REFCL Compliance Maintained Planning Report Belgrave (BGE) Zone Substation

AMS – Electricity Distribution Network

Document number	AMS 20-406
Issue number	2
Status	Approved
Approver	Tom Langstaff
Date of approval	28/01/2020

ISSUE/AMENDMENT STATUS

Issue	Date	Description	Author	Approved
1	3/12/2019	First Issue	Networks Planning	T Langstaff
2	28/01/2020	Minor amendments	Networks Planning	T Langstaff

Disclaimer

Contact

This document is the responsibility of the Regulated Energy Services division of AusNet Services.

Please contact the indicated owner of the document with any inquiries.

T Langstaff
AusNet Services
Level 31, 2 Southbank Boulevard
Melbourne Victoria 3006
Ph: (03) 9695 6000

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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**). The 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.

Belgrave (**BGE**) 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 BGE during the 2022-26 regulatory control period.

By the Tranche 2 compliance deadline of 1 May 2021, BGE will have two standard Arc Suppression Coils (**ASCs**) installed which, for planning purposes, are assumed to have a total capacitive current limit of 200A. If capacitive current exceeds 200A, the ASC 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, at this stage, the increasing capacitive current is driving the need to invest in BGE to ensure AusNet Services can maintain compliance with the Act and 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 that feeders BGE11 and BGE24 be reconfigured and the network augmented as necessary to transfer capacitive load to the adjacent REFCL capable Ferntree Gully (**FGY**) zone substation. This will allow BGE's capacitive current to remain below the capacitive limit of the ASCs.

The associated works for this option will include:

- Close switch BG175 and open switch BG042 - this will transfer 103A from BGE11 to BGE24;
- Close switch BG318 and open switch BG1200 - this will transfer 67A from BGE11 to FGY33; and
- Limited feeder reconductoring and augmentation to achieve thermal capacity required.

The estimated cost for this option is $1.29 million ($'real, 2019).

2 Background

2.1 Purpose of this report

This report investigates any constraints that are forecast to occur at BGE, identifies and assesses potential options, and seeks funding for the preferred option. BGE 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 switching zone, 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, conservative, augmentation timing.
- **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. Hence, a planning constraint of a maximum of two REFCLs per zone substation has been used.

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:

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

- 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 enables the use of three REFCLs at a zone substation, it may enable deferral of the construction of a new zone substation.

3 BGE zone substation overview

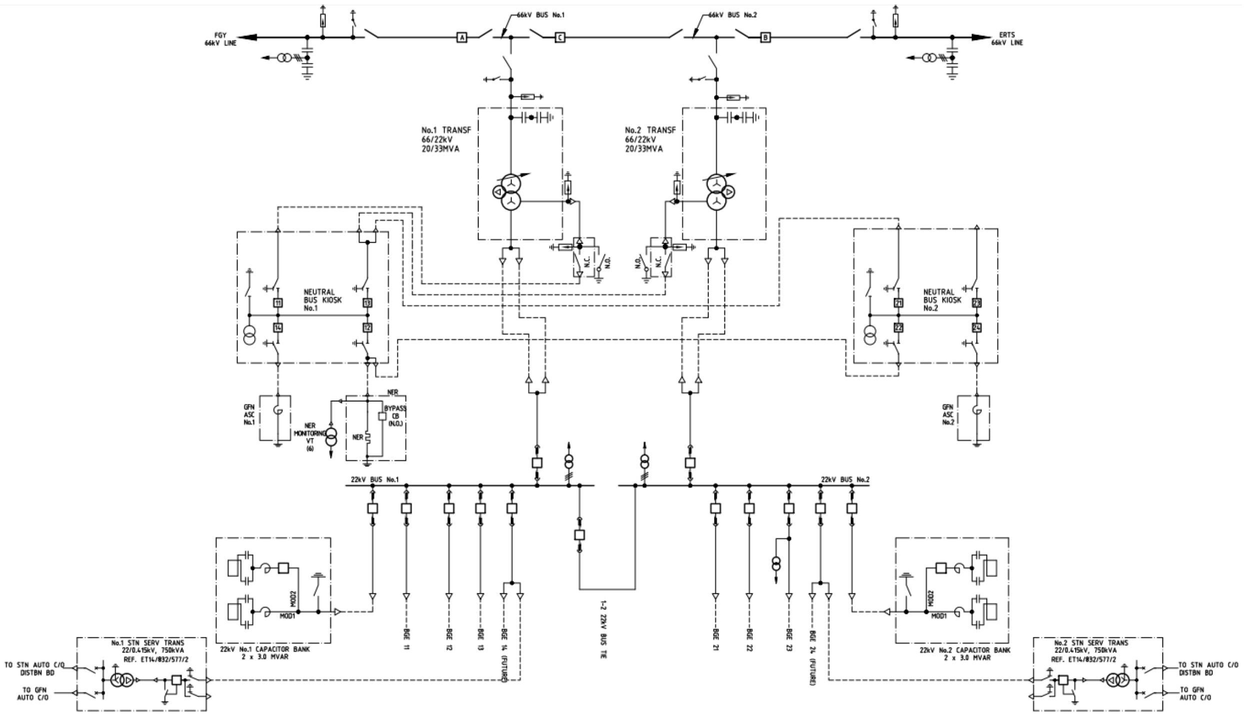
Belgrave (**BGE**) zone substation (**ZSS**) is located in the suburb of Belgrave South approximately 37km south east of Melbourne. Originally constructed in the early 1980s, it is now comprised of two transformers feeding two buses.

As shown in Figure 3.1, BGE consists of two 20/33 MVA transformers supplying two 22kV buses and six 22kV feeders.

Two REFCLs will be commissioned at BGE on neutral buses 1 and 2 by 31 May 2021 as part of Tranche 2 of the AusNet Services REFCL Program to achieve compliance with the Regulations. The future Single Line Diagram, showing the two REFCLs, is shown in Figure 3.1.

Given the existing REFCL software allows a maximum of two REFCLs per zone substation, presently it is not possible to install any more REFCLs at this site.

Figure 3.1 BGE ZSS Single Line Diagram



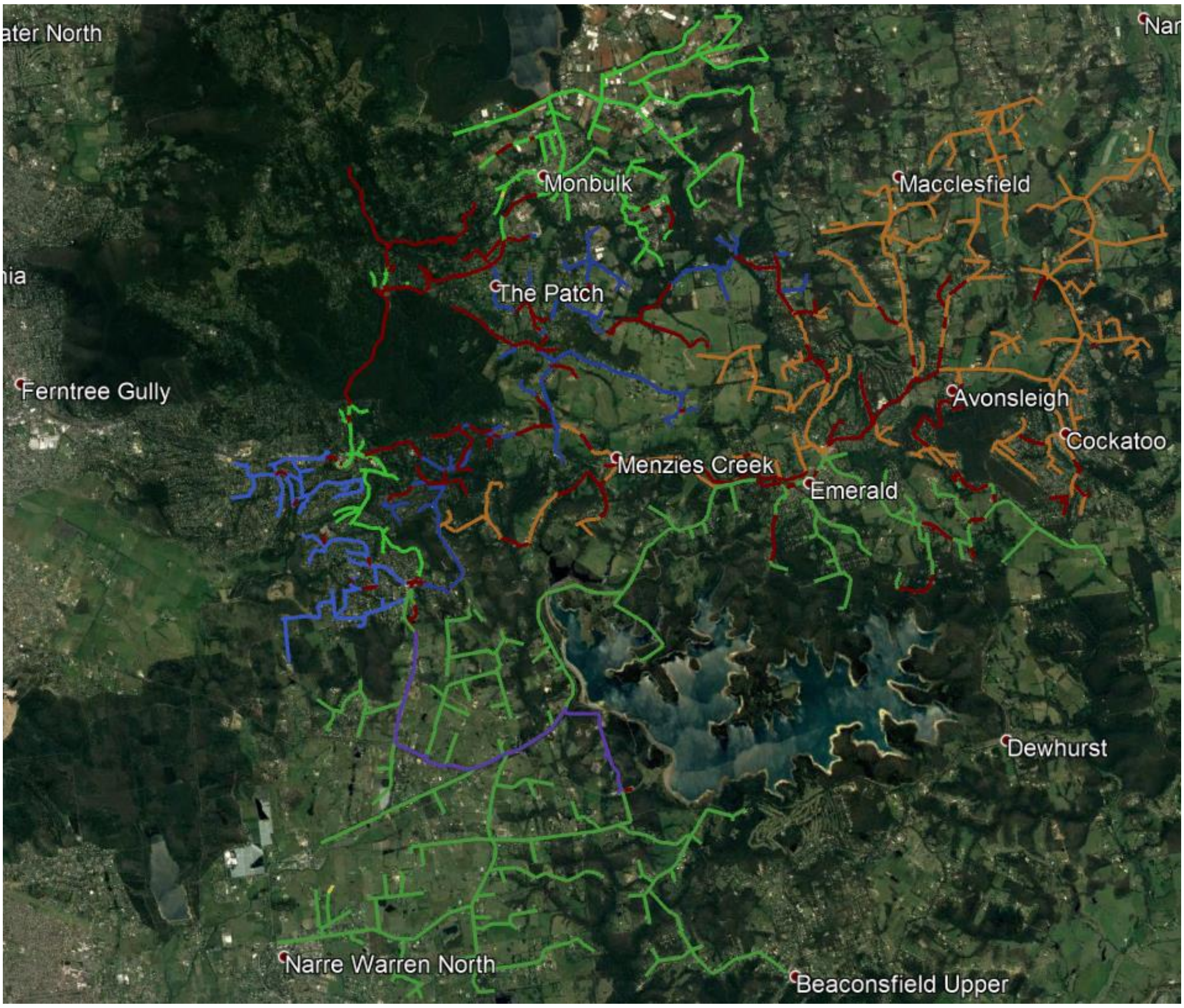
An aerial view of the 22kV feeders originating from Belgrave electricity distribution area is shown in Figure 3.2. The distribution area includes the residential areas around Belgrave as well as semi-rural areas between Narre Warren North, Monbulk and Cockatoo. There are interconnections with Ferntree Gully zone substation to the south east though Upwey. Connections exist though the 6.6kV network but do not have enough capacity to be considered for long term transfers.

The image shows that the feeders are predominately overhead with the breakdown of overhead and underground conductors per feeder shown in Table 3.1. Overhead feeders contribute a lower amount of capacitive current compared to underground cables.

Table 3.1 Overhead and underground conductor lengths

Feeder	Overhead (km)	Underground (km)	Total length (km)
BGE11	48.2	14.6	62.8
BGE12	94.6	4.0	98.6
BGE21	7.8	1.3	9.1
BGE22	53.3	19.3	72.6
BGE23	18.8	1.9	20.7
BGE24	27.2	16.6	43.8
Grand Total	**249.9**	**57.8**	**307.6**

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



As part of the REFCL Program and other capital works programs, capacity and capacitive current management projects are being undertaken.

Ferntree Gully (FGY) is an adjacent zone substation to BGE and is also a Scheduled zone substation. As part of the REFCL Program, a new zone substation is being constructed at Rowville (RVE) with load and capacitive current from three underground residential estates to be transferred from FGY to RVE. This transfer will create spare capacity at FGY that can be used to help manage the capacitive current at BGE.

3.1 Network forecast

This section discusses the demand and capacitive current forecasts to identify if either attribute is exceeding the capacity of the zone 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.

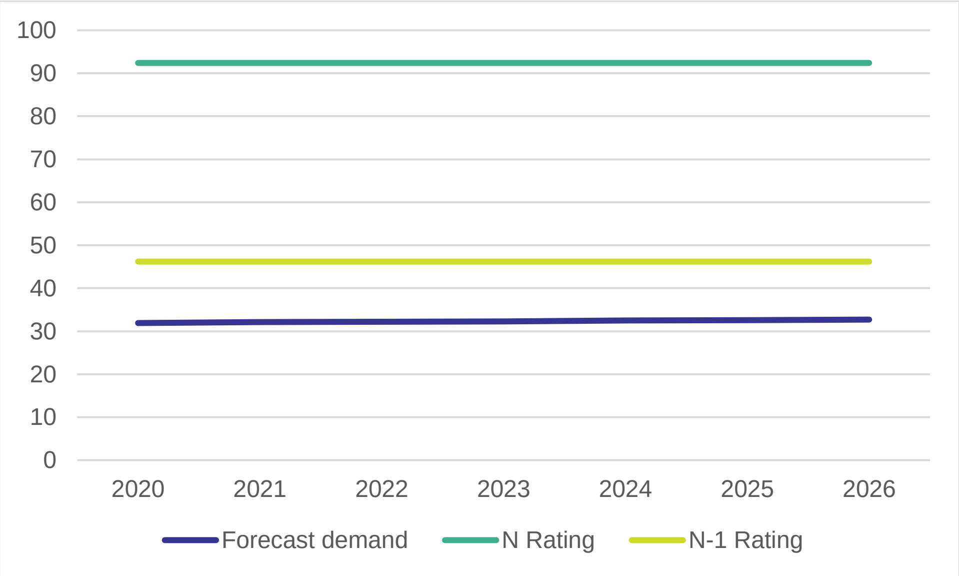
3.1.1 Demand forecast

Table 3.2 shows the BGE maximum demand forecast (MVA) between 2020 and 2026. By 2026, the summer demand is expected to increase by approximately 1 MVA. Figure 3.3 shows that the forecast demand will not exceed the N-1 cyclic rating of the substation within the next regulatory period.

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

	2020	2021	2022	2023	2024	2025	2026
BGE Winter (50POE)	25.5	25.3	25.1	25.0	24.8	24.6	24.3
BGE Summer (50POE)	31.3	31.5	31.6	31.7	31.9	32.0	32.1
BGE Winter (10POE)	26.8	26.7	26.5	26.3	26.1	25.9	25.7
BGE Summer (10POE)	33.3	33.5	33.6	33.7	33.9	34.0	34.2
BGE Consolidated Forecast[3]	31.9	32.1	32.2	32.3	32.5	32.6	32.7

Figure 3.3 Demand forecast



3.1.2 Capacitance forecast

The network capacitance 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.

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.

Since the growth in capacitance is strongly related to the growth of URDs, 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 indicative 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 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.

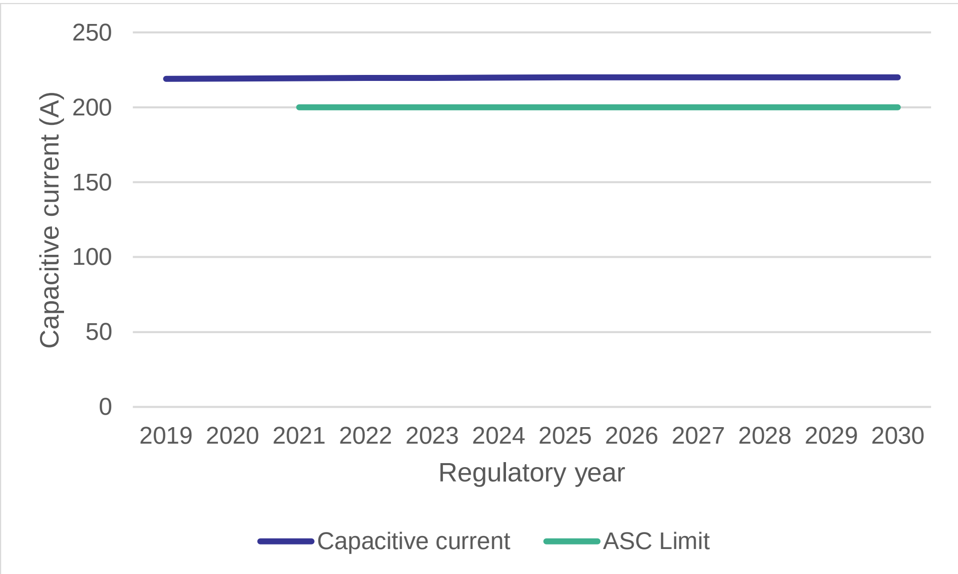
AusNet Services is acting prudently to address the network capacitive limits at each Tranche 2 zone substation by deferring investment until the network damping can be accurately measured when the REFCL is brought online whilst working on refining network damping modelling. In the event the capacitance 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.

By 31 May 2021, BGE will have two standard ASCs installed which, for planning purposes, is assumed to provide a capacitive current limit of 200A. As shown in Table 3.3, this limit is forecast to be exceeded by 2021.

Table 3.3 BGE capacitive current forecast

	2020	2021	2022	2023	2024	2025	2026
BGE Capacitive Current	219	219	220	220	220	220	220
ASC Limit	N/A	200	200	200	200	200	200
Excess Capacitive Current		19	20	20	20	20	20

Figure 3.4 Capacitive Current Forecast for BGE – 2019 to 2030



Overhead feeders contribute a lower amount of capacitive current compared to underground cables. Table 3.4 estimates the capacitive current (I_{CO}) per feeder. The total current was split proportionally based on the amount of underground cable per feeder. This identifies if any feeders are expected to exceed the individual feeder limit of 80A and also where the greatest capacitive current reduction can be achieved. Importantly, the table shows:

- The I_{CO} at BGE is forecast to exceed the planning limit of the combined two REFCLs.
- The I_{CO} is not spread evenly across the feeders with Bus 1 forecast to reach 71A and Bus 2 forecast to reach149A by 2026.
- Feeder BGE22 is forecast to be approaching the individual feeder limit. The I_{CO} for Feeders BGE11 and BGE24 is also high.

Mitigation measures to address this are discussed in section 4.

Table 3.4 Estimated Capacitive Current contribution per feeder

Feeder	Forecast I_{CO} (A) 2026
BGE11	55.8
BGE12	15.3
BGE21	5.0
BGE22	73.3
BGE23	7.4
BGE24	63.2
Grand Total	**220.0**

3.1.3 Transfer capacity

A constant transfer capacity of at least 67A has been identified to be available at FGY as shown in Table 3.5.

Table 3.5 Capacitive current transfer capability from BGE to FGY

	2020	2021	2022	2023	2024	2025	2026
Transfer capacity to FGY	**NA**	67	67	67	67	67	67

3.2 Identified need

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

The forecast continued residential growth and network augmentation in the BGE supply area, particularly URDs which increase the capacitive current on the network, means that the capacitive current capacity of the REFCL at BGE may be exceeded in 2021:

- The zone substation may exceed its overall planning limit of 200A (two REFCLs installed);
- Bus 2 may exceed its individual planning limit of 100A; and
- Feeder BGE22 is shown to be approaching the individual feeder limit. The I_{CO} for Feeders BGE11 and BGE24 is also high.

As the demand growth and asset condition are not identified to be constraints for the zone substation, AusNet Services needs to identify the most economic option to address the capacitive current constraints that will affect compliance with the Regulations by 2021.

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 eight options that could maintain compliance with the Regulations. These are summarised in Table 4.1.

Initial assessment of the eight options found that six were non-credible on a technical or cost basis. The reasons for this assessment are set out in in Table 4.1.

Two of the options (option 2 and 4) were found to be credible and are discussed in further detail in sections 4.1 to 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 BGE which will entail no additional investment at BGE to manage the impact of the capacitive current. With a capacitive current forecast exceeding the thresholds used for forecasting purposes, BGE may become non-compliant with the Regulations, the community served by the BGE 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	This option proposes to reconfigure feeders at BGE and transfer capacitance/load to the adjacent Ferntree Gully (**FGY**) Zone Substation. This is a credible option and is discussed further in section 4.1.	Y
Option 3 – Install isolation transformer on entire feeder	This option proposes to install an Isolation Transformer to isolate an entire feeder. Use of Isolation Transformers requires that all conductors downstream of the isolation transformer are underground cables. Also, it requires and an exemption to be granted by by the Governor in Council. The BGE network is comprised of large rural feeders with overhead and underground sections. Hence significant undergrounding of lines would be required for this option to be eligible for an exemption. The feeder with the least overhead conductor that would reduce I_{CO} to below the limit is BGE24. However, this would require undergrounding 136km of overhead line with an estimated cost of approximately $95.2 million. Therefore, this option does not present cost effective isolation opportunities and is not considered as a credible option.	N
Option 4 - Install isolation transformers and undergrounding work	This option proposes to install an isolation transformer to a section of a feeder(s). There are various underground cable sections that can be isolated. However, finding land would be difficult for the isolation transformers. This option is discussed further in section 4.2.	Y
Option 5 – 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 issues were identified with this option: - they require at least 30m x 30m land size in a	N

Option	Discussion	Credible
	developed urban area which will be difficult and expensive to acquire - to reduce the capacitive current sufficiently at BGE, one Remote REFCL would be required in 2021. The cost excluding land is expected to be $7.5m for this REFCL, which is more expensive than other options. Therefore, this option is considered non-credible due to cost and difficulty in purchasing land.	
Option 6 - Undergrounding Over Head line in High Bush Fire Risk Area	BGE is comprised of 250km of overhead line. The cost, including converting overhead distribution transformers and switches to underground assets, is estimated at $175 million and therefore is not a credible option.	N
Option 7 - Install third REFCL	There is currently no deployed REFCL software solution to operate three REFCLs at a single zone substation. Hence, due to technology limitations, this is not a credible option.	N
Option 8 - New Zone Substation	Installing a new zone substation to reduce the capacitive current at BGE is a technically viable option. However, the cost of a new single transformer ZSS (with REFCL) is a minimum of $20 million depending on the location and proximity to a sub transmission line and its load. There would also be a significant negative social impact due to the land area required to accommodate a new zone substation and given that this is an established area it will be very difficult to find available land for the ZSS. Hence, this option is considered non-credible due to the cost.	N

4.1 Option 2 – Capacitance/load transfer

This option proposes to transfer capacitance/load from BGE to FGY which is a Scheduled zone substation and has been identified to have sufficient capacitive current and demand capacity following the construction of RVE.

Demand and capacitive current will be transferred from FGY to RVE, thereby creating spare capacity at FGY. Table 4.2 below shows the capacitive current capacity available at FGY that can be used to support BGE.

Table 4.2 Capacitive current transfer capability between BGE and FGY

	2021	**2022**	**2023**	**2024**	**2025**	**2026**
Transfer capacity available to FGY	67	67	67	67	67	67
Transfer required from BGE	**19**	**20**	**20**	**20**	**20**	**20**
Outcome	**OK**	**OK**	**OK**	**OK**	**OK**	**OK**

The scope of this option involves load transfers from BGE to FGY as well as reconfiguration of feeders at BGE to distribute capacitive current across the two buses to ensure both buses stay within the REFCL limit during split bus operations. The scope includes:

- Close switch BG175 and open switch BG042 - this will transfer 103A from BGE11 to BGE24; and
- Close switch BG318 and open switch BG1200 - this will transfer 67A from BGE11 to FGY33.

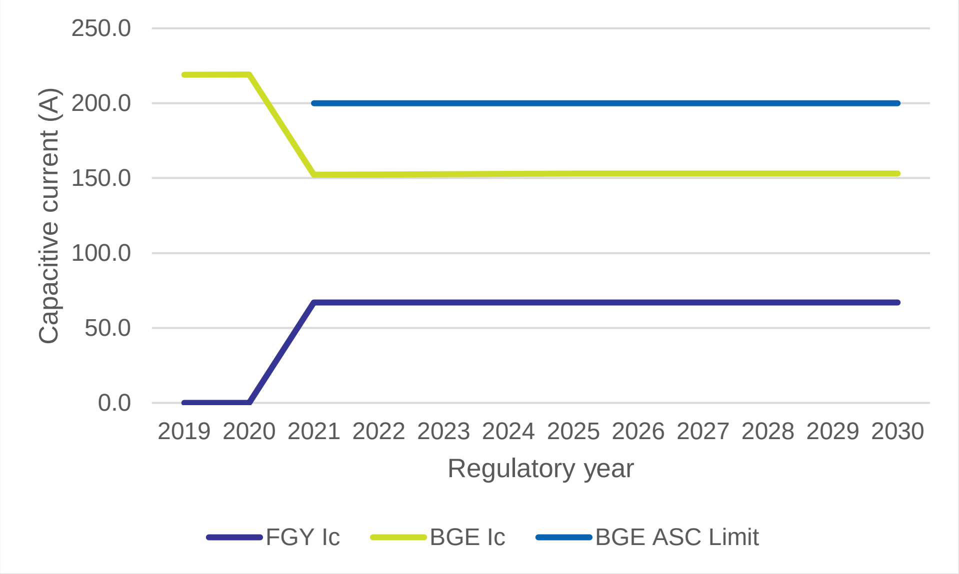
The assumptions made for this are:

- available capacitive current transfer capacity from BGE to FGY is 67A based on thermal constraints;
- the planning ASC current limit of 100A; and

- best case scenario that all the capacity transfer required can be achieved through the available connection point between BGE and FGY.

Figure 4.1 shows that as soon as the capacitive current is transferred to FGY, the capacitive current at BGE reduces to below the ASC limit and will remain below the limit until at least 2026 based on current forecasts.

Figure 4.1 BGE and FGY capacitive current compared to BGE ASC limit



Capital expenditure for the reconfiguration of feeders and associated works is $1.29 million with a NPC of $1.1 million (in 2019 terms). This solution will ensure AusNet Services can achieve the requirements of the Regulations. No negative social impacts are expected as all works are within the existing zone substations.

This is the recommended option.

4.2 Option 4 – Install isolation transformer and undergrounding work

This option proposes to install isolation transformers to reduce the capacitive current the ASC is subject to. The requirement for this approach is that all conductors downstream of the isolation transformer are underground cables and it requires an exemption to be granted by the Governor in Council. There is precedence in receiving exemptions for this approach and is an established process.

The following two feeders have been identified to be suitable for isolation transformers:

- BGE24 – Install isolation transformer at the switch BG1055
  - Reduces capacitive current by 47A
  - Requires 15 km of overhead lines to be undergrounded
- BGE22 – Install isolation transformer at the switch BG108
  - Reduces capacitive current by 41A
  - Requires 8 km of overhead lines to be undergrounded

The scope of work to implement this option is:

- two isolation transformers;
- appropriately located land (not costed); and

- undergrounding of 23 km of overhead plus associated distribution transformers and switches.

Due to the imbalance of capacitive current across the two buses, both of the isolation transformers are required to ensure the capacitive current on each bus is below 100A and below 200A in total for the zone substation.

The estimated cost of the option, excluding land, is $18.5 million. Due to the locations of cable on BGE being in established urban areas, there is a high risk that AusNet Services will not be able to acquire sufficient land in the necessary locations within the required timeframes. To achieve the capacitance reduction, there is very little ability to change the location without significantly increasing the cost due to installation of additional underground cable.

Therefore, since the cost is expected to exceed $18.5 million (NPC greater than $16.3 million in 2019 terms) and there is a high risk to implementation, this option is not recommended.

4.3 Option comparison

The two viable options studied in this report are summarised below. The comparison of the options shows that Option 2 is the preferred option.

Table 4-3 Feasible Options Comparison

Option	Technical feasibility	Cost	NPC	Regulatory feasibility	Social impact	Preferred
Option 2 – Capacitance/Load Transfer	Yes	$1.29 M	$1.1 M	Yes	No	Yes
Option 4 - Install isolation transformer and undergrounding work	Yes	Greater than $18 M	>$16.3 M	Needs exemption	Yes	No

5 Recommendation

It is recommended that Option 2 (transfer load/capacitance) be approved. This option shall utilise existing electrical infrastructure. Network augmentation that includes reconductoring shall be done on the necessary sections of the network to facilitate this option.

In summary, following the approval, AusNet Services will complete the following works:

- Close switch BG175 and open switch BG042 - this will transfer 103A from BGE11 to BGE24;
- Close switch BG318 and open switch BG1200 - this will transfer 67A from BGE11 to FGY33; and
- Limited feeder reconductoring and augmentation to achieve thermal capacity required.

The estimated cost for the works associated with this option is $1.29 million ($'real, 2019).

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.