AusNet Electricity Services Pty Ltd

Electricity Distribution Price Review 2016–20

Revised Regulatory Proposal

Appendix 3A: Capital Expenditure Supporting Information

Submitted: 6 January 2016

AMS – Electricity Distribution Network

Capital Expenditure Supporting Information

EDPR 2016-20 Revised Regulatory Proposal

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1 Purpose

This document has been prepared to provide additional and supporting information relating to AusNet Services' Revised Regulatory Proposal for the regulatory period 2016-20. Specifically the document provides information relating to capital expenditure.

2 Augmentation

AusNet Services regulatory proposal included expenditure of $67M to augment the network to meet additional forecast demand. This network augmentation expenditure was split into the components shown in Table 1.

Augmentation Component	Proportion of forecast augmentation	Nature of augmentation
Subtransmission	18%	A single sub-transmission line to improve supply security to customers in the growing northern suburbs[1] of Melbourne.
Distribution feeders	36%	Establish 5 new high voltage distribution feeders and upgrade the capacity of 11 existing feeders.
Distribution substations & LV – Routine supply improvement	12%	Augmentation of distribution substations and LV network, including fuses, in response to supply quality complaints and other technical deficiencies.
Distribution substations & LV – Summer preparation works	4%	Minor network augmentation projects carried out in preparation for summer.
Distribution substations & LV – Distribution transformer upgrades	30%	Augmentation of overloaded distribution substations and associated LV circuits.

Table 1 – Components of augmentation expenditure – Regulatory proposal

Since the regulatory proposal, the projections of Victorian population growth have been revised resulting in the forecast need to connect additional customers to the network. This will involve additional expenditure in the Sub-transmission and Distribution feeder components. No additional expenditure is forecast in the other components involving distribution substations and LV.

2.1 Sub-transmission

Sub-transmission augmentation includes work which increases the capacity of the sub-transmission (66kV) lines and zone substations. AusNet Services regulatory proposal involved the augmentation of a single sub-transmission line and no augmentation of zone substations.

The increase in forecast customer connections in the Clyde North area has resulted in the need to bring forward augmentation of the Clyde North zone substation into the forecast 2016-20 regulatory period. This augmentation will involve the installation of a third transformer at Clyde North zone substation (CLN) and a third bus to accommodate a new feeder emanating from the station.

The maximum demand forecasts at CLN have increased due to the additional customer numbers affecting the zone substation and two 22 kV feeders from that zone substation. The maximum demand forecast for the zone substation has increased by 14% in summer 2019/20 from 66.0 MVA in the previous forecast to 75.4 MVA in this revised forecast.

The project to install a third transformer and third bus at CLN was originally forecast for completion in 2022 but due to the additional growth in customer numbers this project is required to commence in 2019, bringing the forecast expenditure into the 2016-20 regulatory period.

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[1] The area of the northern growth corridor north of Craigieburn including Kalkallo and Wallan.

2.2 Distribution feeders

Distribution feeder augmentation work includes the installation of new feeders, upgrading sections of feeders and reconfiguration of the network[2]. In the regulatory proposal 5 new feeders and 11 capacity increases were required as shown in Table 1. This has now been revised due to the additional customer growth and 6 new feeders and 14 capacity increases are now required.

The CLN13 and CLN23 22kV feeders supply the area south of CLN in Melbourne's south-east growth corridor and this area has experienced substantially increased housing development. The CLN13 feeder forecast is now 40% higher and the CLN23 feeder forecast is now 19% higher in summer 2019/20. This will require a new feeder emanating from CLN to be constructed to manage load growth. The new feeder will connect to the new bus at CLN and the work will commence in 2019.

In addition to the new feeder, a further 3 projects involving capacity increases and network reconfiguration are required to meet forecast growth. The additional projects involve reconfiguration of the CLN feeders with some minor works at the adjacent feeders emanating from Cranbourne zone substation and feeders emanating from Bayswater zone substation.

2.3 Alternatives to augmentation

Demand management is routinely used to defer AusNet Services' forecast augmentation. The proposed augmentation program relies on demand management to defer part of the proposed expenditure. As noted in the regulatory submission, growth in network peak demand is becoming more geographically concentrated on urban residential growth corridors. In these locations, AusNet Services' established non-network solutions, such as embedded generation and commercial and industrial customer demand management contracts, have limited applicability.

Following the revised new customer connections forecast, an investigation into commercial and industrial customer-side demand management potential was completed, based on forecast feeder and zone substation demands. This investigation focussed on the growth areas within the Central region which includes the Cranbourne, Clyde North, Officer and Pakenham areas.

A number of large customers on feeders in the Central region are current participants in the Network Support Program (to provide ad-hoc demand reductions over summer), whilst other customers have been approached by AusNet Services but have not expressed an interest in participating. Experience has shown customers that consistently participate in the five critical peak demand days called over summer make very good candidates for participation in the Network Support Program, to provide demand management on-request.

The recent investigation of remaining customers on Central region feeders found mainly smaller customers (<250 kW peak demand). These smaller customers have not historically responded to the critical peak demand tariff and are therefore unsuited to providing a demand side response.

Very little additional demand management at a commercial & industrial level is likely to be available on Central region feeders, over and above currently-contracted customers and therefore no effective deferral of the newly identified projects is possible. Other new demand side options such as residential demand response enabled through the AMI network or through battery storage are not considered feasible to defer augmentation over the 2016-20 period due to the near-term time frames of the growth.

2.4 Augmentation summary

Expenditure proposed for network augmentation is shown in Table 2.

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[2] Reconfiguration of the network can involve the installation of new switches and associated works to constrain the load on one feeder and supply an area from adjacent feeders.

$M 2015	2016	2017	2018	2019	2020	Total
Proposal	8.24	20.24	17.28	11.01	10.70	67.46
Resubmission	9.91	22.55	18.25	14.97	16.97	82.64
Difference	1.68	2.31	0.97	3.96	6.27	15.18

Table 2 – Augmentation expenditure

3 Overhang removals

AusNet Services regulatory proposal included expenditure to meet a regulatory obligation that requires the space above high-voltage lines to be kept free of vegetation. Capital expenditure was proposed to insulate the overhead conductor or underground the conductor at locations where it is not possible to clear the overhanging vegetation. This program of ‘overhang removals’ is also known as ‘56Ms’, a reference to an old inspection code. It is reported as ‘Augment spans – habitat trees – HBRA’ in the Safety and Bushfire tab of the annual RIN. The proposed expenditure is categorised as ‘augmentation’ in the EDPR RIN and was analysed by the AER under this category.

This section explains the regulations that drive the expenditure, the scope of proposed works, and the relationship between the proposed works and other programs which result in the replacement of high-voltage overhead conductor.

3.1 Regulations

The Electricity Safety (Electric Line Clearance) Regulations 2010 imposed additional vegetation management and bushfire mitigation requirements on the Victorian DNSPs. These regulations came into force from December 2009.

The Victorian DNSPs identified nine changes in the Electricity Safety (Electric Line Clearance) Regulations 2010 relating to:

1. the cessation of exemptions;
2. aerial bundled cables and insulated cables (clause 10);
3. powerlines up to 22 kV and 66 kV powerlines in low bushfire risk areas (clause 11);
4. spans exceeding 100 metres (table 2);
5. native trees and trees of cultural or environmental significance (clause 2(3));
6. habitat trees (clause 4);
7. notification and consultation (clause 5);
8. hazard trees (clause 3); and
9. overhanging branches (clauses 11(4) and 12(4))

3.2 Overhang Removals (56M Program)

The regulations relating to overhanging branches introduced a new requirement that prohibits vegetation overhanging bare overhead powerlines. Prior to the introduction of these regulations, it was possible to conduct risk assessments of the area and implement risk management approaches that allowed some overhanging vegetation.

AusNet Services managed to comply with the new regulations through pruning for most of the spans. However, the elimination of overhanging vegetation from 2,000 spans could not be achieved by pruning alone. These remaining spans were planned to be made compliant with the new regulations through a HV aerial bundled cable (ABC) solution.

The need to undertake this work was recognised in the 2010-15 EDPR. Expenditure to install an HV ABC solution to eliminate 2,000 overhang spans and achieve compliance was allowed by the AER in its 2010-15 final decision.

AusNet Services initiated a project in 2011 to undertake the capital works necessary to comply with the regulations. A significant proportion of the remaining 2,000 spans was made compliant with the new regulations through removal of trees or replacing bare overhead conductor with ABC.

3.3 Changes to the Program

During the 2013/14 summer period, AusNet Services experienced a number of HV ABC failures[3] and subsequent multiple fire events. This caused an urgent review of the HV ABC[4] maintenance and replacement strategy which resulted in the need to replace a material volume of HV ABC. The failure of HV ABC presented a much higher risk than overhanging trees and expenditure was redirected from the overhang removal project to HV ABC replacement. This resulted in the deferral of the overhang removal project from its original completion date of 2015 to the forecast 2016-20 regulatory period.

A recent reconciliation of the number of 56M spans requiring removal identified an additional 284 spans beyond the original total of 2,000 spans. This, along with the decision to replace remaining spans with hybrid underground cable, which has a longer installation time but is a safer long term option than overhead, has resulted in a delay to completion of the program until 2017.

The expenditure profile has been revised since AusNet Services' EDPR submission to reflect the completion of the program in 2017. The forecast to complete the project is shown in the table below:

	CY2016	CY2017
$000s Real Dec $2015	16,709	13,672
% of expenditure	55%	45%

3.4 Program's relationship to other powerline undergrounding or insulating works

This overhang removal program is not directly related to other network safety programs that result in the undergrounding or insulation of overhead powerlines. In a small number of cases, the overhang removal will overlap with other programs and in several cases overhang removals have been completed adjacent to other works.

AusNet Services is currently undertaking four overhead conductor programs which result in replacement of bare overhead conductor throughout the Hazardous Bushfire Risk Area (HBRA). The scope of each project is identified and reviewed collectively to ensure that there are no overlaps. The four programs are:

1. Overhang removals – the undergrounding of bare overhead powerlines where vegetation overhangs the powerline;
2. Conductor Replacement program – the replacement of bare overhead powerlines that are approaching the end of their effective life. This program replaces bare conductor, primarily steel and copper conductor, with new bare conductor;
3. HV ABC program – the replacement of deteriorated high voltage aerial bundled cable (ABC) which is at end of life, with new overhead or underground insulated cable technologies; and
4. Powerline Replacement Fund (PRF) program – the replacement of bare high voltage overhead powerlines in high-risk locations with underground or insulated cable technologies. These works are funded by the State of Victoria, Department of Economic Development, Jobs, Transport and Resources (DEDJTR).

There is no overlap between the overhang removal project (1) and the conductor replacement project (2) as the conductor replacement project does not eliminate the need to insulate or underground sections of line. i.e. the replacement of bare conductor in deteriorated condition with new bare conductor does not ensure compliance with the regulation to remove overhanging trees.

There is no overlap between the overhang removal project (1) and the HV ABC program (3) as locations which have HV ABC installed are already compliant with the regulation to remove overhanging trees. i.e. trees are allowed to overhang the HV conductors where the conductor is insulated such as in the case of HV ABC.

There is some potential overlap between the overhang removal project and the PRF program however:

- The scope of the overlap is very limited as explained below; and

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[3] The ABC failures occurred on NMS ABC. This type of cable is no longer installed. LDMS ABC is used for new installations and replacements.

[4] Further detail of the condition and failure of HV ABC is contained in plant asset strategy AMS 20-65 Insulated Cable Systems

- A process is applied to the evaluation of the works which eliminates the potential for the Victorian Government to pay for works at locations where overhang removals are necessary.

3.4.1 Scope of overlap

The remaining PRF works are to be completed in the Dandenong Ranges, Healesville, Warburton Valley and Warrandyte areas. Figure 1 to Figure 5 show the geographic routes of high voltage aerial feeders in blue, the remaining PRF works in green and the overhang removal spans in red.

These figures highlight there is minimal overlap between the remaining PRF program and the overhang removal program.

In the case of the Dandenong Ranges, Figure 1 and Figure 2 show there is minimal overlap between the remaining PRF works (shown in green) and the overhang removal spans (shown in red).

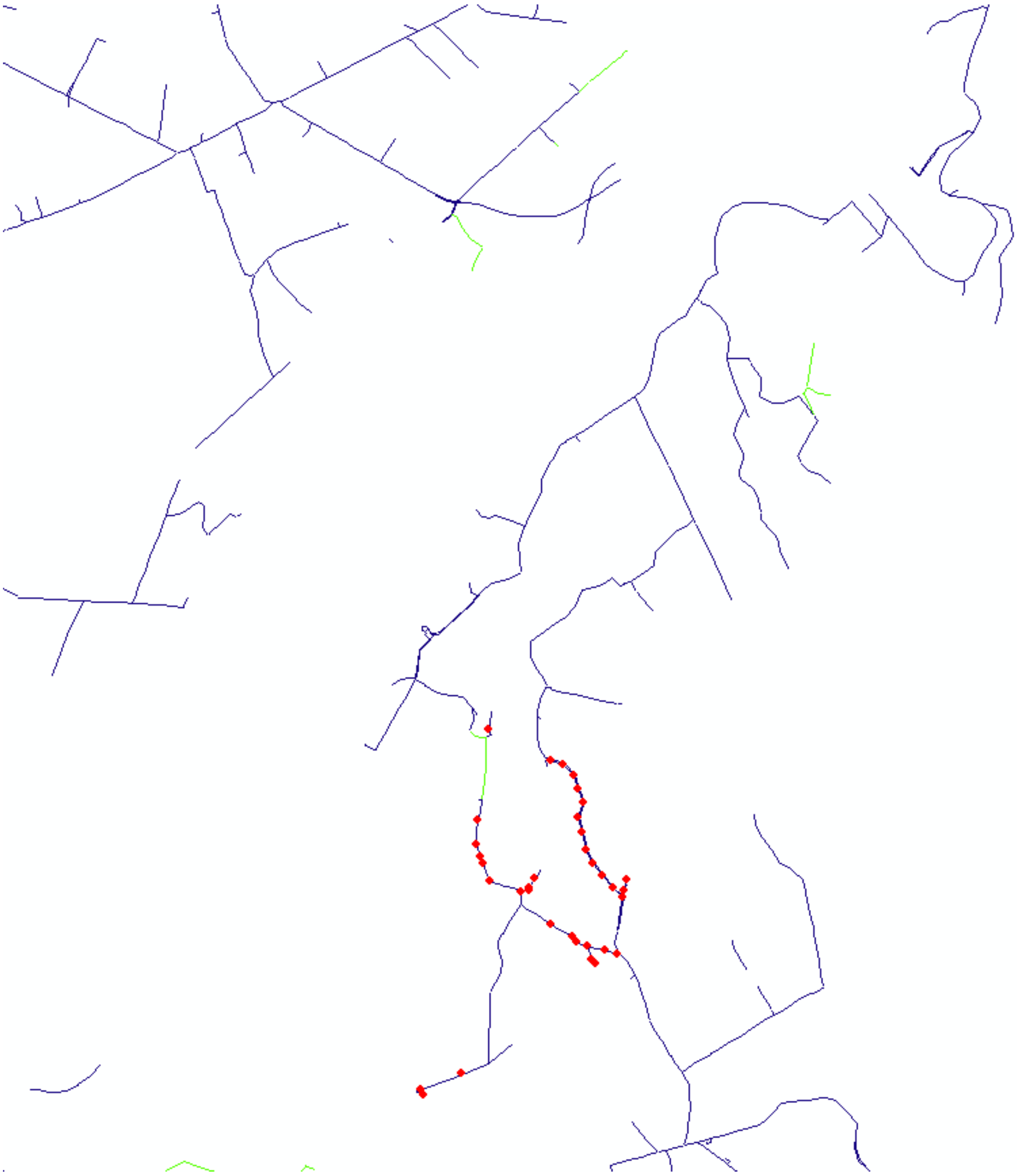


Figure 1 - Electrical HV diagram showing the remaining PRF within the Dandenong Ranges

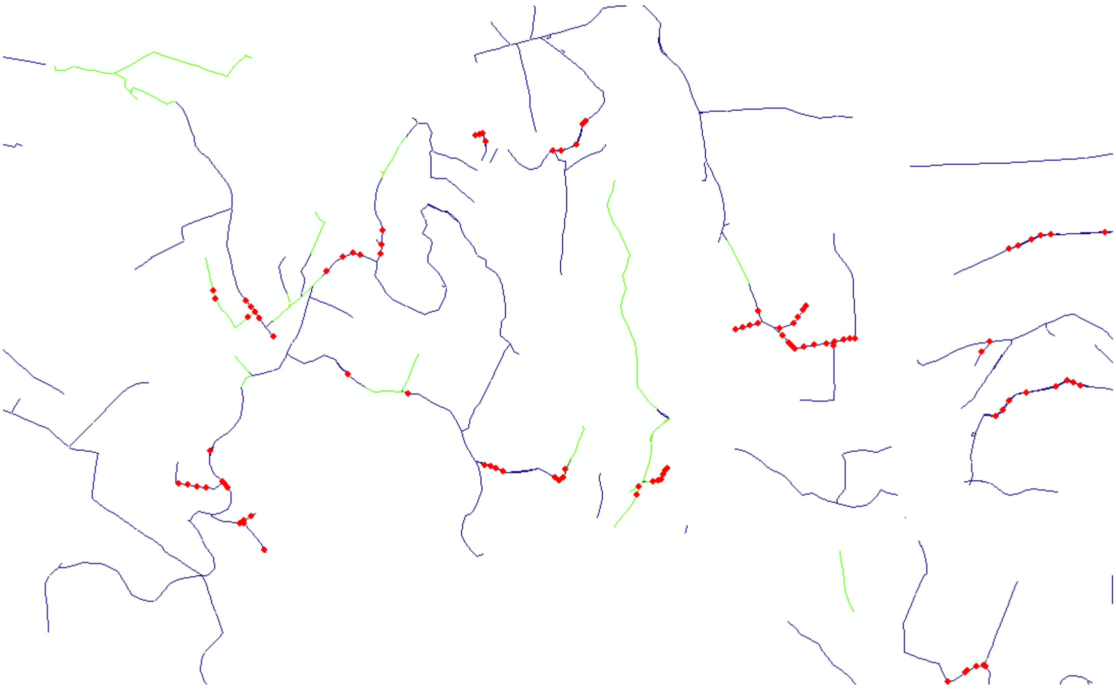


Figure 2 – Electrical HV diagram showing the remaining PRF within the Dandenong Ranges (cont.)

In the case of Healesville, Figure 3 below illustrates that there is no overlap with the remaining PRF work (shown in green) and the single overhang removal span (shown in red).

Figure 3 – Electrical HV diagram showing the remaining PRF at Healesville

In the case of the Warburton Valley, Figure 4 below illustrates that there is minimal overlap between the remaining PRF works (shown in green) and the overhang removal spans (shown in red).

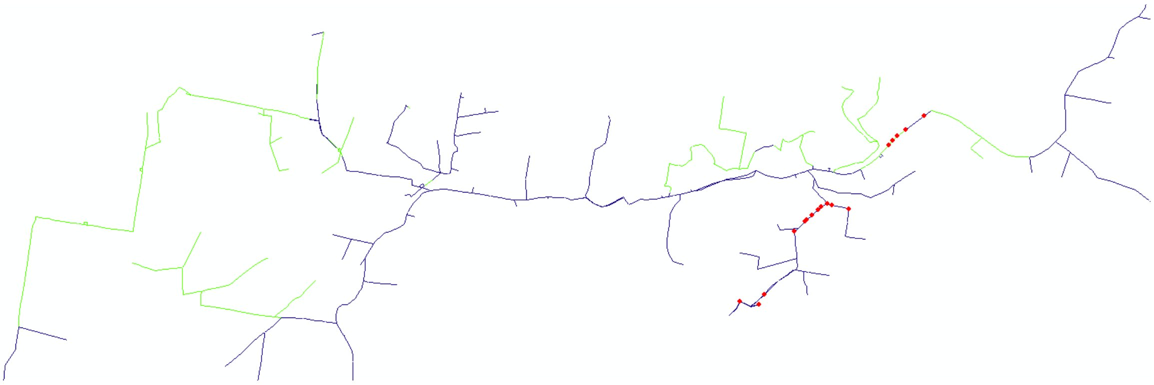


Figure 4 – Electrical HV diagram showing the remaining PRF within the Warburton Valley

In the case of Warrandyte, Figure 5 below illustrates that there is no overhang removal spans in the vicinity of the remaining PRF work (shown in green).

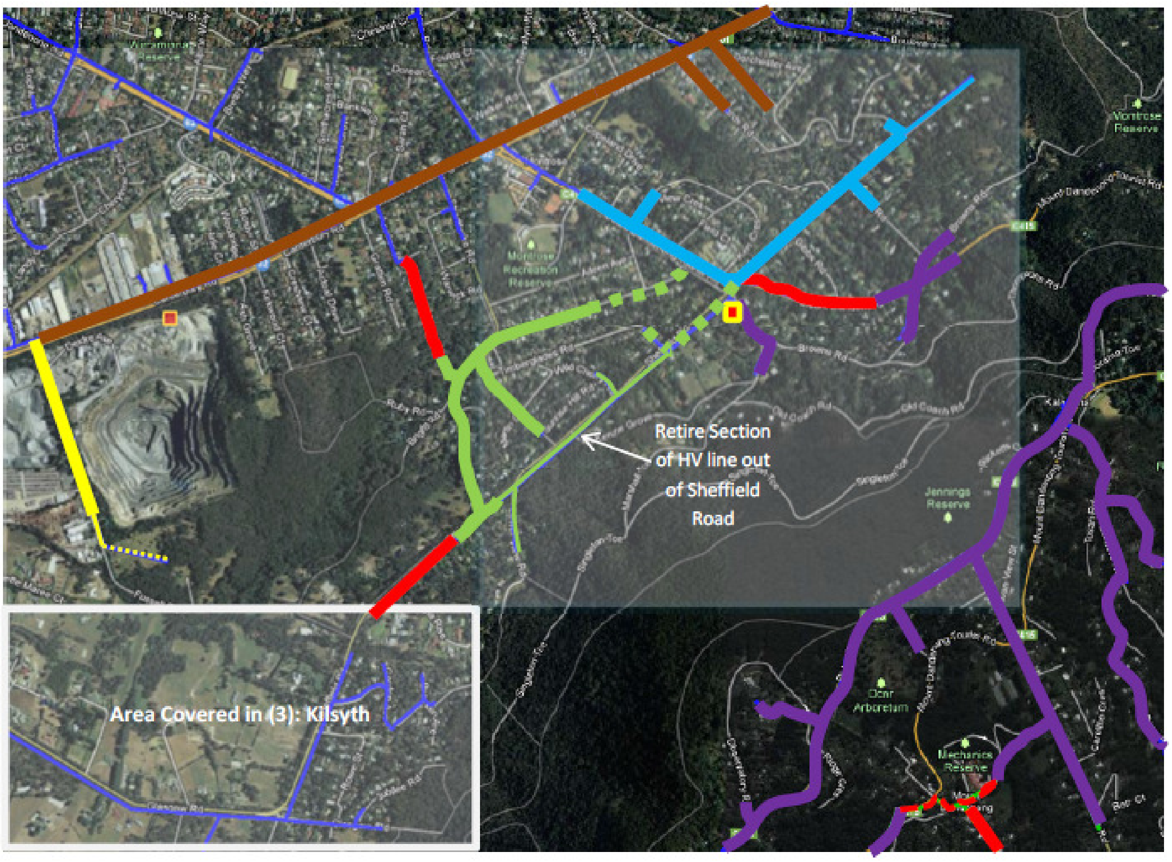
Figure 5 – Electrical HV diagram showing the remaining PRF within Warrandyte

3.4.2 Program evaluation process

A two-stage process approves each individual project carried out under the PRF program. This involves acceptance at the Assessment Advisory Panel, and the Process Control Board, prior to works being approved for construction.

Each project submitted by AusNet Services to DEDJTR is accompanied by detailed design drawings which provide sufficient detail for the approvers to establish any overlapping or adjacent overhang removal works. An example of this information is shown in Figure 6.

Where proposed powerline replacement overlaps with an overhang removal site, the section of overhang removal is removed from the powerline replacement project. i.e. the cost of the overhang removal is excluded from Government funded powerline replacement. In some cases, DEDJTR personnel will site visit work locations to ensure validity of the proposed works prior to granting approval.



🟥	Future 56M HV ABC Project
🟥 🟥 🟥 🟥 🟥 🟥	Future 56M Underground Project
🟪	Existing HV ABC
🟨	Tolhurst Fire Point

No.	Line Colour	Length of Line (km)		Replacement Technology	Cost (+/- 20%)
		Pre	Post		
1	🟨	1.04	1.04	HV ABC 35mm, LV ABC & LV Underground Cable	
2	🟩	3.47	3.89	HV Underground Cable 185mm, HV Underground Cable 35mm, HV ABC 185mm, HV ABC 35mm, Two New Pole Type Substations, Gas Switch & LV ABC	
3	🟫	3.52	3.52	HV ABC 185mm & HV ABC 35mm	
4	🟦	2.20	2.20	HV ABC 185mm, HV ABC 35mm & LV ABC	

Figure 6 - Sample PRF project proposal containing geographical maps

4 Animal and bird proofing

AusNet Services proposed expenditure to install Animal and Bird proofing in the initial Regulatory Proposal 2016-20. The programs of animal and bird proofing were accepted though the AER has sought more information from AusNet Services on project prioritisation and the location of installations[5]. This section provides additional information on the background of the project and proposed installation approach.

4.1 Background

Incidents caused by Bird and Animal flashovers remain a significant contributor to ground fire ignitions as shown in Figure 7.

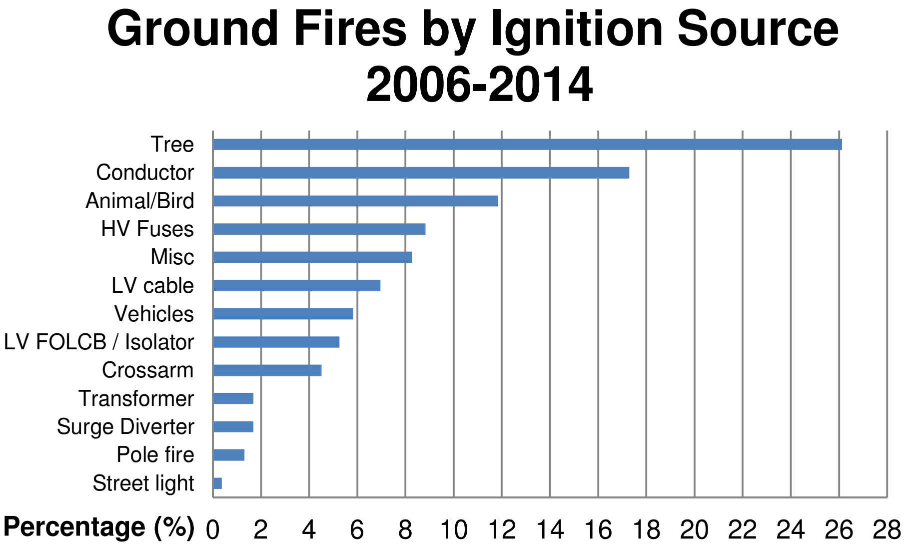


Figure 7 - Ground fires by cause 2006-2014

In order to address the fire risks associated with Bird and Animal faults, the consequence of a fault must be considered. Therefore all pole top assets which are prone to these faults and are located in bushfire risk areas are of concern. Figure 8 shows the location of asset and ground fires caused by birds and animals over a four year period. Fires were distributed across the network and most fires occurred in areas with high or very high fire risk (areas shown as blue or dark blue in the figure).

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[5] AER Preliminary Decision AusNet Services distribution determination – Attachment 6 – Capital Expenditure p6-45

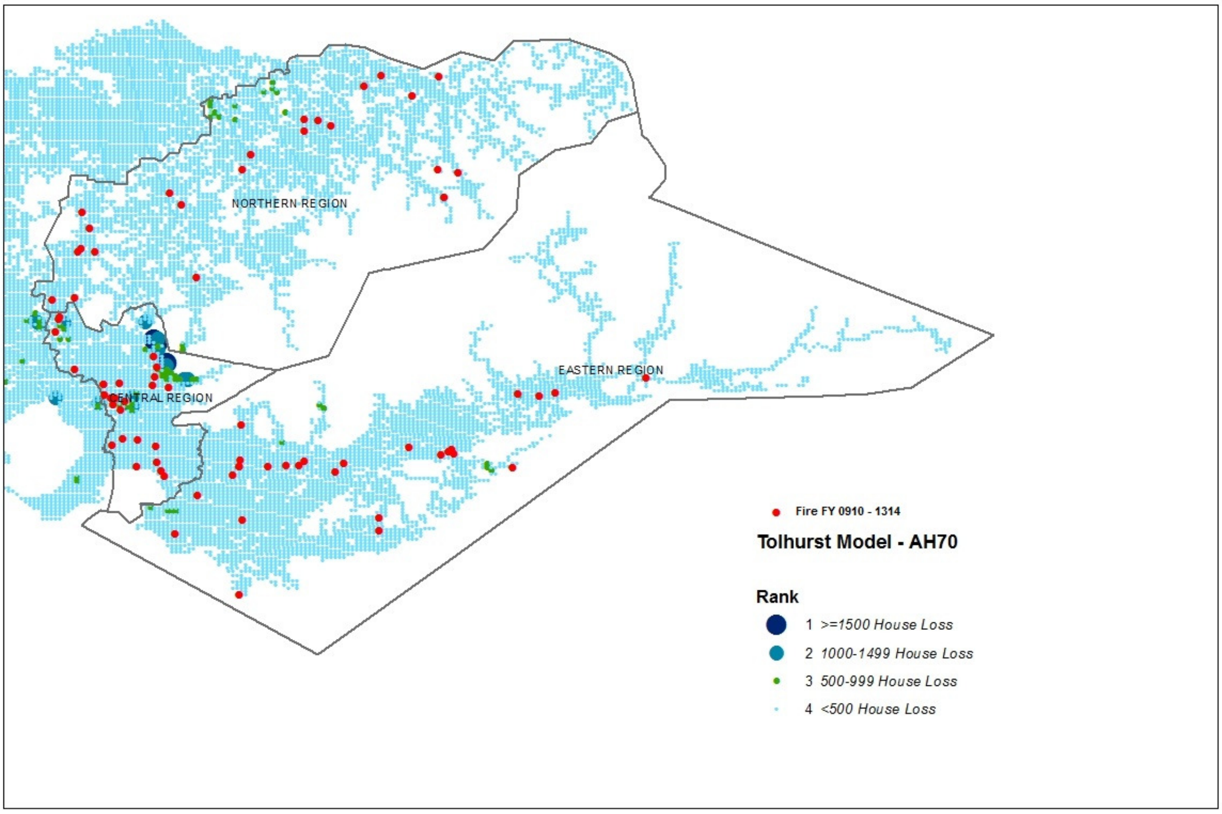

Figure 8 – Location of asset and ground fires caused by Birds and Animals

53,000 HV complex structures are located in HBRA areas. Of these, 37,000 are not Bird and Animal Proofed.

AusNet Services is obliged to complete a ground inspection of its 372,000 poles on a five year cycle. Since 2007, all HBRA areas must be inspected within a 37 month interval. This inspection can be completed by ground assessment or overhead aerial inspections focussed on pole cross arms, insulators and attached equipment.

In a typical year, approximately 93,000 ground inspections are completed of which 60% are in HBRA. Additionally, approximately 44,000 aerial inspections are completed in HBRA.

Maintenance of poles, lines and associated assets is initiated in three ways. Firstly, the pole and line inspection program identifies items which require maintenance, including assets which require replacement. The majority of all maintenance activities are initiated following an inspection. Secondly, maintenance activities can be raised after a fault. Thirdly, proactive maintenance of existing assets is initiated following a formal feeder review which is generally targeted at poorly performing feeders. These three methods are illustrated in Figure 9.

4.2 Implementation

The proposed program involves Bird and Animal Proofing through asset replacement and proactive retrofitting to existing assets. This program is targeted at the 37,000 HV complex structures in HBRA areas. All HBRA areas are targeted for Bird and Animal proofing as the fire risk is broadly distributed across the network.

The approach to installation of Bird and Animal proofing is aligned with maintenance activities as shown in Figure 9. The first component of the program will install Bird and Animal proofing where a maintenance activity is identified that involves replacing an asset on a complex structure located in an HBRA area.

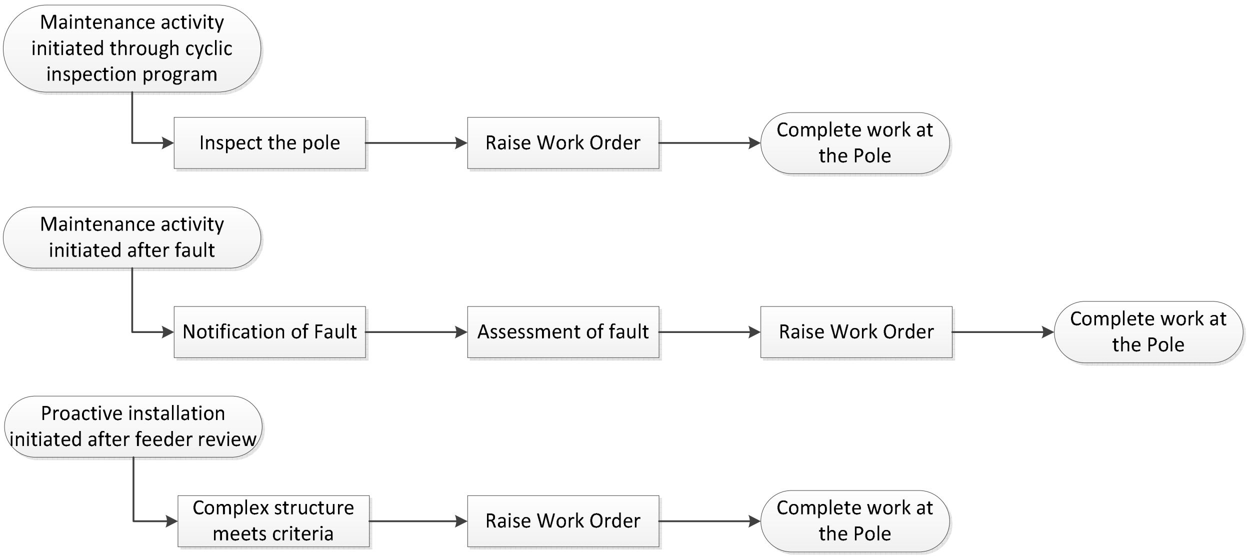

Figure 9 – Flow chart to action maintenance activities

The second, smaller component of the program will involve proactively installing Bird and Animal proofing in high risk areas. This will involve prioritising installations located in HBRA areas targeted at complex structure on feeders which have a history of animal and/or bird strikes and present bushfire risk. Wherever possible, these installations will be carried out in conjunction with other maintenance activity. For example, if a work order involves the replacement of a crossarm and the adjacent pole is a complex structure in the target area, then the complex structure will have animal and bird proofing installed.

The forecast program volumes are shown in Table 3.

Bird and Animal Proofing	2016	2017	2018	2019	2020	Total
Animal Bird Proofing installed during asset replacement	2,335	2,335	2,335	2,335	2,335	11,675
Proactive Animal Bird Proofing (fit to existing assets)	1,915	1,915	1,915	1,915	1,915	9,575
Total	*4,250*	*4,250*	*4,250*	*4,250*	*4,250*	*21,250*

Table 3 – Bird and Animal Proofing replacement volume forecast for the 2016-2020 regulatory period[6]

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[6] Excerpt from Network Capital Expenditure overview 2016-20 document (Table 47)

5 Downed conductor sectionalisation

The Downed Conductor Sectionalisation project was included in AusNet Services' Initial Proposal 2016-20. The expenditure proposed for this project ($16.4M $2015 real) was included in the Reset RIN (2.2 Repex) in the SCADA, Network Control & Protection System asset group. The AER did not accept AusNet Services' proposed expenditure in the SCADA, Network Control & Protection System asset group, and developed a substitute forecast based on historical expenditure[7].

The Downed Conductor Sectionalisation project is intended to improve the safety of the network by reducing the potential for a bushfire ignition by reducing fault current and isolating a section of a high voltage overhead feeder when a fault results in a conductor touching the ground.

The use of historical expenditure to forecast expenditure in the SCADA, Network Control & Protection System asset group does not appropriately consider expenditure planned to improve the safety of the network.

This section describes the background to the project, the scope of works and the benefits that will arise from completing the proposed works. An explanation of the allocation of expenditure into the SCADA, Network Control & Protection System asset group is provided.

5.1 Background

Conductors can be brought to the ground by a number of means such as impact from a falling tree, vehicles hitting poles or asset failure. The safety risks of downed conductors are:

- Fire ignition
- Electrocution of the public or employees coming into contact with the live conductor
- Loss of livestock
- Damage to customer equipment due to brownout and voltage variation.

Electricity protection systems are designed to detect a fault on the network and to operate a switch (typically a circuit breaker) to interrupt the supply of electricity. Interrupting the supply of electricity is intended to reduce the safety risk by eliminating the potential for a person or animal to touch a live conductor, preventing the ignition of fire and preventing damage to network assets/equipment through high fault currents. Systems that detect downed conductors or limit fault currents have clear safety benefits through reducing the risks outlined above.

Protection systems are limited in their ability to detect faults on a network. Some common network faults, such as when two conductors contact each other, are easily detected by conventional protection systems. However, some faults, such as when a conductor breaks and falls to the ground, are not easily detected and traditional earth-fault protection relays cannot confirm this type of fault. As a result, there may be instances where conductors can potentially remain energised on the ground and lead to fire ignition or electric shock.

A method of enhancing the protection system to detect and confirm downed conductor faults is to utilise a Master Earth Fault (MEF) protection relay. A field device, such as an Automatic Circuit Reclosers (ACR) may detect an abnormality but the MEF relay confirms that current is flowing from the conductor to the ground. The distribution feeder automation (DFA) system isolates the faulted section to reduce the safety risk. (Using the DFA system to isolate the faulted section means that fewer customers are affected by the fault.)

The three steps involved in order to achieve downed conductor sectionalisation are:

1. ACR to identify abnormalities on the section of line it is protecting
2. MEF relay identifies and confirms the abnormality is a downed conductor
3. DFA system isolates the faulted section

5.2 Trial Project

During the 2010 to 2015 regulatory period, a research and development project was completed at Belgrave to establish the suitability of installing new technology MEF protection relays. The trial project involved the implementation of technology to identify and then isolate a downed, live, conductor.

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[7] AER Preliminary Decision AusNet Services distribution determination – Attachment 6 – Capital Expenditure p6-72

After the trial project had commenced, a decision was made to trial REFCLs and the project was modified to ensure that both MEFs and REFCLs could be implemented together. From the trial, it was concluded that the technology to identify and isolate a downed conductor can be introduced onto the distribution network.

5.3 Implementation

The proposed program involves three related projects. These are:

1. Replacing MEF protection relays	} Asset replacement project
2. Modifying existing DFA systems	} Downed conductor sectionalisation program
3. Installing Neutral Earthing Resistors	

The second and third projects combined (Modifying existing DFA systems and Installing Neutral Earthing Resistors) form the 'Downed conductor sectionalisation' program.

The first project involves replacing MEF protection relays with new technology which has the ability to provide current signatures that enable downed conductors to be detected and also provide monitoring and fault recording for Neutral Earthing Resistors. Following detection of a downed conductor, further automated action can be taken such as opening circuit breakers or ACRs to isolate the fault and using DFA to restore customers outside the faulted section. MEF protection relays will be replaced at 31 sites commencing in 2015. These new MEF relays also enable the implementation of REFCLs. i.e. The relays are necessary for REFCLs to be utilised at the zone substations.

The second project modifies or replaces DFA schemes where items such as ACRs and switches don't currently have the functionality to identify the direction of a fault. This 'automatic sectionalisation' of downed conductors will be implemented at stations where new MEF protection relays and DFA has been installed.

The third program involves the installation of fault level reducing systems, such as NERs, at two zone substations, Foster (FTR) and Kinglake (KLK). NERs are already installed at most zone substations. The installations at FTR and KLK will improve the safety of the network by targeting two zone substations which present a level of bushfire risk and do not currently have an NER installed.

5.4 Benefits

The primary benefit resulting from this project is a reduction in the risk of ground fire ignition when a live conductor falls to the ground. A live conductor can fall to the ground as a result of several incidents or initiating events including:

- Tree branch falling onto conductor
- Vehicle hitting pole
- Failure of a crossarm or insulator or tie
- Failure of a conductor due to deterioration or lightning strike
- Failure of a connector

The secondary benefits arising from this project include:

- NER reduces fault current to a safe level which is sufficient enough to operate protective relays
- NER reduces consequential station equipment damage at FTR and KLK
- NER provides station back-up protection
- NER reduces consequential damage to the network (leading to less customer impact) at FTR and KLK
- NER has the ability to detect high impedance faults such as a branch remaining in contact with a live conductor
- Online monitoring of NERs ensures the NER is fit for purpose by identifying any malfunctions.

5.5 Expenditure allocation and assessment

AusNet Services allocated a number of expenditure components into the SCADA, Network Control & Protection System RIN asset group. This includes:

- Replacement of secondary and protection relays, systems and associated assets
- Replacement of communications systems
- Replacement of local network wiring assets
- An allocation of a proportion of 'zone substation rebuild projects'. This allocation is an estimate of the secondary, protection and communications expenditure portion of an integrated zone substation rebuild project involving replacement of primary plant and secondary systems.
- Downed conductor sectionalisation involving modification of existing DFA systems and installation of NERs as described above.

Total expenditure of $107.0 M ($2015 real) was proposed in the SCADA, Network Control & Protection System category. Of this, $16.4 M (15%) is the forecast Downed conductor sectionalisation program.

5.5.1 RIN expenditure allocation

AusNet Services has reviewed the historical allocation of expenditure into the SCADA, Network Control & Protection System RIN asset group and compared this to the EDPR RIN allocation. Historically, some expenditure which could have been allocated in the SCADA asset group has been allocated to other groups such as Switchgear. For example, the cost associated with replacement of a protection system which is replaced at the same time as a circuit breaker may have been allocated into the Switchgear category as data is not available to identify the actual component of the total project expenditure associated with the protection system. However, in the EDPR forecast RIN the same cost has been allocated to the SCADA category.

The result of this allocation issue is for the forecast SCADA expenditure to appear much higher than historical expenditure.

5.5.2 AER review

In its review of replacement expenditure, the AER has considered both repex modelling and historical expenditure levels. The RIN allocation issue described in section 5.5.1 is only relevant to the extent that it could lead the AER to incorrectly evaluate expenditure. AusNet Services is satisfied that the approach taken by the AER to evaluating replacement expenditure and producing a substitute forecast should result in an appropriate level of forecast replacement expenditure even though some minor RIN allocation inconsistencies exist. However, the AER's approach does not appropriately consider the 'Downed conductor sectionalisation' program because the program is driven by planned safety improvements.

As noted in section 5.3, three related projects are proposed. The first of these, replacing MEF relays, is effectively an asset replacement program where assets which have reached the end of their effective life (due to obsolescence) are replaced. The AER's approach to evaluating this expenditure and producing a substitute forecast appropriately considers this expenditure.

The second and third projects combined (Modifying existing DFA systems and Installing NERs), which form the 'Downed conductor sectionalisation' program are not appropriately considered by the AER's approach as historical expenditure or repex modelling does not provide a satisfactory forecast of this expenditure. Historical expenditure does not provide a satisfactory forecast as this type of expenditure was not incurred is the 2011-15 regulatory period. Repex modelling does not provide a satisfactory forecast as the program involves development and/or replacement of relatively new DFA schemes and installation of new NERs.

6 Surge arresters

The replacement of surge arresters was included in AusNet Services' initial Regulatory Proposal 2016-20. Forecast expenditure of ($30.3M $2015 real) was included in the Reset RIN (2.2 Repex) in the Other asset group. The AER did not accept AusNet Services' proposed expenditure in the Other asset group, and developed a substitute forecast based on Repex modelling[8].

This section explains the background and scope of the proposed surge arrester replacement program, and explains why the AER's approach does not appropriately consider this expenditure.

6.1 Background

The AusNet Services medium-voltage (22kV, 11kV, 6.6kV & 12.7kV) electricity distribution network in Victoria has approximately 125,000 surge arresters protecting approximately 62,000 distribution substations, 4,000 ACRs and gas-insulated switches, 140 line voltage regulators, 70 pole-mounted capacitors and more than 1,200 underground cable termination poles.

Surge arresters are also installed in zone substations to protect plant such as power transformers and circuit breakers. Approximately 1,600 surge arresters are located in zone substations.

Surge arresters are also known as 'surge diverters' or 'lightning arresters' (LAs).

6.2 Line Surge Arresters

A subset of the surge arrester[9] population installed on distribution feeders are exhibiting signs of deteriorated condition such as degraded insulator material, housings, venting duct covers and/or diaphragms. Condition assessments indicate that 38% of units are in "very poor" (C5) condition and 2% are in "poor" (C4) condition. The vast majority of surge arresters in condition C4 and C5 are gapped silicon carbide line surge arresters with porcelain housings. Installations of this type of surge arrester occurred during the early 1980's and were predominantly manufactured by Bowthorpe.

Gapped Silicon carbide units can fail explosively causing hot ceramic material to spread. This failure mode could cause health and safety consequences if the failure occurred in a populated area. Failure of surge arrester can also cause ground and asset fires. Fire Loss Consequence (FLC) modelling data was used to assess potential losses due to wildfire ignitions caused by surge arrester failures. The FLC data, provided by Energy Safe Victoria (ESV), further quantifies failure consequences associated with network assets in the traditionally homogenous "hazardous bushfire risk areas" HBRA.

Risk assessment performed using condition assessments and FLC data has shown that units which are both in poor condition (C4 & C5) and situated in areas susceptible to wildfire should be replaced as a priority.

6.3 Proposed Surge Arrester Replacement Program

A new program of pre-emptive surge arrester replacements specifically targeting porcelain-housed silicon carbide surge arresters in FLC fire risk areas is proposed. This program will replace an average of 2,700 surge arresters or 1,350 installations per annum and will be completed in 2025. Such replacements provide community benefits primarily in the form of wildfire avoidance, and protection of costly electrical plant.

Line surge arresters have traditionally been replaced if they are identified as being unfit for service during routine inspection or if the installation (transformer, switch, regulator, cable head) they are protecting is replaced. Surge arrester risk assessments have shown that a step increase in replacement volumes is required to promptly address the risks in an accelerated manner.

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[8] AER Preliminary Decision AusNet Services distribution determination – Attachment 6 – Capital Expenditure p6-74

[9] Further information on the population of surge arresters in contained in asset strategy AMS 20-67 Line Surge Arresters

6.4 AusNet Services RINs

AusNet Services has not been consistent in the categorisation of the assets titled 'Other – Surge Diverters in the RINs. In Category Analysis RINs for 2009-13 and 2014 (2.2 Repex and 5.2 Asset Age Profile), AusNet Services included a category in the 'Other' asset group titled 'Other – Surge Diverters'. This line only included the approximately 1,600 surge arresters located in zone substations. It did not include the majority of the surge arrester population (125,000) located on the distribution feeders.

In the EDPR Reset RIN (2.2 Repex), AusNet Services included forecast expenditure and volumes in the 'Other' category in the asset group titled 'Other – Surge Diverters'. The forecast asset replacements and expenditure in the EDPR Reset RIN relates to the pre-emptive replacement of surge arresters located on distribution feeders and in zone substations.

This difference in categorisation of surge arresters has led the AER to draw incorrect conclusions such as the proposed replacement volumes being significantly higher than the apparent number of assets in commission[10].

6.5 Repex Modelling

Predictive asset replacement modelling based on historical data will not model the proposed volume of surge arrester replacements as:

- The historical RINs show a population of approximately 1,600 Surge Diverters when the actual volume of surge arresters located on distribution feeders is approximately 125,000.
- The unit rate for a surge arrester replacement calculated from the historical RIN is based on replacement of surge arresters in zone substations and is much higher than the rate proposed for replacement of surge arresters on distribution feeders.
- This modelling does not consider the need for a step change in replacement volumes due to the risks associated with deteriorated assets and the consequences of any failures.

The AER has used predictive based modelling to assess the prudency of Repex proposed in the "Other" asset group. Predictive based modelling is age based and does not effectively account for asset condition and the risks associated with explosive type based failure modes exhibited by gapped silicon carbide surge arresters. In addition, predictive modelling does not consider location based failure consequence such as those related to bushfire ignition.

Further, predictive based modelling uses age profiles to forecast replacement volumes. Surge Arrester age profiles provided by AusNet Services in historic Annual RIN's have related to zone substation surge arresters only.

As the age profiles and volumes of surge arrester units situated in zone substations are considerably different to those operating on overhead line systems, predictive based modelling is not an accurate means to assess prudency of the proposed expenditure.

6.6 Conclusion

The expenditure proposed by AusNet Services to replace surge arresters is not appropriately forecast using a repex model. A defined sub-group of surge arresters has been identified that present an unacceptable risk of explosion and potential fire ignition, and the program to replace these surge arresters should be approved in addition to the repex modelled expenditure.

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[10] AER Preliminary Decision AusNet Services distribution determination – Attachment 6 – Capital Expenditure p6-73