23E	22	0	22
LDL23N	50	0	50
LDL24	41	0	41
Total Bus 2	**130**	**0**	**130**
Grand Total	**235**		**184**

In summary, the following work is proposed at LDL to maintain compliance:

- Installation of one 7.5MVA isolation transformer on LDL11 past switch LD727;
- Undergrounding 350m of overhead HV ABC and associated assets;
- Network load to be assessed after summer and transfers from Bus 2 to Bus 1 to be implemented to move approximately 10A of capacitance from Bus 2 to Bus 1.

The estimated cost of the option is $4.3 million. There is a high risk of being unable to acquire the land in the necessary location for the isolation transformer, and there is very little ability to change the location and still achieve the same current reduction. This risk can be mitigated through additional undergrounding to the isolation transformer location but will result in an increased cost.

There will be some impact to the community due to the installation of an isolation transformer in an urban area. However, it is the least cost, technically feasible option and hence it is the preferred option.

4.2 Option 6 – Remote REFCL

This option proposes to install a Remote REFCL to reduce the capacitive current experienced at LDL. The remote REFCL solution is currently under development by AusNet Services. It isolates part of a feeder and protects the isolated section with its own REFCL to ensure the Required Capacity can be achieved. The remote REFCL must be located no closer than 100m to the zone substation due to earthing issues.

As per the capacitive forecast shown in section 3.1.2, remote REFCL would be required on a Bus 1 or Bus 2 feeder, followed by load transfer, to ensure capacitance on both buses is below the limits. LDL11 is the feeder with the most capacitance forecast, hence, is the likely target. However, the following issues were identified with this option:

- require at least 22m x 11m land size in a developed urban area which will be difficult and expensive to acquire;
- there will be a negative impact on the community through the installation of new large infrastructure in residential areas;
- for the remote REFCLs to achieve its purpose, the locations for the remote REFCL assumes new development will be down stream of the remote REFCLs, however, locations of new development cannot be predicted; and

- the effectiveness of a remote REFCL to isolate capacitance from new development growth will be limited by feeder thermal constraints.
- the estimated total cost is $10 million including land for a remote REFCL.

Therefore, although this option is considered credible, it is higher risk due to the uncertainty of purchasing a larger parcel of land in an established urban area, the impact of the additional infrastructure in urban areas and the high cost.

The long-term benefits of this option are unclear as new large development may be built upstream of the remote REFCLs. This reduces the potential benefits for capacitance reduction in the future and will not guarantee compliance.

This option is not recommended.

4.3 Option comparison

The two credible options studied in this report are summarised below. The comparison of the options shows that option 3 is the preferred option is the least cost, technically feasible solution.

Table 4.3 Feasible Options Comparison

Option	Technical feasibility	Estimated Cost (real $ 2020)	Regulatory feasibility	Social impact	Preferred
Option 3 - Install isolation transformer and network augmentation	Yes, but load transfers are required to ensure both buses are within limits	$4.3 M	Yes	Yes	Yes
Option 6 – Remote REFCL	Yes, but load transfers are required to ensure both buses are within limits	$10 M	Yes	Yes	No

5 Recommendation

It is recommended that option 3 (installation of an isolation transformer and network augmentation) is approved. This is an established solution which has already been deployed in part at other zone substations. Once approved, AusNet Services will undertake the following work:

- Installation of one 7.5MVA isolation transformer on LDL11 past switch LD727;
- Undergrounding 350m of overhead HV ABC and associated assets;
- Network load to be assessed after summer and transfers from Bus 2 to Bus 1 to be implemented to move approximately 10A of capacitance from Bus 2 to Bus 1.

The estimated cost for this solution and associated works is $4.3 million.

6 Appendix A

6.1 The Regulation stipulates the requirements

AusNet Services' network's geographical location means that it is exposed to extreme bushfire risk. These conditions warrant significant investment to mitigate the risk of bushfires that may occur following earth faults on the distribution network.

The Victorian Bushfire Royal Commission, established in 2009, made several recommendations with respect to fires initiated from electricity distribution networks. Subsequently, the Victorian Government established the Powerline Bushfire Safety Taskforce (**PBST**) to investigate new cost efficient and effective technologies and operational practices to reduce catastrophic bushfire risk.

The PBST identified Rapid Earth Fault Current Limiters (**REFCLs**) installed in zone substations as an efficient and effective technology.

The *Electricity Safety (Bushfire Mitigation) Amendment Regulations 2016* (**Amended Bushfire Mitigation Regulations**), which came into operation on 1 May 2016, set out new requirements for major electricity companies including the requirement for Polyphase Electric Lines (defined as multiphase distribution between 1 kV and 22 kV) at selected zone substations to have the following abilities:

- to reduce the voltage on the faulted conductor for high impedance faults to 250 volts within 2 seconds
- to reduce the voltage on the faulted conductor for low impedance faults to
  i. 1900 volts within 85 milliseconds; and
  ii. 750 volts within 500 milliseconds; and
  iii. 250 volts within 2 seconds; and
- Demonstrate during diagnostic tests for high impedance faults to limit
  i. Fault current to 0.5 amps or less; and
  ii. The thermal energy on the electric line to that resulting from a maximum I^2t value of 0.10 A^2s;

The Amended Bushfire Mitigation Regulations define the low and high impedance faults as follows:

- High impedance = a resistance value in ohms that is twice the nominal phase-to-ground voltage. This is equal to 25.4 kilohms or a fault current of 0.5 amps on a 22 kV network.
- Low impedance = resistance value in Ohms that is the nominal phase-to-ground network voltage divided by 31.75. This is equal to 400 Ohms or a fault current of 31.75 Amps on a 22 kV network.

6.2 The Act stipulates non-compliance penalties

The penalties for not complying with the requirements set out in the Regulations are set out in the *Electricity Safety Act 1998* (the **Act**). The Act states that there will be a fine of up to $2 million for each point less than the prescribed number of points that must be achieved at each of the three specified dates and an ongoing fine of $5,500 per day that compliance is not achieved.

The detail of the fines is set out in Clause 120M (3) which states a major electricity company is liable to pay:

a *if subsection (1)(a) or (b) [(1)(a) - A major electricity company must ensure that for the initial period, a sufficient number of zone substations in its supply network are complying substations so that the total number of allocated substation points prescribed in respect of all of the complying substations is not less than 30 (the period 1 minimum points); and (1)(b) for the intermediate period, a sufficient number of zone substations I its supply network are complying substations so that the total number of allocated substation points prescribed in respect of all of the complying substation is not less than 55 (the period 2 minimum points)] is contravened, a pecuniary penalty not exceeding $2 000 000 for every point forming the difference between the total number of allocated substation points prescribed in respect of all of the complying substations and, as the case require:*

i *the period 1 minimum points; or*

ii *the period 2 minimum points; and*

b *if subsection (1)(c) [on or after 1 May 2023, of if Energy Safe Victoria specifies a later date under section 120X, that date, all zone substations in its supply network are complying substations] is contravened, a pecuniary penalty not exceeding $2 000 000 for every allocated substation point prescribed in respect of each zone substation that is not a complying substation; and*

c *if there is a continuing contravention of subsection (1)(a), (b) or (c), a pecuniary penalty that is a daily amount not exceeding $5500 for each day that contravention continues after service on the major electricity company by Energy Safe Victoria of notice of that contravention.*

6.3 Exemptions and time extensions

Electricity businesses can seek an exemption from both the Act and Regulations.

Exemption from the Act can be sought under section 120W of the Act from the requirements under section 120M of the Act. An exemption requires the Director of ESV to consult with the Minister for Energy, Environment & Climate Change and Governor in Council approval. The process can take up to 6 months.

Clause 13 of the Regulations allows for the electricity businesses to apply for exemptions from complying with the requirements of (7)(1)(ha) and (7)(1)(hb).

13 Exemptions

2 *Energy Safe Victoria may, in writing, exempt a specified operator or major electricity company from any of the requirements of these Regulations.*

3 *An exemption under subregulation (1) may specify conditions to which the exemption is subject.*

Time extension requests under S120X of the Act can be made to the Director of Energy Safe Victoria clearly stating the reasons for the request.