Powercor

Response to Regulatory Impact Statement

Bushfire Mitigation Regulations Amendment

30 December 2015

Table of Contents

1 Summary

1 Summary

We support the Victorian Government initiatives to reduce the risk of our assets contributing to starting a fire, where the overall community benefits outweigh the costs borne by our customers.

To ensure the best outcomes for customers, it is vital that the Regulatory Impact Statement properly accounts for reliability and safety benefits and costs. There are a range of matters on which the Regulatory Impact Statement is silent and makes incorrect assumptions, such as only having to replace one third of surge arrestors, which is likely to lead to overstatement of benefits and understatement of costs.

The implementation of the Victorian Government initiatives is an undertaking which should not be taken lightly, given the costs and potential positive and negative reliability outcomes for customers. We strongly encourage the Victorian Government to consider a transitional operational approach to REFCLs, given these technologies are untested on the scale the Victorian Government is considering. Such an approach will ensure we best understand the reliability and public safety outcomes and ensure customers are getting value for money.

On 23 November 2015, the Department of Economic Development, Jobs, Transport and Resources (**DEDJTR**) released a Regulatory Impact Statement (**RIS**) outlining proposed amendments to the Electricity Safety (Bushfire Mitigation) Regulations 2013 (**draft Regulations**).

The RIS proposes to require us to:

- install Rapid Earth Fault Current Limiters (**REFCL**s) into 22 of our zone substations by the end of 2022 for the purpose of reducing the energy produced by a phase to earth fault on a polyphase powerline;
- install 1,064 new generation automatic circuit reclosers (**ACR**s) on single wire earth return (**SWER**) lines; and
- replace end-of-life conductor with insulated cable or underground cable in declared areas.

The RIS estimates that the installation of REFCLs and replacement of end-of-life conductor with underground or insulated cable provides net benefits to consumers over the life of the assets. In contrast, the installation of SWER ACRs is estimated to impose a net cost on consumers, but the RIS recommends that the project be undertaken anyway.

The RIS estimates that the costs to our customers from these three initiatives is $400 million.

Table 1.1 Undiscounted cost associated with recommended options ($ million)

	Install REFCL	Install SWER ACRs	Replace powerlines	Total cost
Powercor	154.5	53.2	185.1	392.8

Source: ACIL Allen Consulting, *Regulatory Impact Statement - Bushfire Mitigation Regulations Amendment*, 17 November 2015, p. xv.

While we strongly support the intent of the draft Regulations, we are concerned about the following aspects of the RIS:

- the costs associated with the installation of REFCLs in zone substations are understated, primarily due to the inexplicable two-third reduction in the replacement of surge arrestors;
- there is currently only one supplier in the world who can produce REFCLs to meet the technical specifications set out in the RIS. This exposes us to monopoly-supplier risks if the supplier is unable to deliver the required number of REFCLs in what is an ambitious deployment timeframe, as well as exposing us and our customers to monopoly-supplier price risk;

- the analysis underpinning the assumptions around reliability benefits is not transparent. Despite the RIS being silent on the times at which the REFCLs must be operated, it appears to assume they will be operated on more than just Total Fire Ban (**TFB**) days based on the magnitude of the purported reliability benefits;
- as we have not trialled the operation of REFCLs, we are unable to commit to operating the equipment on more than TFB days and will need to work with Energy Safe Victoria (**ESV**) to assess the appropriateness of different operating modes. However, based on our preliminary analysis, we believe operating REFCLs outside of TFB days is likely to result in negative impacts on network reliability;
- the unit costs assumed in the RIS to replace conductor in declared areas are unrealistic, given that they involve an unsubstantiated 50 per cent rate reduction by 2020, rely upon the installation of a conductor type that does not yet exist in the marketplace, and will vary depending on the circuit type, conductor type and characteristics of the geographic area where the conductor is to be replaced, e.g. population density, environmental issues, local council requirements etc;
- the areas proposed to be electric line construction declared areas could change from year to year. Further, the definition of how much electric line to be replaced under the definition of *wholly or substantially replaced* is open to interpretation and could result in orders of magnitude cost differences; and
- the drafting of the draft Regulations is unclear, such that the actual costs could be significantly more than indicated in the RIS.

1.1 REFCLs

We intend to install REFCLs in our zone substations at Woodend (**WND**) and Gisborne (**GSB**) in 2016. This trial will enable us to undertake detailed scoping and preliminary operational tests, as well as understanding the processes required and limitations of operating a REFCL network adjacent to a non-REFCL network. There is much conjecture on the likelihood of REFCLs reducing bushfires. It is important that the conversation on REFCLs is based on fact and promises of safety and reliability benefits to consumers can be delivered. A case in point was the Minister for Energy & Resources statement that REFCLs will "stop a fault before it can start a fire"[1], yet the RIS notes the recent CSIRO report that REFCLs will reduce the likelihood of bushfires starting by polyphase lines supplied by a zone substation by between 48 and 60 per cent.

In terms of costs, our analysis indicates that every surge arrestor in a zone substation area needs to be replaced given the rating on the existing equipment. That is, the assets are unable to withstand the over-voltages that would result if the REFCL was operated. Therefore, the RIS assumption that only one third of surge arresters require replacement is incorrect. This specific requirement can account for as much as 30 per cent of the total project cost per zone substation and therefore the costs of REFCLs are understated in the RIS.

We estimate that half of our zone substations will require more than one REFCL to achieve the technical specifications in the proposed draft Regulations. Additionally, the cost of each REFCL unit is likely to be higher than estimated, given the recent price rises that we have been quoted from the sole supplier of the equipment. Furthermore, network balancing costs are likely to be higher than anticipated, based on the experiences of AusNet Services. These three factors also suggest that the costs to deploy REFCLs are understated in the RIS.

Conversely, we consider that the non-fire related benefits arising from the installation of REFCLs are overstated in the RIS. We are unclear of the operating mode that has been assumed in calculating the reliability benefits,

---

[1] See for example, Minister for Energy & Resources, *New Powerline Bushfire Safety Standards to Protect Victorians*, media release, 23 November 2015.

however it appears the RIS assumes REFCLs are operated on more than TFB days. As noted, it is would be prudent to transition the introduction of REFCLs, given there are still many unknowns. As a consequence we consider it is sensible to only operate REFCLs during TFB days. We will work with the ESV to discuss the appropriateness of different operating modes, potential public safety implications and ensure customers don't end up experiencing negative reliability outcomes and unrealistic expectations of bushfire mitigation outcomes.

That said, we recognise that there may be some improvement in momentary outages from installing a REFCL. However, there are unlikely to be any benefits to the duration of sustained outages — in fact, the reliability could be worse.

The deliverability of REFCLs in the timetable proposed by the Victorian Government is problematic. Our primary concerns are:

- risks from a sole supplier of the REFCL equipment who may not be able to deliver within the required timeframes;
- inherent risks associated with projects of this complexity and consequence; and
- the operational changes which will require changes in training and operating procedures within our business.

To ameliorate these risks, we believe consideration should be given to a 'stop the clock' or other mechanism to extend the timeframe to complete the deployment of REFCLs in zone substations, together with a longer timeframe of up to 10 years for the entire program to be carried out. Such a mechanism will, in our view, ensure the program is executed in the most prudent and efficient manner.

Finally, we note that the RIS acknowledges that remediation works would be required for high voltage customers. The RIS is however silent on who is responsible for costs associated with this work, and does not acknowledge that the potential cost impact for certain sites could be material.

1.2 SWER ACRs

We are already committed to undertaking the SWER ACR project during the 2016–2020 regulatory control period.

Our program of works relating to the installation of SWER ACRs is set out in our Bushfire Mitigation Plan, in accordance with a Direction we received from ESV on 5 April 2012. Our proposed expenditure to undertake this program has been approved by the Australian Energy Regulator (**AER**) in their preliminary determination for the 2016–2020 regulatory control period.

1.3 Electric line construction declared areas

The draft Regulations, while well intentioned, will materially increase costs to our consumers.

The costs associated with electric line construction in declared areas are highly uncertain. The draft Regulations are premised on the introduction of a technology in around 2020 that has not been tested in the network, nor available commercially so that the costs can be understood. The technology is also proposed to be sourced from a single supplier, again exposing us to monopoly-supplier risks.

The legal drafting of the draft Regulations is unclear. This exacerbates the uncertainty around the compliance obligations and costs.

We agree with the RIS that there are no reliability benefits from undergrounding or installing insulated cable in declared areas.

We are concerned about complaints received from new customers seeking to connect in declared areas, as the customer connection costs will be less discretionary and significantly higher than for customers outside of those areas. We encourage the Victorian Government to communicate to the community the impact of the draft Regulations on new connections and the higher costs for customers in the area.

2 REFCLs

2 REFCLs

The RIS proposes that we install REFCLs in 22 of our zone substations in the period from 2016 to 2022.

Despite the RIS indicating that the total cost to install 20 of our 22 REFCLs is $154 million, this cost is understated by at least $40 million as the analysis has used outdated preliminary cost estimates and has incorrectly omitted a percentage of our network hardening costs.

There are no short term reliability benefits from operating REFCLs. The operation of the REFCLs on TFB days meets the recommendations of the Powerline Bushfire Safety Taskforce. However, extended operation of REFCLs on days other than TFB days could potentially result in negative reliability and public safety outcomes. We will work with the ESV to determine whether extended operation of REFCLs on days other than TFB days will lead to positive reliability and public safety benefits. It is prudent that the approach is carefully planned and iterative to ensure we deliver the best outcomes for customers.

2.1 Background

Our network operates as a solidly-earthed or low impedance earthed network. That is, system neutral is connected directly, or through a resistor of low ohmic value to ground such that when there is a fault of a conductor to ground, high levels of fault current pass through the earth returning to the system neutral. Such a fault has minimal effect on healthy parts of the system and is quickly detected and disconnected by network protection systems.

In contrast, the inclusion of a REFCL requires the network to be operated as a resonant system, where the earth is used to provide a high impedance resonant circuit under fault conditions. When a conductor faults on a resonant network, there is minimal current flow and an increase in the voltage of the two remaining healthy phases.

There are significant operational and technical challenges in shifting from operating an entirely ‘low impedance’ network which we have been operating for around 100 years, to incorporating a very substantial ‘resonant’ network within the broader network in a relatively short period of time.

While we have been actively engaged in industry laboratory trials pertaining to REFCL performance, we have limited practical experience of operating resonant earthing systems. We therefore are planning to undertake a trial of REFCLs in our WND and GSB zone substations in 2016 to assist us in understanding the technical, operational and commercial impacts of such an undertaking.

2.2 Costs

This section discusses:

- the RIS reduction in our network hardening costs associated with replacement of surge arresters by two-thirds;
- the number of REFCLs required to be installed in each zone substation and risks associated with the cost of each REFCL unit; and
- network balancing costs.

We also note that the RIS analysis omits the costs of the zone substations where we have already committed to installing REFCLs such as WND and GSB. This cost assumption artificially reduces the overall program costs and hence distorts the cost-benefit analysis results. This omission means that consumers are prevented from seeing the true total cost of the overall package of initiatives.

Replacement of surge arrestors

We consider all surge arrestors will require replacement on feeders served by a zone substation where a REFCL is being installed, plus additional units on adjacent feeders used for contingency load transfers.

For an earth fault on a resonant network, full voltage displacement of healthy phases occurs on a system wide scale for periods in excess of thirty (30) seconds which will exceed the existing surge arresters capabilities. Our surge arresters have a maximum continuous operating voltage of 20kV by design, with limited temporary over-voltage withstand capacity. This is insufficient to accommodate any form of REFCL compensation as the full phase-to-ground voltage is elevated to at least 22kV during REFCL operation.

Failure to replace all of the surge arrestors would lead to an increase in the number of fire starts. In particular, the failure of a surge arrestor that is unable to withstand the over-voltages arising from the operation of a REFCL would induce a cross country fault on the distribution system that would result in multiple feeder outages, and potential fire starts. Our existing surge arrestors are inadequate for resonant networks and we now require arrestors with a continuous temporary over-voltage (**TOV**) of at least 22kV with a 24kV TOV rating for up to 10 hours.

The 24kV surge arrestor rating is required for the following reasons:

- to allow for constructive superposition of one of the healthy phases and the standing dissymmetry; and
- to enable long term compensation and fault detection and isolation strategies to be employed.

It is incorrect to assume surge arrestors would not require replacement if REFCLs are only operated on TFB days. REFCL confirmation tests can take 10-20 seconds after the activity is requested, and this may exceed the temporary over-voltage capability of existing arrestors. Given the fire risk posed by a failure of a surge arrestor, it is prudent to replace all surge arrestors at the time of installing a REFCL.

Contrary to the claims made in the RIS, the number of lightning or surge arrestors cannot be reduced by adopting one of the following approaches:[2]

1. only replacing lightning arrestors when they fail, either through stress testing or over time, noting that some lightening arrests may be appropriately rated, particularly as the higher voltages may not need to be withstood for a long period of time with the REFCL installed;
2. rationalising the number of lightning arrestors installed; or
3. connecting the lightning arrestor in a "Neptune" formation, where one new lightning arrestor is connected in series with three existing lightning arrestors.

First, replacing a surge arrestor upon failure is an unacceptable response and counter-intuitive to the key objective of reducing bushfire risk. Not only will such an approach increase the risk of our assets starting a bushfire, but it will also reduce our supply reliability due to the unplanned, reactive nature of addressing failed surge arresters. Our extensive experience with surge arresters is that they degrade over time, and as they age become less likely to be able to withstand over-voltages, and depending on the failure mode, may be difficult to locate.

Secondly, it is inappropriate to rationalise the number of lightning arrestors installed in our network, as this will result in the downgrading of our current approach to lightning protection across our network. The introduction of the REFCL should in no way degrade our existing asset management strategies.

2 ACIL Allen Consulting, *Regulatory Impact Statement - Bushfire Mitigation Regulations Amendment*, 17 November 2015, pp. 69-70.

Finally, we consider the suggestion of connecting the lightning arrestors in a "Neptune" formation to be flawed given the physical constraints of building such an arrangement on existing structures (pole mounted transformers, cablehead poles and gas switches). A preliminary design assessment of such an option indicates the design and site rework required to implement such an arrangement would likely exceed, or at best be cost neutral compared to simply replacing all three existing arresters with appropriately rated units.

Costs of the REFCL units

To comply with the proposed draft Regulations, the REFCL would need to detect a current of less than 0.5 amperes. The capability of a resonant network to detect such low levels of current is proportional to system:

- capacitance;
- damping; and
- dissymmetry.

Given the factors above, we are currently anticipating that two arc suppression coils are required at the Woodend zone substation to enable us to meet the proposed regulatory standard. The trial will assist in determining the appropriate coefficients in our network such that the necessary amount of damping and dissymmetry can be better estimated going forward to meet the draft Regulations.

At this stage, we believe that approximately 50 per cent of the target REFCL zone substations will likely require at least two REFCLs to be installed to achieve the neccessary performance requirements. These items are in the order of $1.5 million ($2015) per unit to purchase and install, and the cost of the second REFCL has not been included in the RIS.

Furthermore, recent discussions with the sole supplier of the REFCL units for the purposes of our trial at the WND and GSB zone substations has indicated that the costs of each unit is likely to be higher than our initial indications. Our recent firm quotation from the sole supplier of REFCLs has seen a material price increase of 20 to 30 per cent compared to the budget estimate provided to ACIL Allen to assist in the preparation of the RIS. We expect this cost impact to carry through to all targeted REFCL sites over the duration of the program.

Network balancing costs

Network balancing is an essential element to ensuring the REFCL operates as required. This typically involves:

- extending the three phase network to supersede the existing one phase;
- implementing overhead line transpositions to better distribute and balance system charging capacitance; and
- installing capacitive balancing units at strategic locations.

AusNet Services recent experiences with the trial installation at Woori Yallock zone substation has shown an increase in the costs associated with the network balancing works required. We are likely to experience similar issues as our rural network has similar characteristics. As such, the RIS is likely to understate network balancing costs.

2.3 Benefits

The RIS identifies the following benefits associated with the installation of REFCLs that have been quantified in the analysis:

- an improvement in bushfire risk;
- a reduction in the number of minutes that customers are off supply due to electricity interruptions; and
- a reduction in the number of momentary interruptions (those less than a minute in duration).

While we do not have any comments with respect to improvement in the State's bushfire risk, we are concerned that the reliability benefits in the RIS have been overstated.

The primary objective of installing the REFCLs is to reduce the risk of our assets starting a bushfire. Once deployed, it is our intention to operate the REFCLs to meet this objective.

The proposed changes to the draft Regulations are not for the purposes of delivering a more reliable network to our customers. Indeed, the assumptions that the deployment of REFCLs will result in reliability benefits is predicated on a number of assumptions with respect to the operating mode and the outcomes from unrelated overseas studies. This is further discussed below.

Compensation mode

The calculation of reliability benefits in the RIS appears to assume that the REFCL will operate on more than just TFB days. We have not committed to extended operation of the REFCLs on more than just TFB days, and we will work with ESV to discuss the appropriateness of different operating modes. That said, we set out below how we intend to practically operate the REFCLs in "limited compensation" modes when they are first introduced.

Normal operating mode (non-TFB days)

This operating regime is similar to that used at United Energy's Frankston South zone substation. Following the detection of a fault:

- the REFCL applies initial compensation to the conductor for a period of three to five seconds; and
- after this time, the zone substation switches from the REFCL back to a neutral earth resistor (**NER**) or direct earth mode, whereby conventional protection equipment is used to isolate the fault through normal discriminative means.

Consequently, in this operating mode, the REFCL would only beneficially impact momentary outages on the network during the compensation period. That is, the REFCL would only be in use for several seconds and any subsequent protection operation would occur in less than 60 seconds.

Total Fire Ban (**TFB**) only operating mode

The purpose of this operational mode is to minimise the likelihood of fire start. Following the detection of a fault:

- the REFCL applies compensation to the conductor for a period of three to five seconds;
- following the period of initial compensation, the REFCL invokes a "soft" fault confirmation test:
  - if the fault is gone, the REFCL compensation is removed and the network continues to operate as usual; or
  - if the fault is detected to be a permanent fault, then the circuit breaker of the affected feeder is tripped at the zone substation.

This operating mode will result in more customers being disconnected than normal, as downstream devices such as fuses and reclosers are not being utilised.

This operating model may also lengthen the time to restore supply to customers. Crews would be required to patrol the entire length of the 22kV feeder to identify the fault location. Our existing fault indicators are also unlikely to function effectively with the REFCL, as they rely on significant changes in current.

Calculation of reliability benefits

In terms of reliability benefits, the RIS analysis provides no transparency as to the assumptions or calculations employed.

The RIS claims that we should expect a 30 per cent improvement in reliability for phase-to-earth faults, and that this equates to an overall improvement of 21 per cent in reliability.[3]

There is very little supporting information to validate the claimed percentage improvement in reliability. The RIS claims this is based on data from a report by Marxsen Consulting on the trials at Frankston South zone substation, and also references overseas studies and a study by Auckland University. We do not consider these studies to be robust or applicable to our network.

Comments on Marxsen Consulting report

Frankston South zone substation is not representative of the average Victorian zone substation where REFCLs are required to be deployed. First, the average 22kV feeder length of the 20 Powercor zone substations that are discussed in the RIS is 839km. In contrast, the average feeder length for United Energy (including their Frankston South zone substation) is 100km. Secondly, Frankston South serves a predominantly urban and semi-urban environment, whereas the Powercor zone substations included in the RIS are predominately in rural locations, exposed to a wide variety of environmental and terrain conditions.

The results of the Frankston South trial were reported over the period from November 2013 to November 2014. Any improvements in system average interruption duration index (**SAIDI**) or momentary average interruption frequency index (**MAIFI**) were therefore captured over a very short period of time and may reflect seasonal influences. A much longer sample period would provide a higher level of confidence to any results.

Furthermore, distributors also have numerous maintenance and reliability improvement programs in place, and these may be implemented in parallel with the introduction of a REFCL. Therefore it is difficult to attribute any quantifiable reliability improvements to one single initiative.

The Marxsen report is the primary report used in the RIS to justify its claims in relation to improvements in reliability. While the report contains considerable comment about the potential sources of reliability improvements, such as comparing solidly-earthed/ NER networks against resonant networks, it does not discuss the compensation mode to deliver any such benefits. The only reference in the report to an actual improvement is a study undertaken by Auckland University where they saw a 62 per cent improvement in SAIDI. There is no mention that New Zealand and other overseas countries leave compensation in place for longer periods of time than currently proposed in Victoria.

The Auckland University report was a case study of 11kV Poroti zone substation. We note the following from the report:

- the assessment period for review was two years prior to the REFCL going into service and two years after. The Poroti protection system operated for 37 faults prior to REFCL installation. After REFCL installation the number of faults detected increased significantly.[4] This increase can be attributed to the increased sensitivity of the REFCL protection system. Events previously not detected were now being detected. The annual number of permanent faults per year also increased, although the basis for this was not explained. For example, whether it was due to over-voltage events damaging equipment when the REFCL operated;
- the number of earth faults significantly increased as a percentage of total faults after the installation of the REFCL — from around 32 per cent prior to the installation of the REFCL to around 93 per cent after; and

---

[3] ACIL Allen Consulting, *Regulatory Impact Statement - Bushfire Mitigation Regulations Amendment*, 17 November 2015, p. 79.

[4] Qixum, P., *Assessing Ground Fault Neutraliser (GFN) deployment and benefits in 11kV electricity network*, University of Auckland, undated, Table 1, p. 4.

- the reliability data supplied showed a significant increase in SAIFI in the year of commissioning.[5]

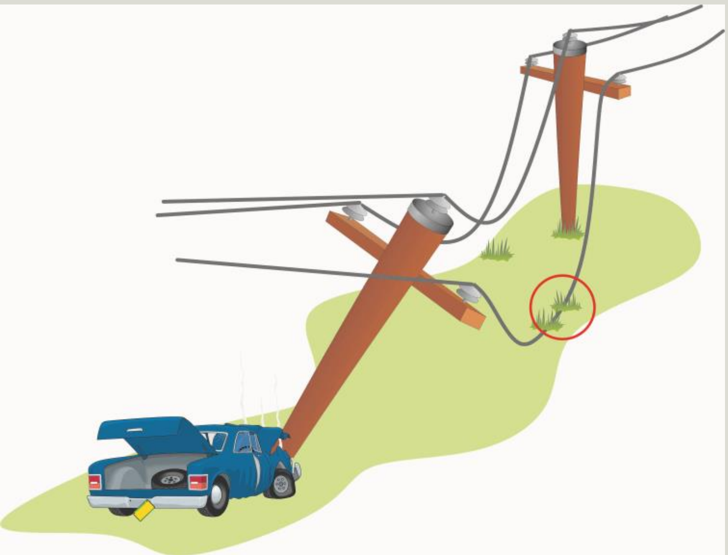
It would appear that the REFCL in Poroti zone substation was operated with compensation on until the fault was found. However, we were unable to find any direct reference to the length of compensation in the report. While permanent compensation may offer reliability benefits, it introduces other public safety risks — these are described in the box below. The RIS offers no commentary on this issue.

Safety considerations with operation of REFCLs in permanent compensation mode

Public safety issues with the operation of the REFCL in extended compensation modes have not been discussed in the RIS. Extended compensation following the detection of a fault would involve the REFCL applying compensation and increasing voltages on the remaining healthy conductors for an extended period of time (e.g. eight hours). Customers would remain on-supply while the fault condition exists and the REFCL applies compensation.

Take for example a situation where a pole is hit by a car and comes down, such that one phase is in contact with the ground at zero potential, and the remaining two phases are closer to the ground but remain energised. The potential for a member of the public to contact these two live conductors is substantially increased.

Figure 2.1 Scenario of safety risks to be considered for different operating modes of a REFCL



Source: Powercor

We understand that this situation has occurred on networks with REFCLs installed and that there has been a potential safety risk during such events.

Given the box above, we note that safety risks of REFCLs are still being considered.

Clause 98 of the *Electricity Safety Act 1998* (Vic) obligates us to design, construct, operate, maintain and decommission our network to minimise as far as practicable the hazards and risks to the safety of any persons

---

5 Qixum, P., *Assessing Ground Fault Neutraliser (GFN) deployment and benefits in 11kV electricity network*, University of Auckland, undated, Table 2, p. 4.

arising from the supply network. We demonstrate our compliance with this clause by operating our network in accordance with our Electricity Safety Management System (**ESMS**), accepted by ESV.

Additionally, we have obligations under the *Electricity Safety (Installations) Regulations 2009* (Vic) to ensure that earthing and protection systems isolate unsafe electrical conditions up to the protective equipment of the electrical installations (regulation 233).

Our ESMS confirms our protection policy of isolating faults on the network. Operating REFCLs with an extended compensation mode does not isolate a fault on the network, as the network remains energised as the fault condition exists. Furthermore, as recognised in the Marxsen report, permanent faults may not be located for long periods of time, particularly on large rural networks.[6] Formal safety risk assessments would need to be undertaken to understand the risks associated with the implementation and operation of an extended compensation mode for REFCLs, which may be informed by experience following our GSB and WND trial installations. These assessments will then be discussed with ESV for consideration in an amended ESMS. At a minimum, this would not be expected to occur for a period of four to five years.[7]

Our proposed REFCL operating regime on TFB days is consistent with our current ESMS.

<u>Our view of reliability benefits</u>

Given our proposed operating regime for the REFCLs that we set out above, we consider that there may be some improvement in MAIFI however in the medium term there is unlikely to be any benefit to SAIDI — in fact, the reliability could be worse.

In terms of MAIFI, the REFCL should eliminate momentary outages caused by phase-to-ground faults on the 22kV feeder network in those zone substations where REFCLs have been deployed. This would occur whether the REFCL is operating in normal or TFB operational mode.

In terms of SAIDI, there may be some longer term benefits as current-related stresses on the network will be reduced for phase-to-ground faults as the fault current will be reduced. However, this benefit may be offset by an increase in equipment related faults due to over-voltages arising from the operation of the REFCL.

Furthermore, the operation of REFCLs on TFB days will result in additional customers losing supply, and experiencing extended outages, compared with the normal operating mode using traditional protection equipment. On TFB days, the detection of a fault will result in the REFCL de-energising the entire 22kV feeder rather than isolating the outage to the portion of the line that would otherwise be de-energised by fuses and automatic circuit reclosers (**ACR**s). Experience overseas and in Australia has shown that finding faults once the REFCL operates is more difficult and outage durations are likely to increase while the field crew find the fault. Restoration times may also increase as different restoration procedures are followed to reduce the risk of fire ignitions, which increases the time between when a faults occurs and when the distributor attempts to restore supply.

2.4 Deliverability

Throughout the RIS preparation process, we have consistently expressed concerns about the seven year timeframe to complete the installation of REFCLs in zone substations. This is an aggressive timeframe to deploy a large number of REFCLs that will fundamentally alter the way in which we operate our network.

Our primary concerns are:

---

6 Marxsen Consulting, *REFCL Trial: Ignition Tests*, 4 August 2014, p. 96.

7 Marxsen Consulting, *REFCL Trial: Ignition Tests*, 4 August 2014, p. 92.

- risks from a sole supplier of the REFCL equipment in terms of delivery;
- inherent risks associated with projects of this complexity and consequence, and the irreversible nature of this rollout once it is underway; and
- planning, design and operational changes, including staff training, IT system changes and process changes within our business to incorporate the resonant network within our existing network.

First, there is risk of delay to our ability to comply with the draft Regulations if the sole supplier of the REFCLs is unable to provide the REFCL units in the necessary timeframes. We are unclear whether the supplier has the capacity and capability to deliver the intended number of units that will be required by AusNet Services and Powercor to meet the Victorian Government's proposed timeframes.

As noted above, we estimate that around half of the 22 zone substations where we are required to deploy REFCLs will require more than one REFCL unit. It is not clear whether the Victorian Government was aware of this in preparing the RIS.

Should there be clear deliverability issues arising as a consequence of the reliance on a sole supplier to provide the REFCL units, we consider that the legal instrument should provide a 'stop the clock' or other mechanism to extend the timeframe for distributors to complete the deployment of REFCLs in zone substations.

Secondly, this is a large scale project of a technology that has not been tried and tested in our network. Network specific issues may arise that may take time for us to identify and resolve. Following our planned trial in Woodend and Gisborne in 2016, we intended to evaluate the performance of these REFCLs over the ensuing twelve month period to gain a better understanding of its performance in a rural distribution network. Our intention was to take the learnings from the first installation into subsequent projects to ensure the best technical and commercial outcomes are achieved from the outset. The current timeframe does not accommodate this learning and evaluation process and obligates us to proceed, with no time to analyse operating experience and update the design and operating protocols.

Thirdly, there are a large number of internal operational changes that need to take place. This includes providing technical and safety training to our field crews and engineers to respond to faults in the resonant network with consideration to the operating mode for the network. Our asset inspection programs, operating systems and procedures and other day-to-day operational processes will need to be updated to cater for the resonant network.

In addition, as the traditional protection equipment will no longer be operated on TFB days, our control room and IT systems will need to be updated to assess the appropriate approach to respond to a fault.

A more realistic profile for deployment would be preferable, for example over a 10 year period from 2016 to 2025. A longer deployment is consistent with the Marxsen report which advocates “at least a decade” is required to prudently implement such a program. [8]

---

[8] Marxsen Consulting, *REFCL Trial: Ignition Tests*, 4 August 2014, p. 10.

Figure 2.2 Challenges facing network owners in adoption of REFCLs

For Victoria's network owners to adopt REFCL technology, they must address a number of cultural and technical challenges. Wide-scale roll-out of REFCLs is likely to take at least a decade if the risks posed by these challenges are to be properly managed. Some of the challenges are:

1. **Learn by doing – culture change for network owners and suppliers:** The thinking patterns among engineering and operations staff required to get full value from REFCL technology are profoundly different from those that are prevalent today. Suppliers also face major challenges in understanding the priority of fire risk goals in Victoria and the implications for their products.
2. **Harden networks to reduce risk of cross-country faults:** Vulnerabilities to the over-voltages created by REFCL responses to earth faults must be identified and addressed so cross-country faults do not disrupt customer supply and start fires.
3. **Upgrade networks to REFCL-compatible equipment:** Many items of network equipment and network protection systems do not work with REFCLs and they must be upgraded or replaced to become REFCL-compatible.
4. **Minimise network imbalance:** Future REFCL products may be more tolerant of network imbalance (different capacitance to earth from each of the three phases). However, today's products are not and network owners deploying REFCLs must act to minimise imbalance to achieve minimum fire risk.
5. **Fault location:** With a REFCL in service many faults draw so little current they leave no evidence of their presence, i.e. they are hard to find. This is a complex challenge and new products are emerging to address it.

Source: Marxsen Consulting, *REFCL Trial: Ignition Tests*, 4 August 2014, p. 10.

The basis for the Victorian Government's seven year timeframe to deploy REFCLs is not clear and we believe requires a sensitivity analysis on the impacts of such a timeframe.

We set out below the deployment schedule for the installation of REFCLs that would meet the points system in the draft Regulations. Subsequently, we provide an alternative timetable which could assist in addressing some of the issues that we have raised in this response.

Table 2.1 Proposed Bush Fire Mitigation Regulation Program Deliverables

	31-Dec-18	31-Dec-20	31-Dec-22	
1	Gisborne	Eaglehawk	Stawell	
2	Woodend	Maryborough	Geelong	
3	Colac	Charlton	Waurn Ponds	
4	Camperdown	Bendigo	Corio	
5	Winchelsea	Ballarat South	Koroit	
6	Bendigo TS	Ballarat	Terang	
7	Castlemaine	Ararat	Hamilton	
8			Merbein	

Table 2.2 Our preferred deployment schedule

	31-Dec-18	31-Dec-20	31-Dec-22	31-Dec-25
1	Gisborne	Bendigo TS	Ballarat South	Geelong
2	Woodend	Castlemaine	Ballarat	Waurn Ponds
3	Colac	Eaglehawk	Ararat	Corio
4	Camperdown	Maryborough	Stawell	Koroit
5	Winchelsea	Bendigo	Charlton	Terang
6				Hamilton
7				Merbein

We note that we support the concept of the Victorian Government's proposed points system set out in the draft Regulations which allows for prioritisation of projects whilst allowing some level of flexibility to integrate these works with other existing programmed works and network constraint considerations. If the point system is retained, we suggest that it be adjusted to align with our preferred deployment schedule over the longer time period to 2025.

2.5 Other comments

There are a range of other matters relating to REFCLs which we note below:

- the Waurn Ponds (**WPD**) zone substation is listed in Schedule 2 of the draft Regulations, as it currently covers high consequence areas. However, we are planning to construct the Torquay (**TQY**) zone substation in 2018, and then transfer load from WPD to TQY. This will result in several feeders that originated from WPD being transferred to TQY, including those that cover high consequence areas. We consider that the draft Regulations should be amended to remove WPD given this particular situation;
- our Geelong (**GL**) zone substation serves a very large urban area, with only two feeders supplying the high bushfire risk area. There is an opportunity to install a REFCL in just the area of the network supplied by these two feeders, and avoiding significant costs in hardening a very dense and large urban network. We consider that ESV should have the ability to provide an exemption for a particular zone substation such as GL, where we can provide an alternative solution at a lower cost;
- the RIS states the Distribution Business Reference Group (**Group**) will "monitor implementation including progress and any unexpected challenges and delays to implementation". It is unclear how this Group will have any ability to influence or amend the Regulations in light of unexpected challenges;[9] and
- the RIS acknowledges that HV connected customers may require asset replacement works and has estimated an average of $100,000 per installation.[10] In practice an individual customer may face costs of up to $500,000 depending on the age, specification and quality of the equipment they have used. As these works would relate to private installations, the RIS should be clear that customers would be required to fund these changes, and that such costs could have a significant impact on many HV customers.

[9] ACIL Allen Consulting, *Regulatory Impact Statement - Bushfire Mitigation Regulations Amendment*, 17 November 2015, p. 110.

[10] ACIL Allen Consulting, *Regulatory Impact Statement - Bushfire Mitigation Regulations Amendment*, 17 November 2015, p. 72.

3 Electric line construction declared areas

3 Electric line construction declared areas

The draft Regulations for electric line construction declared areas, while well intentioned, will increase costs to consumers.

The costs and benefits from electric line construction declared areas are highly uncertain. The draft Regulations are premised on the introduction of a technology in around 2020 that has not been tested in the network, is currently subject to single supplier scenario and is not available commercially so that the costs can be understood. The legal drafting is unclear, thereby exacerbating the uncertainty around the costs.

We are also concerned about complaints received from new customers seeking to connect in those areas, as the customer connection costs will be significantly higher than for customers outside of those areas. We seek the Victorian Government to clearly communicate with communities in affected areas about the impact of the draft Regulations.

Clause 7(hc) proposes that:

> *Details of the preventative strategies and programs referred to in paragraph (h) (including details in relation to timing and location) by which the major electricity company will ensure that, on and from {TBC}, within an electric line construction declared area, each electric line with a nominal voltage of between 1 kV and 22kV that is constructed, or is wholly or substantially replaced, in its supply network is a covered or underground electric line.*

This section discusses the background to this draft Regulation, and the implications in terms of costs and benefits.

3.1 Background

We have been undergrounding powerlines in the Otways throughout 2014 and 2015. This work has been funded through the Victorian Government's Powerline Relocation Fund (**PRF**). Through these works we have gained a good understanding on the complexities, issues and costs associated with undertaking such initiatives.

The Victorian Government has separately supplied a list of "electric line construction declared areas" and these areas will be defined by the Emergency Management Commissioner, and set out in the Government Gazette. The PRF works described above have been undertaken in these areas and will continue to be undertaken in these areas for the duration of the PRF program.

In accordance with the proposed Regulation 5A, the Emergency Management Commissioner may, by notice published in the Government Gazette, declare an area of land to be an electric line construction declared area. There are no restrictions on the ability for these areas to be changed. The RIS does not contain any discussion on the areas that are covered by the cost-benefit analysis.

3.2 Costs

This section sets out that the:

- drafting of the legal instrument is unclear, which results in uncertain compliance obligations and the associated significant differences in the cost of undertaking the activity in the 2016–2020 regulatory control period. Thus the price impact on consumers may be significantly higher than indicated;
- the Regulations do not apply solely to replacements, but also cover augmentations and connections; and
- cost forecasts are highly variable and therefore unreliable.

Draft Regulations are unclear

There are a range of issues in the draft Regulations that lead to uncertainty regarding the extent of compliance obligations and the costs of implementing the proposed new requirements. These include:

- timing of introduction of draft Regulations uncertain i.e. "on and from {TBC}";
- technology that is used is unclear "covered or underground electric line" - covered is not a defined term, although we understand that it could relate to the definition of covered as set out in the Electric Line Clearance Regulations. If that is the case, the legal drafting should be amended to make this clear; and
- reference to "electric line", in the definition of *wholly or substantially replaced* is not defined in this regulation. If "electric line" takes the meaning set out in another regulation, then this will involve significant replacement. Electric Line as defined in the *Electricity Safety Act 1998* (Vic) is stated as:

  electric line means—

  (a) the whole or any part of a wire, cable or other thing used or to be used for the purpose of transmitting, distributing or supplying electricity; or

  (b) anything enclosing or supporting such a wire, cable or other thing— but does not include a wire, cable or other thing directly used in converting electrical energy into another form of energy

To assist in the understanding we provide the following examples of interpretation.

<u>Interpretations of electric line</u>

In reference to Target Area 7 Ballarat – Creswick, if the section circled in figure 3.1 below is identified in accordance with asset management policy as requiring replacement due to conductor condition and meets the definition of "wholly or substantially replaced" as defined in the draft Regulations, then it is unclear on what portion of the electric line is required to be replaced within the declared area.

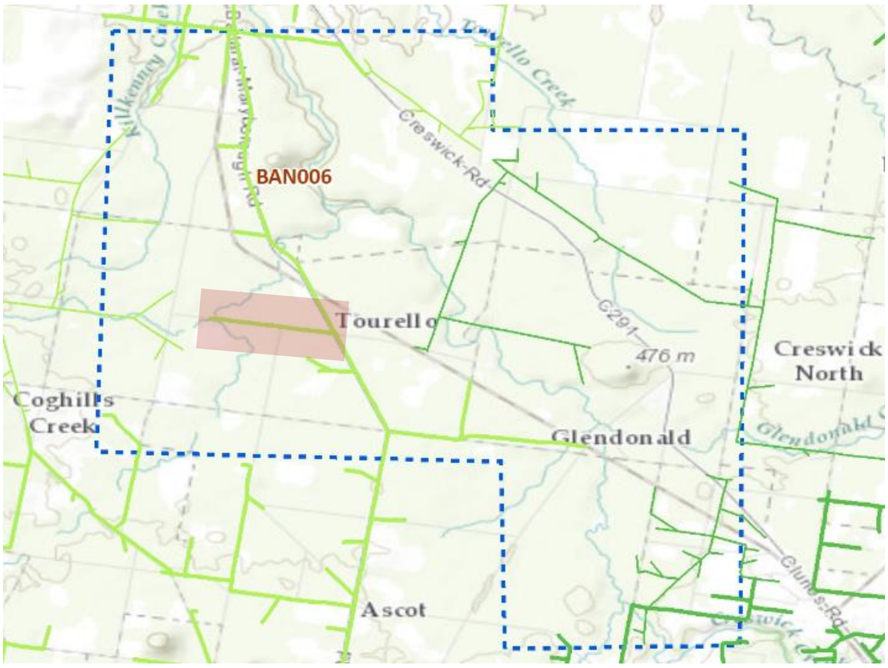
Figure 3.1 Target Area 7 Ballarat – Creswick, area identified for replacement

Source: Powercor

The draft regulation could be interpreted in a number of ways which have significant degrees of impact.

First, the replacement could be assumed to solely relate to the identified spur, as shown in the red highlight in the figure 3.2 below.

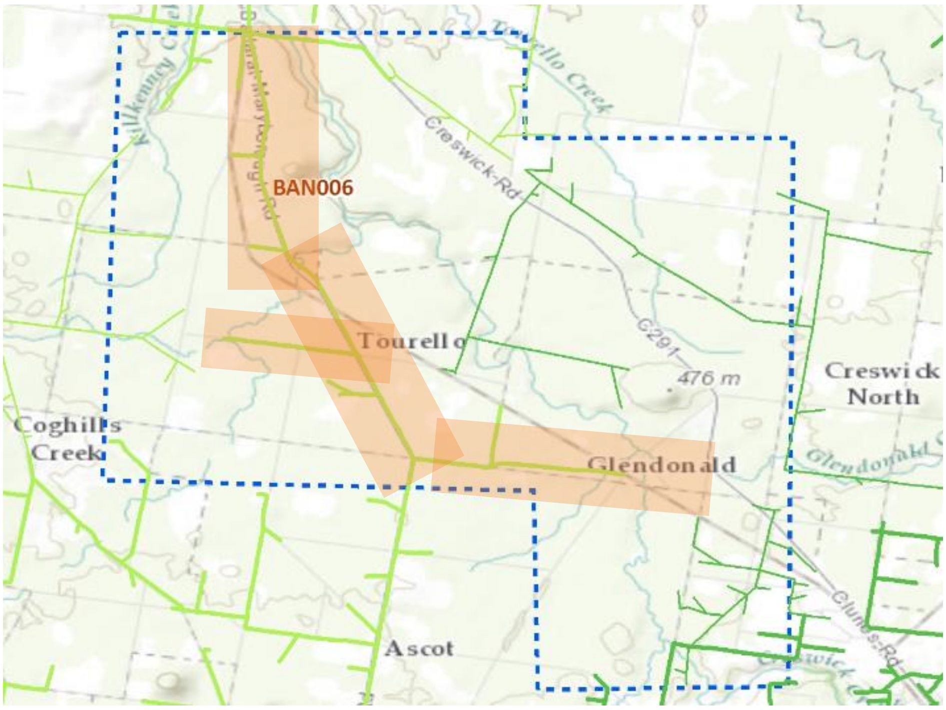
Figure 3.2 Target Area 7 Ballarat – Creswick, replacement of spur



Source: Powercor

Alternatively the regulation could be interpreted as replacement of the spur and backbone of the BAN006 feeder within the declared area, as shown in the orange highlight in the figure 3.3 below.

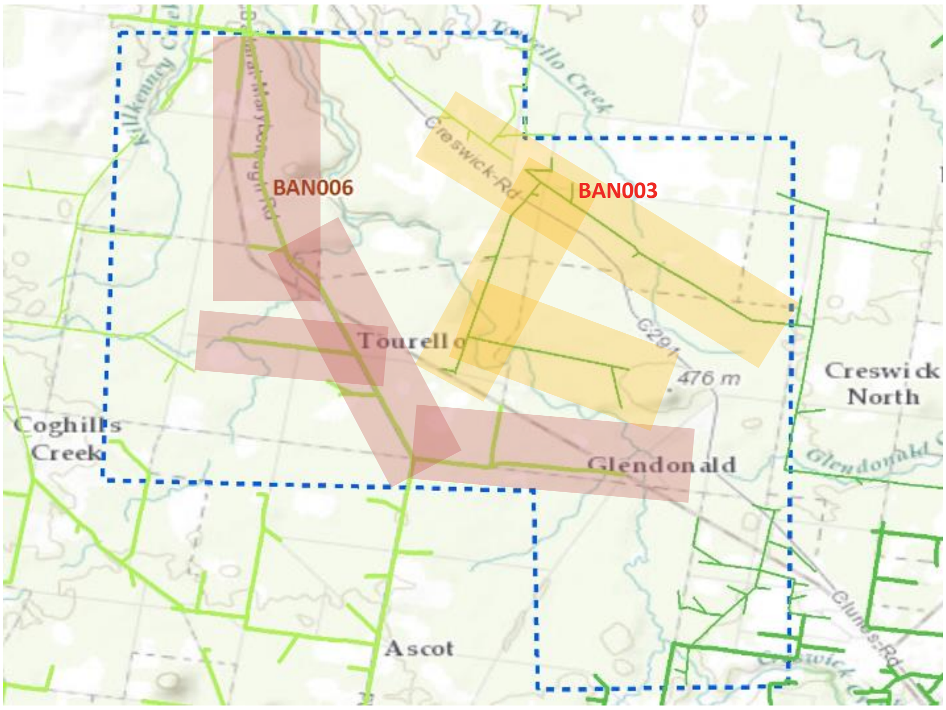
Figure 3.3 Target Area 7 Ballarat – Creswick, replacement of spur and backbone feeder



Source: Powercor

A further interpretation could be replacement of all lines within the electric line construction declared area as shown in the red and yellow highlights in figure 3.4 below

Figure 3.4 Target Area 7 Ballarat – Creswick, replacement of all feeders in the declared area



Source: Powercor

It is clear from the figures above that the lack of clarity regarding the definition of electric line can lead to significant differences in cost estimates for each year, and thus impact the net present value (**NPV**) of the proposal.

Regulations apply to replacement, augmentations and connections

The draft legal instrument makes clear that the draft Regulations apply to:

- replacement of end of life conductor;
- augmentations; and
- connections.

However, it is unclear if the costs set out in the RIS take into account new lines constructed for connections or augmentations.

It is also unclear if subsidiary circuits (high voltage (**HV**) and/or low voltage (**LV**)) are required to be replaced for instances where the top circuit has been identified for replacement.

Costs are highly uncertain

The costs of works in declared areas are highly uncertain. We note that the actual cost will depend upon:

- type of circuit being replaced e.g. three phase, single phase, SWER;
- type of construction adopted e.g. underground, covered overhead variants, subsidiary circuits, presence of LV reticulation, density of LV reticulation;
- market forces, notably that a sole supplier situation exists with the new carbon core conductor technology;
- location and geography;
- installation requirements e.g. laying of duct, ability to direct plough versus boring, reinstatement requirements; and
- other factors, such as local council requirements, environmental issues and cultural heritage issues.

In terms of the incremental unit costs estimated in the RIS, we are concerned that the 'like-for-like' replacement costs may be higher than those actually incurred by distributors. This would have the consequence of understating the incremental cost for declared areas, and thus understating the costs associated with this proposal in the RIS.

Similarly, the RIS focuses on the costs associated with HV feeders. We understand that if there is affected LV open wire conductor in the proposed workzone of a declared area, then we would need to address that conductor. For example, this may involve replacement with LV aerial bundled cable (**ABC**) or undergrounding of the LV circuit. It is not clear whether such costs have also been covered in the RIS.

We have no understanding of the basis for assuming that the new technology (carbon core conductor) would be installed at a rate of $145,000 per kilometre for SWER line replacement. We are the best placed company to understand this cost given that we are the first distributor in the world to be trialling this new conductor as a replacement for SWER lines. Our trial will be concluding in the first quarter of 2016 and will aim to identify the following cost drivers:

- actual unit rate from the manufacturer; the RIS states $20,000/km whereas discussions we have had with the manufacturer suggest a higher unit rate;
- additional system component costs i.e. the need to install surge arresters (and earthing) at regular interval, such as every 300 metres; the insulating piercing connectors required for all connections, tee-offs and

armour rod bonding; the stand-off insulator earthing arrangement required for application of working earths along the line route;

- the replacement strategy to be employed during a fault scenario (e.g. tree across line, car hit pole) where mechanical damage to the carbon core conductor may have been sustained but visually it will be difficult to assess due to the outer sheath; and
- the installation works practices; carbon conductor is more prone to damage due to improper manual handling and bending angles during installation. The rate of installation progress will be different to traditional bare wire conductor installation.

As we do not currently have sufficient experience to fully understand these cost drivers outlined above, we are concerned that the unit rate assumed in the RIS is not based on any actual experience and therefore may be unrealistic.

Similarly, we also have no understanding of the basis for assuming that the new technology (carbon core conductor) would be installed at a rate of $195,000 per kilometre for polyphase lines. We know that the polyphase equivalent carbon core conductor has not been developed yet (it is merely an idea at this stage), and that the manufacturing cost will be higher than the SWER equivalent as it will be a larger conductor due to the higher current carrying requirements necessary to replace certain rural polyphase circuits.

3.3 Benefits

The RIS identifies the following benefits associated with the installation of covered or underground powerlines that have been quantified in the analysis:

- an improvement in bushfire risk;
- a reduction in the number of minutes that customers are off supply due to electricity interruptions;
- a reduction in the number of momentary interruptions (those less than a minute in duration);

The RIS estimates a 50 per cent improvement in SAIDI for the proportion of the feeder that is replaced. The 50 per cent value relates to the underground replacement or overhead insulated replacement.[11] While the RIS sets out how the dollar benefit for replacement of overhead bare lines has been calculated, it is noted that as the length of power lines planned to be replaced is relatively small, the overall reliability benefit was small. The RIS determined that the reduction in the minutes off supply and the reduction in the number of momentary outages would not be material to the analysis.

[11] ACIL Allen Consulting, *Regulatory Impact Statement - Bushfire Mitigation Regulations Amendment*, 17 November 2015, p. 98.

Benefits associated with a reduction in minutes off supply and number of momentary interruptions

> *The estimated present value of the benefits associated with a reduction in the minutes off supply and a reduction in the number of momentary interruptions for each scenario is set out in Table 39. Table 39 indicates that the reliability benefits associated with replacing powerlines are relatively small, particularly under option 3b in which the reliability benefits do not commence until 2041.*
>
> *Accordingly, the assumptions that have been made in relation to the reduction in the minutes of supply and the reduction in the number of momentary interruptions are not material to the analysis.*

Source: ACIL Allen Consulting, *Regulatory Impact Statement - Bushfire Mitigation Regulations Amendment*, 17 November 2015, p. 100.

While we have not undertaken any analysis into the reliability benefits of installing underground or insulated overhead lines on our SWER networks, we agree with the conclusions in the RIS regarding the reliability impacts in relation to power line replacements.

3.4 Other comments

The RIS is silent on the impacts to customers from the imposition of declared areas. In particular, customer contributions to a connection or extension may be higher, given the higher construction standard required. This may result in new customer connections becoming uneconomic for many customers.

This is likely to lead to complaints from new customers seeking to connect in those areas, as the customer connection costs will be significantly higher than for customers outside of those areas. We seek for the Victorian Government to communicate with the impacted communities about the consequences of the proposed draft Regulations.

Additionally, we note that an unusual situation could occur given that the new Regulations apply to HV feeders, so arguably a LV line could be above ground between an underground private overhead electric line (**POEL**) and an underground HV feeder.