SA Power Networks

Supporting document 5.16

2020-25 Reliability & Resilience Programs - Low Reliability Feeders

2020-25 Revised Regulatory Proposal

10 December 2019

SA Power Networks

2020-25 Reliability & Resilience Programs -

Low Reliability Feeders

Program justification

Contents

Document Control

Version	Date	Author	Notes
1.0	31/01/2019	J Ali	Final updates and released version
Draft	02/12/2019	S Jolly	Draft update for revised proposal

Executive Summary

Overview of program

We have developed a **$15.5 million** program to arrest the declining reliability performance of supply to 16,481 of our worst served customers (the low reliability feeder program). This program is proposed to be implemented over the next regulatory control period, 2020/21 to 2024/25.

This program will arrest the declining reliability performance of supply from 95 of our worst performing feeders through a combination of works, covering:

- re-insulation of poor performing line sections
- installation of reclosers and sectionalisers
- undergrounding of critical line sections
- upgrading critical bare wire line sections with covered conductor.

We estimate that this program will reduce the average Unplanned System Average Interruption Duration Index (USAIDI) on these 95 feeders from 421 minutes by on average **170 minutes** in the USAIDI for customers supplied by these feeders, representing a **40% improvement** in their supply reliability (including Major Event Days).

This program only includes solutions that we have found to be economically viable (ie the benefits to customers supplied by these feeders exceed the costs in present value terms). We estimate the total economic (VCR) benefit due to the implementation of the program is **$2.2 million per annum** and the net benefit is **$0.9 million per annum** (or $10.8 million over 15 years).

Our obligations and this program

We have a state requirement - administered by ESCoSA - to annually report on Low Reliability Feeders (LRFs) including our proposed actions to improve the performance of each of those feeders. This current scheme defines 'Low Reliability Distribution Feeders' as feeders within a particular region[1], which have exceeded twice the mean USAIDI for that region for two consecutive financial years[2].

These requirements require us to identify and monitor our worst performing feeders. Currently, we have no direct obligation to improve the supply from these feeders. Nonetheless, there is still an expectation through these requirements that we will reduce the poor performance of those feeders, where it is economically viable. Importantly, ESCoSA have stated in its final decision on the service standard framework to apply to us for the 2020-25 regulatory control period, that low reliability feeder reliability levels should be maintained.

Our low reliability feeder program focuses on those feeders identified as being consistently classified as low reliability by this scheme (i.e. referred to as long term LRF (i.e. (LTLRF)). A feeder is classified as LTLRF where the feeder has been classified as a LRF three times in the last five years, with two of those being in consecutive years.

There are 156 feeders that meet the LTLRF criteria.

SA Power Networks considers the Low Reliability Feeder Program is necessary to maintain performance for LRF as detailed in section 3.1 of the Essential Services Commission of South Australia (ESCoSA), *SA Power Networks reliability standards review.*

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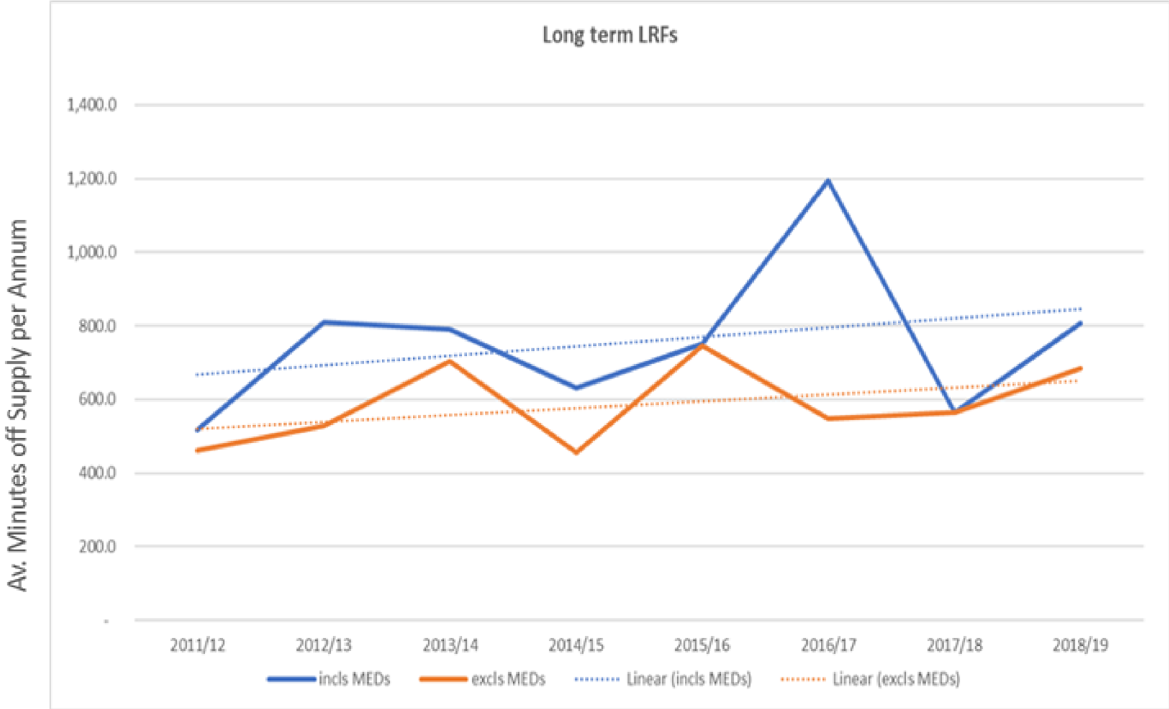
[1] ESCoSA has defined 10 regions, see ESCoSA's SA Power Networks reliability standards review, Final Decision January 2019 section 6.1 Table 7 (pgs 55 & 56)

[2] See ESCoSA's SA Power Networks reliability standards review, Final Decision January 2019 section 6.3 pgs 60 - 62

As represented in the graph below, performance is deteriorating for feeders included in the 2020-2025 Low Reliability Feeders program proposal.



As performance of the targeted feeders continues to deteriorate and ESCOSA reliability service standards framework requires reliability to be maintained at current levels for Low Reliability Feeders, there is what we consider to be a State based expectation to undertake the Low Reliability Feeder program to address the demonstrated decline.

Our low reliability feeder program

Based on our analysis of current and historical outages, we have determined that 111 of our 156 LTLRF have credible and economically viable solutions to arrest their declining performance. We have developed, scoped and costed 120 individual solutions to reduce the performance gap of these feeders.

Alternative options such as local generation has been assessed but is not economically viable enough to be considered prudent or efficient to include in our Low Reliability Feeder Program. We are aware that alternative options (eg local generation) have been installed on other networks interstate on a trial basis through significant government subsidies for assessment.

We have performed formal cost-benefit analysis on each proposed solution to determine the economic viability of each solution and included only those solutions in our program where the benefits exceed the costs, in present value terms. To undertake this analysis, we have estimated the reliability improvement expected from individual solutions on the selected sections of line by applying improvement rates that we have derived through statistical analysis of the actual demonstrated improvements to actual historical interruptions on those sections of line to be improved under the proposed program. We use the Value of Customer Reliability (VCR), as defined by AEMO, to calculate the economic value of these improvements. We have also included an estimate of avoided outage response and repair costs and STPIS Benefit.

Our LRF program only includes solutions that have been assessed as economically (VCR) viable.

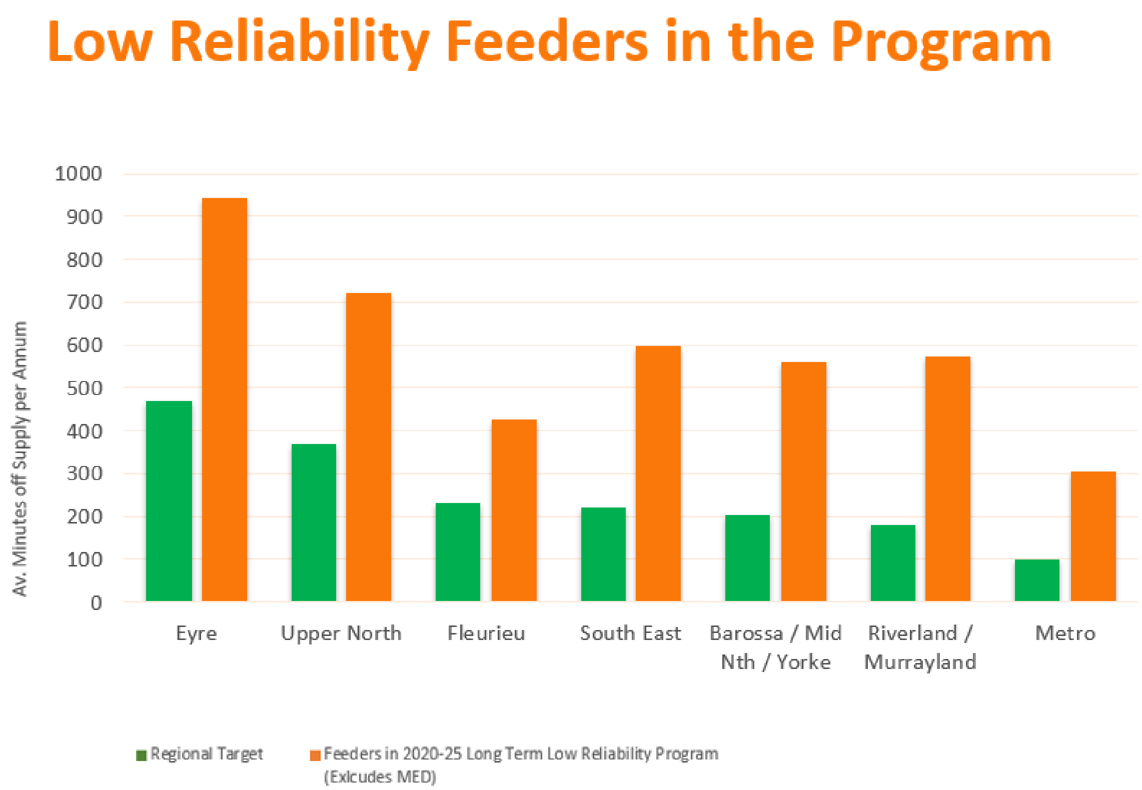
Based on this analysis, we have identified 95 of our LTLRFs, supplying 16,481[3] of our worst served customers, where our analysis determined that it is economically viable to improve the supply reliability. Our program includes 102 solution elements, which should allow for:

- re-insulation of 6,633 line sections;
- installation of 26 new sectionalisers and 18 reclosers; and
- undergrounding of 5 spans.

Customer Service

Our LT Low Reliability Feeder program focuses on those feeders identified as being consistently classified as low reliability by this scheme (i.e. referred to as long term LRF (i.e. (LTLRF)). A feeder is classified as LTLRF where the feeder has been classified as LRF at least three times in the last five years.

Customers supplied by feeders in the proposed programme experience significantly (between 2 to 3 times) worse performance than regional targets per below.



As the 2020-2025 GSL scheme is being capped at $300 for a total annual duration payment (compared to the current maximum of $605 for each individual outage > 48 hrs), customers on Low Reliability Feeders will be disadvantaged more than other customers by this change as historically 37%[4] of duration payments are made to LRF Customers.

As LTLRF customer service and performance is significantly worse than regional targets and continues to deteriorate (refer previous graph) and these customers will also receive a reduced

[3] Based on average customer numbers over the 2017/18 regulatory year.
[4] SA Power Networks reliability standards review – Final Decision – Jan 2019

service level payment, the proposed Low Reliability Feeder program will partly offset future GSL disbenefits these customers will receive.

Customer service level improvements

We estimate that this program should improve the annual SAIDI of these feeders from an average of 421 minutes (including MEDs) and 309 minutes (excluding MEDs) by, on average, 170 minutes (40%), including MEDs, and 117 minutes (38%), excluding MEDs.

Our customers served by low reliability feeders in the Upper North region will receive the greatest improvement, with a 254 USAIDI minute improvement (including MEDs). Customers served by low reliability feeders in the Riverland and Murraylands; Barossa, Mid-North, Yorke Peninsula; and Eyre Peninsula regions will also receive significant improvements, with an average USAIDI improvement (including MEDs) of 187 minutes. Other regions, other than the Rural Metropolitan Centres[5], will still receive significant improvements, ranging between 100 minutes for the South East to 164 minutes for Adelaide Metropolitan Area (including MEDs).

Economic benefits of the program

The economic efficiency assessment conducted by Oakley Greenwood used by ESCOSA for the SSF Review and referred to in the AER Draft Decision was not conducted on our specific 2020-25 LRF program but on different scenarios from information provided to ESCOSA in 2017 of simply improving overall USAIDI and USAIFI by 1%, 5% and 10% on LRF's, without a detailed viability assessment. The purpose of this information was only to provide ESCOSA with indicative costs to facilitate their standards review. The scenarios detailed in ESCOSA's review:

- were focussed on general improvements, whereas our 2020-25 LRF program is focussed on targeted, economically viable improvements
- Our 2020-25 LRF program provides a much greater benefit at a lesser cost to long term LRF's.
- Oakley Greenwood would have obtained a different result if they used the 2020-2025 LRF program data.

In response to the AER Draft Decision, in November 2019 SA Power Networks engaged Oakley Greenwood (OGW) to assess the economic efficiency of the 2020-25 LRF program in light of the findings of the study undertaken for ESCOSA.

"Based on the level of willingness to pay and willingness to subsidise determined in the ESCOSA study, it is of our view that the proposed 2020-2025 LRF program – which focusses on a smaller set of LRFs and delivers a greater level of improvement than the program assessed in the ESCOSA study – is economically efficient."[6]

We estimate that the total economic benefit of this program is $2.2 million per annum, or $26.4 million over a 15-year period. The economic benefit for individual feeders is on average $22,951 per annum, but ranges between $2,547 and $149,988 depending on the feeder. The majority of this benefit (95%) is due to the economic cost of the avoided interruptions to customers' electricity supplies. The remainder is due to avoided network outage response and repair costs.

As noted above, we have ensured that all individual solutions in this program have a positive net-benefit (ie the economic benefit of the solution exceeds the cost of the solution – in present value terms). The total

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[5] We have found no viable solutions for the Rural Metropolitan Centres. However, it is worth noting that there are only 3 feeders identified as long term low reliability in this regional category, all of which are Urban.

[6] 5.18 - Oakley Greenwood - The Economic Efficiency of Improving Reliability on Low Reliability Feeders, p. 01

net-benefit across the program is $0.9 million per annum. Assuming at least a 15-year life of the program assets, this would amount to a net benefit of at least $10.8 million over this 15-year period.

The individual feeder upgrades have an average benefit-cost ratio 1.8 (i.e. the economic benefit is almost two times higher than the costs), with this ratio ranging between 1.02 and 12.7 depending on the solution.

Customer support for this program

We have engaged extensively with our customers and stakeholders during the development of our original and revised proposals. As part of this engagement we spoke with our customers on their views on supply reliability and price trade-offs, and more specifically the reliability of supply to our worst served customers.

We consider that the findings of this engagement provide strong support of our Low Reliability Feeder program. Specifically:

- the feedback from customers that the theme 'Network reliability and resilience', and specifically, 'an acceptable level of reliability for all,' was the highest priority during early customer engagement on our Original Proposal;
- the consistent support from stakeholders for the low reliability feeder program, during both 2018 Deep Dive sessions and the 2018 Draft Plan consultation;
- the demonstrated customer willingness to pay for the program; and
- the unanimous support of the SAPN CCP and other stakeholders to included Re the Low Reliability Feeder Program.

This stakeholder support was validated by Oakley Greenwood in its report that compares the results of an earlier study for ESCOSA on reliability standard with SAPN's proposed 2020-25 Low Reliability Feeder program. This report states*: "Based on the levels of willingness to pay and willingness to subsidise determined in the ESCoSA study, it is our view that the proposed 2020-2025 LRF program – which focusses on a smaller set of LRFs and delivers a greater level of improvement than the program assessed in the ESCoSA study – is economically efficient.*[7]*"*

Regulatory treatment

The low reliability feeder program is a program designed to address the deterioration of LRF performance and so the reliability benefits could affect the Service Target Performance Incentive Scheme (STPIS) outcomes. The STPIS regime currently provides distributors with a five-year increase in revenue for any permanent improvement in underlying reliability. This means that distributors (e.g. SA Power Networks) receive about one third of the long-term benefit provided by the reliability improvements, with the remainder going to customers. Consequently, the benefit-cost ratios for these types of improvement funded by distributors are typically much lower than our more usual reliability improvement projects, which are aimed at addressing underlying reliability. As such, the existing STPIS mechanism does not provide the adequate incentives compared to other reliability projects for SA Power Networks to fund the types of solutions identified for feeders under this program

Therefore, our regulatory proposal to the AER, will include the capital cost of this program and the required adjustments to the STPIS targets if that capital expenditure is included in our Capex allowance.

We believe that the AER can have confidence that the $15.5 million capital cost of this program is in accordance with the NER capital expenditure objectives, criteria and factors, given the following:

- our state-based obligations associated with low reliability feeders
- the detailed analysis we have conducted to develop this program
- the cost-benefit analysis we have applied to ensure that it only includes solutions that provide a positive net benefit; and

[7] 5.18 - Oakley Greenwood - The Economic Efficiency of Improving Reliability on Low Reliability Feeders, p.01

- the findings of our customer and stakeholder engagement which support program of reliability improvement aimed at our worst served customers, where it is economically viable to improve reliability.

The ultimate (i.e. at 30 June 2025) improvement to service targets delivered once this program is fully implemented are estimated as follows:

- STPIS USAIDI targets (ex MEDs) – 1.29 minutes implied at the state level, 6.54 minutes to Long Rural feeders, 0.45 minutes to Short Rural feeders, and 0.27 minutes to Urban feeders.

- STPIS USAIFI targets (ex MEDs) – 0.005 interruptions implied at the state level, 0.0183 interruptions to Long Rural feeders, 0.0026 interruptions to Short Rural feeders, and 0.00213 interruptions to Urban feeders.

We propose that the STPIS targets be adjusted by half the ultimate improvement to reflect that the program will be progressively implemented over the 2020-25 RCP and as such will have minimal impact in 2020/21 and nearly full impact in 2024/25.

It is also noted that the proposed LRF program may potentially reduce GSL payments. This would result in a potential opportunity to gain a reduction in operating expenditure. Detailed modelling will need to occur to forecast the potential GSL offset for the period 2020- 25, taking into account the revised 2020-25 GSL scheme.

Therefore, SA Power Networks will consider adjusting the GSL potential operational savings if the potential GSL payment reductions can be accurately modelled.

1. Purpose and structure

The purpose of this document is to demonstrate that the:

- **scope and cost of our Low Reliability Feeder program is appropriate**, in the context of our obligations and customer preferences; and
- **costs of our Low Reliability Feeder program are being treated appropriately** in our regulatory proposal to the Australian Energy Regulator (AER).

To achieve these aims:

- In the *section* 'Introduction', we will provide relevant background information associated with this program. We will also summarise the key features of the methodology we have used to determine this program.
- In the *section* 'Our obligations', we summarise the legal obligations that underpin how we should assess the service levels of our worst served customers and the criteria we should be applying when deciding whether we should improve these service levels.
- We then set out the key drivers of the program in the *section* 'The drivers and need for this program'. Importantly, this section quantifies the existing service levels of our worst performing feeders and the economic cost associated with this poor performance.
- In the *section* 'Program options considered', we discuss the options we have considered to improve the performance of our worst performing feeders, including the methodology we have used to determine and cost appropriate options.
- In the following three sections, we will discuss our analysis and reasoning that we consider is important in justifying our low reliability feeder program.
    - in the *section* 'Cost benefit analysis of the program', we will discuss the results of our cost-benefit analysis, where we have quantified the benefits (both in terms of improvements to customer service level and the economic cost) of our proposed option and used this to undertake a formal cost-benefit analysis of these options;
    - following this, in the *section* 'Customer support for the program', we discuss the customer and stakeholder engagement we have undertaken and how the findings from this process also support us undertaking this program; and
    - finally, in the *section* 'The preferred program and program scope', we draw together these matters to explain how we have arrived at our LRF and provide further details of its scope.
- The document concludes in the *section* 'Regulatory treatment' by discussing how we believe the costs and consequences of this program should be treated in our next regulatory proposal. This section concludes with a recap of the important matters that we believe should provide confidence that:
    1) the scope and cost of the program is appropriate; and
    2) we have treated this program appropriately in our regulatory proposal to the AER.

The companion Low Reliability Feeder Cost-benefit analysis model

The analysis and results discussed in this document are provided in an excel workbook, known as the Low Reliability Feeder Program Cost-Benefit Analysis model (the *LRF Regulatory mode*l). The LRF Regulatory model provides detailed data and analysis on:

- detailed historical outage data of all feeders considered through this program;
- customer service level analysis, covering measures such as USAIDI, USAIFI, customer minutes (including and excluding Major Event Days);
- economic costing of reliability via Value of Customer Reliability (VCR) calculations;
- individual solution scope and costs, and underlying unit costs assumptions;
- formal cost-benefit analysis of solutions;
- STPIS reward/penalty estimates (assuming a notionally uncapped mechanism); and
- other key inputs and assumptions.

It also includes most of the summary results, tables and charts that are provided in this document. It also provides more comprehensive regional and feeder category summary tables, and detailed feeder-level and solutions-level tables, which can be referred to for a more detailed view of our analysis and results.

2. Introduction

Reliability of supply, our worst served customers and our Low Reliability Feeder program

A key customer service level that we monitor and manage concerns the reliability of the electricity supply we provide to our customers. This service level is typically measured in terms of the following two measures:

- USAIDI, which measures the average unplanned duration that the average customer will not be supplied over a period; and
- USAIFI, which measures the average unplanned number of interruptions to supply that the average customer will see over a period.

These measures provide an aggregate average reliability performance measure across groups of customers over a defined period, which typically represent one year[8]. However, depending on where customers are located and the extent of outages on the network supplying those customers, there can be significant variability in the supply reliability seen by individual customers and localised groups of customers.

Due to the random nature of outage events, any customer can have poorer supply reliability compared to other customers over short time periods. However, worst served customers are viewed as those that experience **reliability** issues, which tend to persist (and possibly) worsen over **longer time periods**.

Most notably for the program discussed here, remote and rural customers are typically prone to having the worst reliability of supply over the longer term. This is because these customers are typically supplied from our longest feeders, which are predominantly overhead bare-wire conductor construction. These overhead arrangements, which are typically radial in design, are far more prone to being affected by storms and so customers supplied from these longer feeders tend to have the poorest reliability of supply.

We also have some of our metropolitan/urban customers, who receive supply reliability significantly worse than our typical metropolitan/urban customers. The metropolitan networks supplying these customers tend to be in less densely populated areas with longer feeders more prone to the effects of weather compared to our typical metropolitan/urban networks.

Unfortunately, it is more costly to supply the sparsely populated rural regions and these outlier metropolitan areas, and as such, there is a trade-off between the reliability of supply we can provide to these customers and the cost/price of providing this reliability. That said, we have various obligations around identifying, monitoring, reporting on and managing our worst served customers. These obligations don't impose a specific requirement on us to correct the supplies to all customers identified as our worst served. However, there is an expectation that we will provide some corrective action where it is clearly prudent and efficient and economically viable i.e. where benefits exceed costs (subject to appropriate regulatory funding being provided).

Importantly, because of the variability in supply and the fact there will be circumstances where the cost would be so high that it would not be efficient for us to improve supplies, we also have a state-based scheme that provides a payment to our customers that have received supply reliability worse than defined limits. This scheme acknowledges that power outages are inconvenient and provides a form of *inconvenience payment* to our customers that receive levels of service significantly worse than our typical customers. This scheme, the service level limits and the payments are collectively called "guaranteed service levels" or GSL.

[8] For the purposes here, the measure also only captures unplanned outages and so are defined as USAIDI and USAIFI.

We typically track, monitor, report and manage customer supply reliability via our high voltage (HV) feeders which supply large numbers of our customers. As such, when we develop plans to address reliability issues, these typically focus on improving the performance of the feeder or feeder sections that are causing the poor reliability for a large number of customers supplied by that feeder.

Our Low Reliability Feeder program is specifically aimed at arresting the declining reliability performance of the supplies to our long-term worst served customers, where we consider these solutions to be prudent and efficient and economically viable (i.e. benefits exceed costs). To be clear however, this program does not address all of our worst served customers, nor does it in all cases remove customers from what would be classified as worst served under our current obligations.

The Low Reliability Feeder program and our previous regulatory proposal

We included a similar Low Reliability Feeder program in our previous proposal to the AER, covering the 2015 to 2020 regulatory control period. This program was aimed at improving 24 of our worst performing feeders, at a cost of $8.1 million. This program was included in our capital expenditure forecast in the previous regulatory proposal.

The AER did not accept the program as part of our capital expenditure forecast. Its primary reasons were that it was not satisfied that:

- "*The capex was necessary to comply with regulatory obligations or maintain network reliability – ie the forecast was not in accordance with the capex objectives of the National Electricity Rules (NER);*
- *There was a positive net benefit in us undertaking this program – ie the benefits exceeded the costs, which the AER considered was a necessary test to demonstrate that the costs reflected efficient costs; and*
- *In the absence of the above, our views of the support by our customers for this specific program was insufficiently demonstrated*" [9].

We have addressed these concerns in preparing this program. More specifically:

- We have conducted a detailed cost-benefit analysis on the Low Reliability Feeder program to determine the net benefits. Importantly, we have only included program components where we find that the benefits are estimated to exceed the costs (ie, there is a positive net benefit).
- We have explained why including the cost of this program in the capex forecast is in line with the NER capex objectives, criteria and factors.
- We have also explained how the results of our customer engagement program, as well as the study conducted by Oakley Greenwood for ESCOSA to inform its review of the reliability standards for 2020-25, indicate strong customer and stakeholder support for the program.

[9] AER final decision, SA Power Networks determination 2015-16 to 2019-20, Attachment 6 pg 53

Program scope

The Low Reliability Feeder program we propose here represents a $15.5 million ($June 2020) capital program. The program will arrest the declining reliability performance of supply to 16,481 of our worst served customers by addressing 95 feeders we have identified as long-term low reliability feeders.

This program will cover a combination of strategies, aimed at addressing the specific causes of the poor performance of the feeders, including:

- Re-insulating vulnerable sections of overhead lines to minimise the possibility of insulator failures due to lightning;
- Alternative network asset configuration / standards to minimise the chance of vegetation outages from outside the prescribed vegetation clearance zone; and/or
- Installing mid line switches to reduce the number of customers interrupted as a result of a storm.

Key features of our forecasting and evaluation methodology

We believe there are several important features to the method we have applied to arrive at this program and its costs, which should provide confidence that the program's scale and scope is appropriate:

- We have undertaken a detailed and comprehensive review of the current and historical performance of all our low reliability feeders to determine the causes of poor performance and develop the most efficient corrective actions to address these causes.
- We have estimated the economic cost of the supply reliability using accepted Value of Customer Reliability (VCR) assumptions and methodology
- We have undertaken a formal cost-benefit analysis of each program component identified as a possible corrective action to ensure all components included in our program should deliver a positive net benefit (ie, benefits will exceed the costs)
- We have consulted with consumers to confirm that they agree, in principle, with the need for a program of this type[10]
- We have analysed the effect of the program on existing reliability incentive mechanisms to ensure that program costs are treated correctly in our next regulatory proposal to the AER.
- We have cross checked the scope of this program with our other programs to ensure there is no overlap.

The above matters will be further discussed throughout the remainder of this document.

[10] Business advocates and Local Government supported regional reliability improvements. Refer to 2020-25 Draft Plan submissions received from Business SA, the Adelaide Hills Council, the City of Playford, Alexandrina Council, Southern Mallee District Council, Tatiara District Council, District Council of Robe, District Council of Grant, Wakefield Regional Council, and the Mid Murray Council, located at https://www.talkingpower.com.au/DraftPlan_Feedback/documents. Further, the Capex Deep Dive workshops demonstrated that 70% of the participants were supportive of the program (Supporting Document 0.13).

3. Our obligations

In this section, we discuss our obligations for managing the reliability of supply to our worst served customers, which in-turn, underpins the need for our Low Reliability Feeder program. Our more general obligations to manage network and supply reliability are covered in more detail in our Reliability & Resilience Performance Strategy document[11].

Importantly, although we have technical criteria that define how we should identify and monitor our lowest reliability feeders, we do not have absolute obligations to improve the supply to customers served from those feeders. However, ESCoSA have stated in its final decision on the service standard framework to apply to us for the 2020-25 regulatory control period, that low reliability feeder reliability levels should be maintained.

That said, we consider that there is a clear expectation in our state-based obligations that we will undertake some form of corrective action where it is efficient. We also consider that this interpretation is in line with the National Electricity Law objectives, as to not to do so in these circumstances would not be in the long-term interests of our customers.

Consequently, we consider that we have a regulatory obligation to undertake actions to address the supply to our worst served customers where it is prudent and efficient and economical to do so.

Low reliability feeders and worst served customers

As a condition of our license, we must comply with Guidelines issued by ESCoSA. One such Guideline is Guideline No.1, which includes the requirement to identify and report on LRFs. Included in that obligation is to detail what actions are being taken or why action can't be taken to improve the reliability performance of each feeder.

ESCoSA conducts five-yearly reviews of our service standards and requirements under the EDC. Importantly, it is these reviews that set our obligations around managing low reliability feeders and our worst served customers for the upcoming regulatory control period.

It is important to note that we are not anticipating our obligations on managing these feeders through the review that was conducted by ESCoSA to cover the 2020-2025 regulatory control period to change. However, the decision has changed the method to identify low reliability feeders. In the decision, low reliability feeders are defined as poor performing relative to regional reliability targets rather than feeder category targets[12]. Therefore, we have based our Low Reliability Feeder analysis, discussed in this report, on the definition for 2020-25 Low Reliability Feeders.

Furthermore, to ensure we are only identifying feeders that have consistently been classified as low reliability over the recent period, we have only considered the feeders under this program that have been defined as low reliability for at least two out of the last five years. We call these here long-term low reliability feeders (LTLRF). It is important to note that the additional criteria that we have applied results in a more conservative view of the feeders we have analysed than the strict application of the ESCoSA definition. That is, we are only assessing those feeders that will have been classified multiple times as a LRF over the last five years. The table below summarises the application of the additional criteria we have applied to identify these LTLRFs.

[11] Asset Plan 2.1.01 Reliability & Resilience Performance Management Strategy

[12] ESCoSA's SA Power Networks reliability standards review, final Decision January 2019 issued 7 January 2019 has confirmed that a LRF will be regionally based. However, it will be based on twice the mean historic performance, not based on service standards, as standards will not be regionally based

To Qualify as a Long Term Low Reliability Feeder	2013/14	2014/15	2015/16	2016/17	2017/18	Part of LFR program
Feeder Doubled Regional SAIDI Target	Y	Y	Y	Y	Y	Yes
Feeder Doubled Regional SAIDI Target	Y	Y		Y		No
Feeder Doubled Regional SAIDI Target	Y		Y		Y	No
Feeder Doubled Regional SAIDI Target	Y	Y		Y	Y	Yes
Feeder Doubled Regional SAIDI Target	Y	Y	Y			Yes

Note: shading indicates two consecutive years of low reliability

Table 1 Criteria for identifying long-term low reliability feeders

Finally, it is important to note that for the analysis conducted here, we have amended the draft regional definitions to ensure that our worst served customers in the Eyre Peninsula are more fairly represented and identified in our analysis. The new draft regional definition proposed by ESCoSA resulted in many poor performing feeders supplying our customers in the Eye Peninsula not meeting the new qualification criteria (an unintended consequence as the Eyre Peninsula regional SAIDI target is significantly higher than the feeder category target). The reliability performance of the Eyre Peninsula has been the subject of an ESCoSA Inquiry, hence the need to also address performance for customers in this area.

The consequence of this amendment to the regional definitions is that we have identified 17 additional long-term low reliability feeders supplying customers in the Eyre Peninsula, which we have included in our analysis.

4. The drivers and need for this program

In this section, we set out the current performance of our long-term low reliability feeders under the draft ESCoSA regime. This section provides:

- A discussion of the recent historical declining performance of low reliability feeders.
- An overview of the service levels of our current set of long-term low reliability feeders, in terms of the SAIDI and SAIFI reliability measures.
- An overview of the economic cost of this low reliability, based on our calculations using the current Value of Customer Reliability (**VCR**).
- A summary of other costs associated with this poor performance.

A more comprehensive summary of the performance of individual feeders classified as long-term low reliability feeders is provided in the LRF Regulatory model.

The recent declining performance of our low reliability feeders

Over the period from 2010 to date, we have observed that a number of feeders supplying our worst served customers have consistently been classified as low reliability feeders using ESCoSA's criteria and the overall performance of these feeders relative to average performance has been worsening. This declining performance is negatively impacting the service levels of our worst served customers, increasing the economic cost of this poor performance, and in turn increasing the need for corrective action.

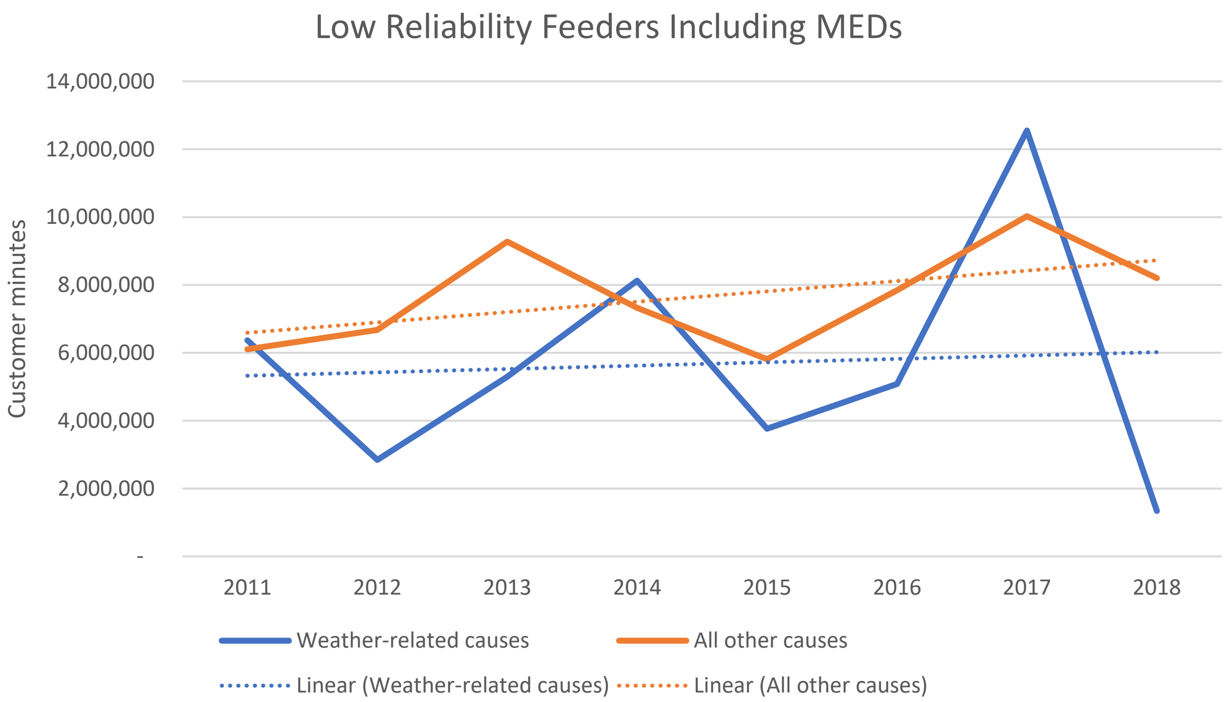
This recent decline in performance is shown in the Figure 1, which charts the total customer minutes not supplied across all the feeders we have classified as long-term low reliability. This figure provides two charts, including and excluding outages on major event days. Each chart shows the annual performance associated with weather-related outage causes and all other outage causes and provides the linear trend in performance for these two cause categories.

The chart excluding major events days show that there is a worsening underlying trend in customer minutes. These figures *do* show that the performance of these feeders was very good – in a relative sense – in 2018. However, from our analysis of our network's performance in this year, this outcome is primarily due to relatively benign weather conditions, resulting in a lower number of major storm events effecting our network. Importantly, without this relatively good year, the worsening trend would be more pronounced than suggested by the trends provided on these figures.

Our analysis suggests that the increase in customer minutes shown in these charts has been driven by the following:

- The storm-related interruptions caused through lightning and or damage from vegetation from outside the prescribed clearance zone and other wind-borne debris[13]. This increase has been due to increases in storm events classified as both major event days and non-major event days. The increases due to these weather-related events are shown separately in the two charts.
- Excluding the good performance of 2018, there has been an increase in the reliability impact of major event days from 2010/11, resulting in a deterioration in overall reliability and customer service.

[13] This would be vegetation that is outside of our prescribed vegetation clearance zone. This vegetation can still contact our lines, particularly during high wind events. We have other processes to manage vegetation, including vegetation inside and outside our prescribed clearance zone. The solutions discussed here should provide sustainable improvements, where enhanced vegetation management would not be effective or efficient.



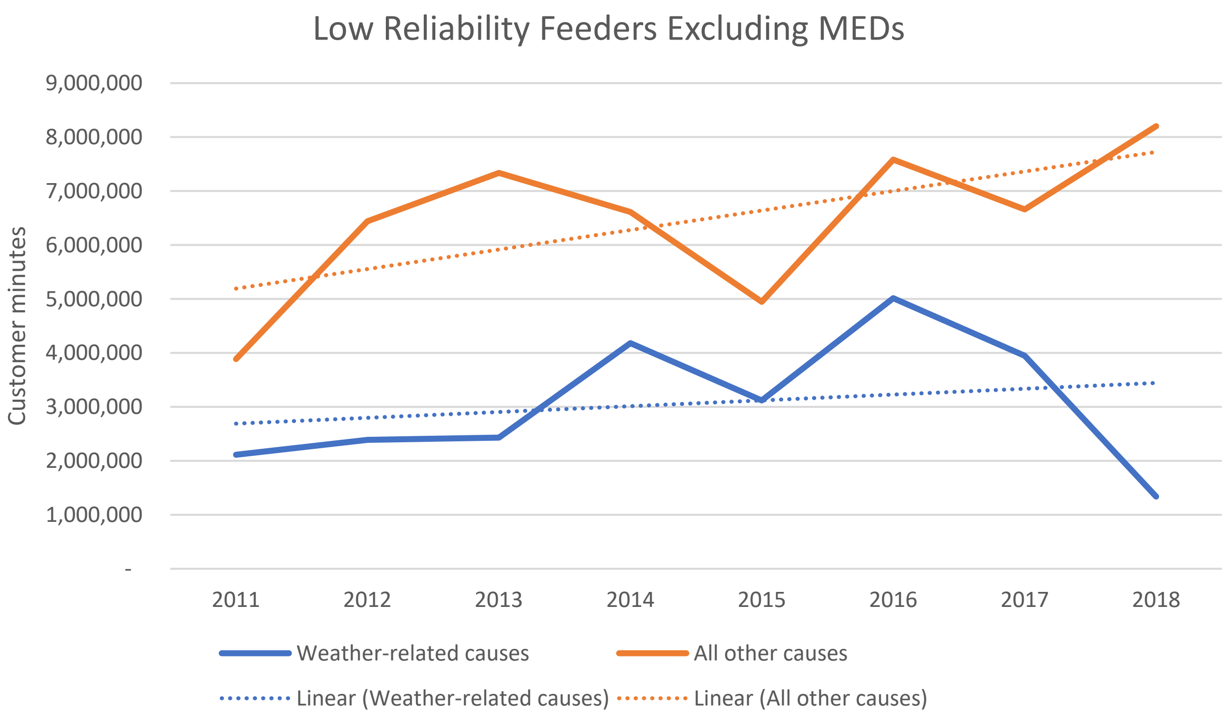


Figure 1 Declining performance of our low reliability feeders and our overall network performance

We believe that it is reasonable to assume that this recent worsening performance is at least reflective of the conditions to be expected moving forward, and there is a good possibility that conditions could worsen marginally over the next regulatory period. This view is supported by a recent report produced by the Bureau of Meteorology (**BOM**), titled "Climate extremes analysis update for South Australian Power Network operations". In this report, the BOM predicts future increases in certain severe weather events (frequency and intensity)[14]. It is also supported in the report commissioned by the Premier of South

[14] Climate extremes analysis update for South Australian Power Network operations published 2017

Australia following the extreme weather event on 28 September 2016, titled "Independent Review of the Extreme Weather Event South Australia 28 September – 5 October 2016" (refer extract below)[15].

> The Commonwealth Scientific and Industrial Research Organisation (CSIRO) and BoM have reported that 2016 was a year of extreme weather events, wetter than average overall, and the fourth warmest on record for Australia and that there is significant evidence that climate change will increase the frequency and intensity of extreme weather events (CSIRO & Bureau of Meterology, 2016).
>
> *As the global climate system has warmed, changes have occurred to both the frequency and severity of extreme weather.*
>
> *Extreme rainfall events are likely to increase in intensity by the end of the century across most of Australia*
>
> *(CSIRO & Bureau of Meterology, 2016).*
>
> All indications are that, increased frequency and severity of severe weather events are part of the 'new normal', and the SA emergency services sector will need to adapt to ensure that prevention, preparedness, response and recovery activities are sustainable in the long-term.

The fifth, biennial State of the Climate 2018 report[16]as published by The Bureau of Meteorology and CSIRO, draws on the latest monitoring, science and projection information to describe variability and changes in Australia's climate. Observations and climate modelling paint a consistent picture of ongoing, long-term climate change interacting with underlying natural variability and climate change will continue in the decades ahead, superimposed on natural variability. Changes in the climate, particularly in weather and climate extremes in the environment are predicted.

Australia's national climate projections indicate that over coming decades Australia will experience:

- Further increase in temperatures, with more extremely hot days and fewer extremely cool days;
- More intense heavy rainfall throughout Australia, particularly for short-duration extreme rainfall events; and
- Fewer tropical cyclones, but a greater proportion of high-intensity storms, with ongoing large variations from year to year.

It is expected that these predictions will have an adverse impact on Network reliability performance.

Importantly, the recent decline in performance, which as noted in the Obligations section only requires us to address low reliability feeders <u>where it is economic to do so</u> (subject to appropriate regulatory funding being provided). Therefore, we will demonstrate this in the following sections, where we consider that this point has been reached for many of our low reliability feeders (i.e. the costs are now outweighed by the benefits to be realised on many feeders). This need is even more pressing given the CSIRO / BOM's view that storm activity could worsen resulting in worsening supply reliability.

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[15] Independent Review of the Extreme Weather Event South Australia 28 September – 5 October 2016 published 2017
[16] State of the Climate 2018 Report published Dec 2018

Current customer service levels associated with our low reliability feeders

We have determined 156 of our feeders to be long-term low reliability feeders, based upon the criteria discussed previously. These feeders supply approximately 39,513 (4%) of our customers. Our customers supplied by these feeders have consistently experienced considerably worse performance than other customers we supply.

As expected, the low reliability feeders are predominately rural and remote feeders. The average SAIDI (including MEDs) over the last eight years for the customers supplied by these feeders is 335 minutes compared to the network average of 234 minutes.

Table 2 (regional) and Table 3 (feeder category) below summarise the average performance of these feeders relative to network average performance.

The key points to note from these two tables are as follows:

- Our Rural Long feeders make up the majority of our low reliability feeders, 122 of the 156. These feeders supply approximately 47% of the customers served by our low reliability feeders.

- Under the ESCoSA's new definitions, a small number of our Urban feeders are also classified as low reliability. Although there are only 17 Urban feeders classified as low reliability, these feeders supply about 46% of the customers served by our low reliability feeders.

- The remainder of the low reliability feeders, 17, are classified as Rural Short. These feeders only supply 7% of the customers supplied by low reliability feeders. However, the performance of these feeders is particularly poor compared to the average for that feeder category, with an average SAIDI (including MEDs) of 464.1 minutes compared to the average of 304.5 minutes. Interestingly, the average performance of these Rural Short feeders is poorer than the average performance of the Long Rural low reliability feeders.

- The majority of the low reliability feeders supply four of the regions classified by ESCoSA, namely the Eyre Peninsula; the Upper North; Riverland and Murraylands; and the Barossa, Mid North and Yorke Peninsula regions. These four regions capture 110 of the 156 low reliability feeders and 38% the customers served by our low reliability feeders.

- The low reliability feeders in the Upper North, Riverland and Murraylands and Eyre Peninsula regions have the poorest performance with an average SAIDI (including MEDs) of 516.1 minutes, 488.4 minutes and 429.4 minutes respectively, compared to their regional averages of 477.2 minutes, 296.9 minutes and 637.3 minutes respectively. (*Note: Eyre Peninsula customers experience the poorest performance with an average SAIDI of over 1,100 minutes p.a. when including Electra-Net interruptions)

- Approximately 39% of the customers served by the low reliability feeders are in the Adelaide Metropolitan Area. This area has 20 of our low reliability feeders, which covers a large portion of the Urban feeders noted above. The remainder of the low reliability feeders in this region are Rural Short feeders. The average SAIDI (including MEDs) of the low reliability feeders in this region is 258.5 minutes, compared to the average of 174.8 minutes for this region.

Region	Network average performance						Low reliability feeders					
	Feeder numbers	Customers supplied	USAIDI (inc MEDs)	USAIDI (ex. MEDs)	USAIFI (inc MEDs)	USAIFI (ex. MEDs)	Feeder numbers	Customers supplied	USAIDI (inc MEDs)	USAIDI (ex. MEDs)	USAIFI (inc MEDs)	USAIFI (ex. MEDs)
Adelaide Metropolitan Area	459	585,899	174.8	109.0	1.429	1.169	20	15,425	258.5	168.5	2.063	1.791
Riverland and Murraylands	207	48,162	296.9	150.0	1.516	1.092	26	3,063	488.4	308.0	1.496	1.197
South East	176	32,280	290.2	240.0	1.911	1.686	14	3,334	344.4	313.3	1.884	1.788
Barossa, Mid-North, Yorke Peninsula	291	57,902	333.0	197.0	1.803	1.399	22	2,912	374.2	240.9	1.139	0.933
Eyre Peninsula	141	16,012	637.3	446.0	2.065	1.695	37	6,043	429.4	347.9	1.084	0.987
Upper North	131	25,073	477.2	273.0	1.638	1.286	25	3,028	516.1	301.1	0.727	0.582
Eastern Hills	86	37,283	657.1	309.0	2.812	2.210	0	0	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!
Fleurieu Peninsula	75	45,514	269.7	198.0	1.912	1.484	9	2,530	347.7	261.9	1.514	1.288
Rural Metropolitan Centres	41	41,095	129.5	88.0	0.951	0.756	3	3,178	155.4	153.1	1.275	1.267
Total	**1,681**	**894,396**	**233.7**	**146.4**	**1.536**	**1.305**	**156**	**39,513**	**335.4**	**239.2**	**1.585**	**1.391**

Table 2 Regional performance – Low reliability feeders (annual average July 2010- June 2018) vs average network performance

Category	Network average performance						Low reliability feeders					
	Feeder numbers	Customers supplied	USAIDI (inc MEDs)	USAIDI (ex. MEDs)	USAIFI (inc MEDs)	USAIFI (ex. MEDs)	Feeder numbers	Customers supplied	USAIDI (inc MEDs)	USAIDI (ex. MEDs)	USAIFI (inc MEDs)	USAIFI (ex. MEDs)
Urban	491	620,832	169.5	1.4	107.058	1.169	17	18,170	239.8	164.6	1.936	1.706
Rural Short	250	125,932	304.5	1.8	191.017	1.579	17	2,795	464.1	329.4	1.785	1.598
Rural Long	793	142,456	452.6	2.1	279.495	1.692	122	18,548	409.6	298.7	1.211	1.052
Total	**1,573**	**894,396**	**233.7**	**1.5**	**146.400**	**1.305**	**156**	**39,513**	**335.4**	**239.2**	**1.585**	**1.391**

Table 3 Feeder-category performance – Low reliability feeders (annual average July 2010- June 2018) vs average network performance

The service level for customers supplied by individual feeders can be worse (or better) than the averages shown in the tables above. The chart below shows the distribution of customer service levels relative to the regional average performance, as measured by the feeder's average annual SAIDI (excluding MEDs) for the worst 3 years of that feeder since 2010[17].

Figure 2 shows that the customers supplied by the low reliability feeder have had performance over these 3 worst years that is approximately 2.1 times poorer than the regional average performance received by all customers in that region. Approximately 26% of these 39,513 customers had at least double the minute off supply compared to the average performance of customers in the region, 13% of these customers had at least 3-times the minutes off supply, and 6% had at least 4-times the minutes off supply on average in these 3 worst years[18].

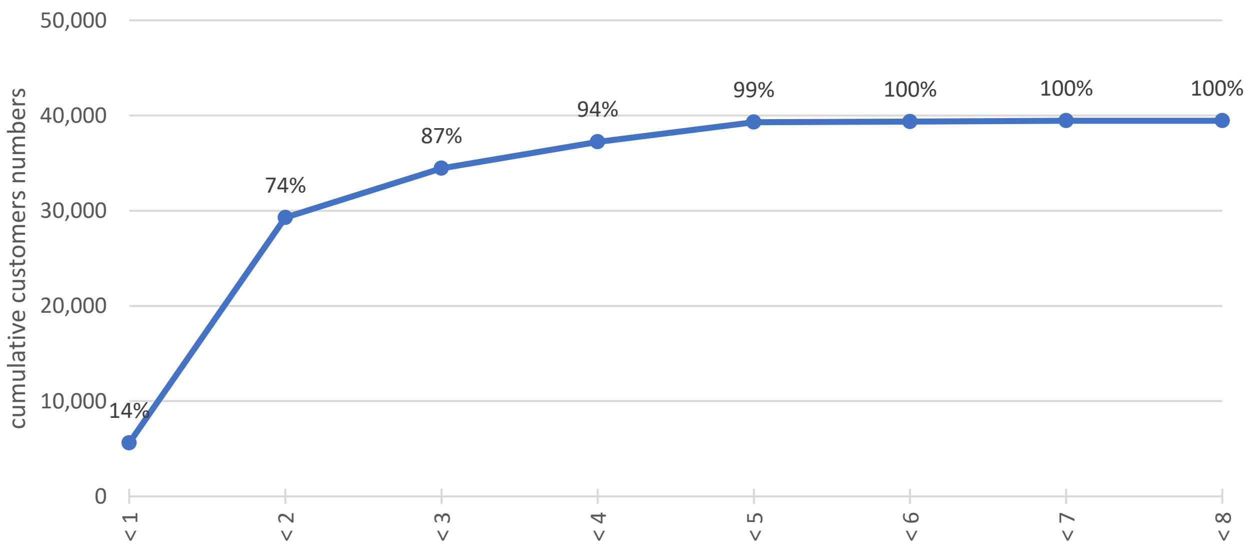


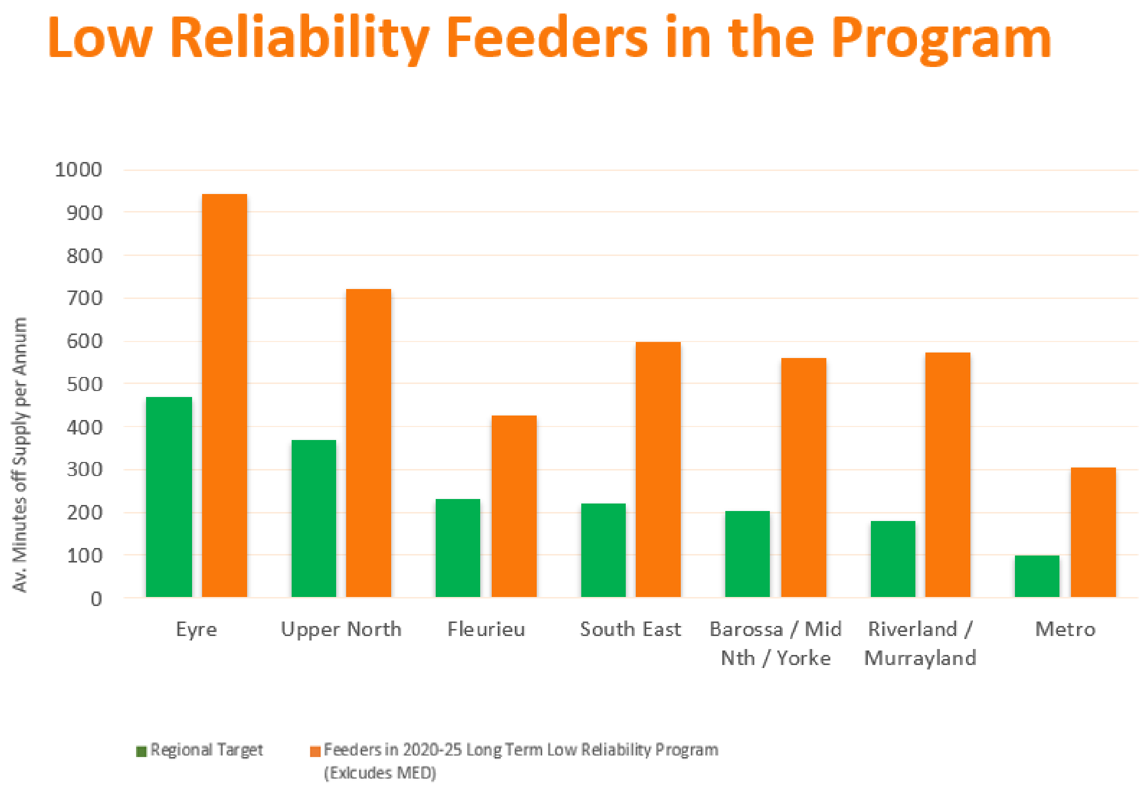
Figure 2 Distribution of customer service levels across low reliability feeders

Our LT Low Reliability Feeder program focuses on those feeders identified as being consistently classified as low reliability by this scheme (i.e. referred to as long term LRF (i.e. (LTLRF)). A feeder is classified as LTLRF where the feeder has been classified as LRF at least three times in the last five years.

Customers supplied by feeders in the proposed programme experience significantly (between 2 to 3 times) worse performance than regional targets per below.

[17] We use this measure as it is simple to calculate and is similar to how we identify long-term low reliability feeders.

[18] Note, this analysis will likely understate the performance of the customers supplied by the low reliability feeders as it does not capture poor performance due to outages upstream of the feeder. For example, it is the effects of these upstream outages causing 10% of the customers to have performance that appears in this chart to be better than the regional average.



The economic cost of this performance

The above section has shown that our customers that are served by feeders classified as low reliability, are experiencing significantly poorer service levels than our average customers. However, as noted in "Our obligations" section above, we only need to undertake significant corrective action where it is economic to do so.

Therefore, to estimate the economic cost of this poor performance we valued the interruptions to customer supplies on each low reliability feeder using the Value of Customer Reliability (VCR) for our network as provided by AEMO (escalated by CPI to March 2018). For this valuation, we have used the average annual customer minutes off supply for each feeder over the last-8-year period[19].

We estimate that the total economic cost due to this poor service is $10.3 million per annum in total or $1.2 million relative to the performance we provide to the average customers of the relevant feeder type. The breakdown of this economic cost across the various regions and feeder categories is shown further in Table 4 and Table 5 below.

[19] This customer minute annual average is multiplied by the average kwhr/minute relevant to that feeder type to produce an estimate of the kwhr not supplied, which can then be multiplied by the VCR to produce a total economic cost.

Region	Average annual economic cost ($ millions per annum)	
	Total interruptions	Relative to average performance
Adelaide Metropolitan Area	3.50	1.13
Riverland and Murraylands	1.08	0.42
South East	0.82	0.13
Barossa, Mid-North, Yorke Peninsula	0.79	0.09
Eyre Peninsula	1.89	-0.91
Upper North	1.12	0.08
Eastern Hills	0.00	0.00
Fleurieu Peninsula	0.67	0.16
Rural Metropolitan Centres	0.43	0.07
Total	**10.30**	**1.18**

Table 4 Average annual economic costs by low reliability feeder types – regions

Low reliability feeder type	Average annual economic cost ($ millions per annum)	
	Total interruptions	Relative to average performance
Urban	3.84	1.17
Rural Short	1.03	0.19
Rural Long	5.44	-0.17
Total	**10.30**	**1.18**

Table 5 Average annual economic costs by low reliability feeder types - feeder categories

Similar to the range of the reliability performance of the low reliability feeders noted above, the economic cost due to the performance of individual feeders can be worse (or better) than the averages. The economic cost associated with each feeder range between $171 and $438,855, with a mean economic cost of $58,488. It is worth noting that the very low minimum economic cost relates to two SWER feeders supplying very few customers. Although, the economic cost is low for these two feeders, the customers still have very poor performance compared to typical customers. Other than these two feeders, all other low reliability feeders have average economic costs greater than $1,000 per annum.

Figure 3 below shows the distribution of the economic cost for each low reliability feeder. This figure indicates that 88 (approximately 56%) of the feeders have an average economic cost between $1,000 per annum and $30,000 per annum. Although, it is worth noting that these feeders only account for 15% of the customers supplied from the low reliability feeders. Approximately 64% of the customers supplied from low reliability feeder are supplied from feeders that have an average economic cost of greater than $100,000 per annum.

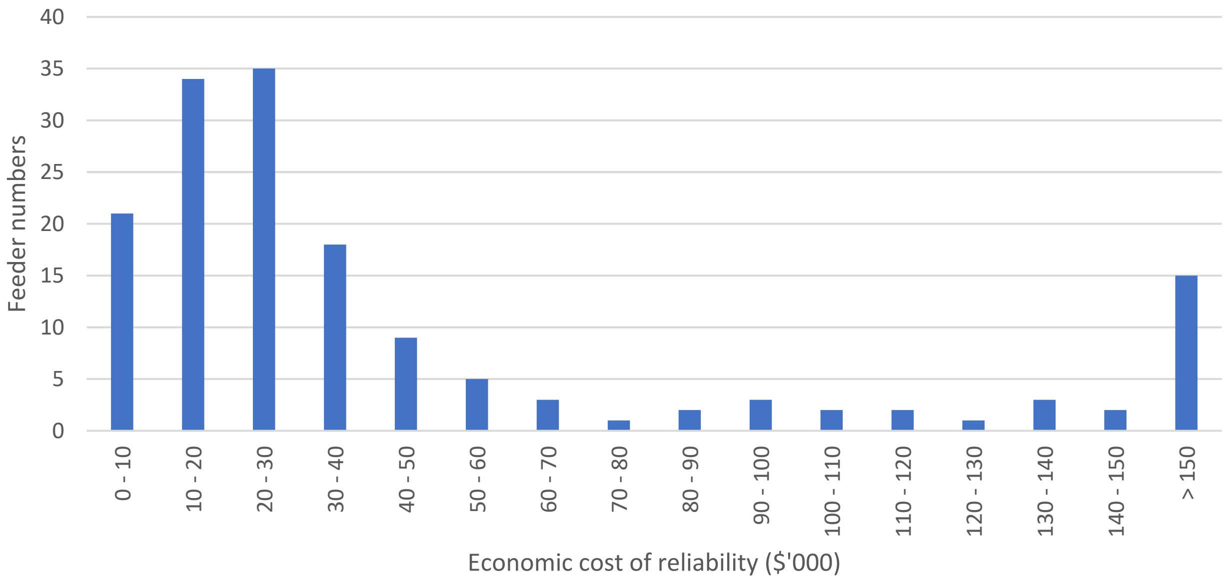


Figure 3 Distribution of economic cost of performance of low reliability customer service levels

Other costs associated with this performance

The above section has discussed the economic cost due to unplanned interruptions to our customer supplies. However, there are other costs that we incur because of these interruptions. These costs are not as significant as the economic cost of the interruptions discussed above but would still be reduced should we improve the supply performance of these low reliability feeders. As such, these costs can have a small but still material effect on the cost-benefit analysis of the program, and they are relevant to how this program should be treated in our regulatory proposal.

For example, as the 2020-2025 GSL scheme is being capped at $300 for a total annual duration payment (compared to the current maximum of $605 for each individual outage > 48 hrs), customers on Low Reliability Feeders will be disadvantaged more than other customers by this change as historically 37%[20] of duration payments are made to LRF Customers.

As LTLRF customer service and performance is significantly worse than regional targets and continues to deteriorate (refer previous graph) and these customers will also receive a reduced service level payment, the proposed Low Reliability Feeder program will partly offset future GSL disbenefits these customers will receive.

[20] SA Power Networks reliability standards review – Final Decision – Jan 2019

5. Program options considered

Options considered and our methodology to identify the optimal solution

We have considered various options that should provide a long-term sustainable solution and arrest the decline in the performance of the low reliability feeders[21]. These options reflect the methods we have generally been applying. Furthermore, we have used an independent statistician to validate the scale of the improvement we can typically expect from these types of options (i.e. option effectiveness), and so we can have confidence in the scale of the improvements that should be realized through these approaches.

The options are tailored to address specific causes of network outages. The key options being considered are summarised in the Table 6 below.

Low Reliability Feeder – Augmentation Option	Primary outage causes addressed and effect
Augmentation of insulators with high lightning withstand capability	Reduces outages caused by lightning, and so reduces the likelihood of future outages and resulting customer interruptions.
Undergrounding of critical line sections	Reduces outages caused by vegetation contact and other wind-blown debris[22], reducing the likelihood of future outages and resulting customer interruptions.
Installation of reclosers and sectionalisers	Does not reduce the number of network outages but reduces the number of customers that will have a sustained interruption following a network fault.

Table 6 Mitigation options - solutions vs outage causes and effects

To develop an optimal set of options for each feeder, we have undertaken a detailed review of all the outage locations and causes (over the last 8 years) for each low reliability feeder. Knowledge gained from this review has been used to define the set of solutions for each feeder or feeder section that would be most appropriate to address the range of causes of the outages on that feeder.

For each solution identified through this process, we develop:

- the analyses and scope of work to implement that solution, based on where these outages have occurred on the feeder;
- the cost of that solution, using our estimate of the number of work units required and our historical unit costs relevant to the option types; and
- the expected improvement in supply reliability achieved by the solution (i.e. solution effectiveness), based on independent statistical analysis that we have previously commissioned, which has estimated the expected improvement rates of the various options from the improvements achieved by our recent historical reliability programs.

In this way, for each low reliability feeder, where we consider some form of improvement will be feasible, we have developed a set of mutually exclusive solutions that we can separately analyse (via the cost-benefit analysis discussed in the next section).

[21] All options that will provide a sustainable improvement will be capitalized and would be allocated to the AER's augmentation expenditure category.

[22] This option is aimed at reducing outages due to vegetation contact from outside our prescribed clearance zones, which can occur during high winds. Our business-as-usual vegetation management practices addresses outage risks from vegetation within the clearance zones; although it is worth noting that such undergrounding will remove the need for these vegetation activities on any undergrounded section.

Comment on do-nothing option

It is important to note that our cost-benefit analysis approach inherently considered the "do nothing" option because the benefits of any solution are measured relative to doing nothing. Therefore, although we have not explicitly listed a "do nothing" option above, this does not mean we have not considered the effects of doing nothing in our evaluation. We do not consider the "do nothing" option to be a suitable option as discussed in the section 'Our obligations' and we believe the 'do nothing' option would not be considered acceptable by our customers.

Based on this analysis, we have developed solutions to address the specific causes of outages on each low reliability feeder.

Option	No. of feeders	Total solution units	Total Cost ($ millions)
Re-insulations of poor performing line sections	82	7,328 poles	$12.94
Underground of critical line sections	1	5 spans	$0.25
Installation of reclosers and sectionalisers	15 (sectionalisers) 21 (reclosers)	27 sectionalisers and 23 reclosers	$4.30 ($0.81 sectionalisers and $3.49 reclosers)

Table 7 Mitigation options - Low reliability feeders analyses results

In appreciating the significance of the information in this table, it is important to note that this is provided as a guide only of the extent of the solutions we have analysed through our cost-benefit model. Solutions have only been developed in detail for the low reliability feeders where we consider some investment would be credible and feasible. These solutions do not cover all low reliability feeders.

For 45 feeders, based on our analysis of historical outages on those feeders, we could not find any solutions that we considered would be credible and feasible or we have already provided some corrective action to these feeders through planned works in the current regulatory period. Furthermore, as we will show in the later sections, not all these solutions will form part of our low reliability program as some of these solutions will not be economic to implement. These uneconomic solutions have been rejected and do not form part of our low reliability feeder program.

Therefore, this table indicates the scale of the cost that would be necessary to address the problems identified on the low reliability feeders, where we consider some investment could be credible and feasible – even if not economic.

More detailed information on the individual solutions we have identified and analysed for each low reliability feeder are contained in the LRF Regulatory model.

6. Cost benefit analysis of the program

In Section 'The drivers and need for this program', we have discussed the performance of our low reliability feeders, including the economic cost of this poor performance to customers. In Section 'Program options considered', we discussed the solutions we have identified to address this poor performance.

In this section, we discuss the benefits we would expect to achieve by implementing these solutions. Importantly, we present the results of our cost-benefit analysis of these solutions. We have applied this cost-benefit analysis to determine whether the benefits exceed the costs for each solution (using discounted cash flow techniques). The results of this analysis tell us whether there is an economic case to implement any of the solutions, and how strong the evidence is.

As we will show below, our analysis suggests that a significant portion of the solutions, discussed in the section above, should provide a positive net benefit if implemented.

More comprehensive results of our analysis are contained in the LRF Regulatory model.

The customer service level benefits of the possible program

Table 8 and Table 9 below summarises the expected benefits in the service levels achievable through implementing all the solutions discussed in the section above, measured across all the low reliability feeders. These tables indicate the improvement in the SAIDI; additional tables and information showing the expected improvement in SAIFI and other reliability measures are provided in the LRF Regulatory model.

These tables indicate that there is the potential to improve the service levels to our worst serviced customer by, on average, 72 SAIDI minutes including MEDs – a 21% improvement from their current service levels.

	SAIDI (average per annum)					
	Including MEDs			Excluding MEDs		
Region	current (minutes)	improved (minutes)	improved (%)	current (minutes)	improved (minutes)	improved (%)
Adelaide Metropolitan Area	258	232	10%	169	152	10%
Riverland and Murraylands	488	368	25%	308	229	26%
South East	344	261	24%	313	239	24%
Barossa, Mid-North, Yorke Peninsula	374	234	37%	241	147	39%
Eyre Peninsula	429	324	25%	348	272	22%
Upper North	516	339	34%	301	196	35%
Eastern Hills	#DIV/0!	#DIV/0!	n/a	#DIV/0!	#DIV/0!	n/a
Fleurieu Peninsula	348	264	24%	262	199	24%
Rural Metropolitan Centres	155	155	0%	153	153	0%
Total	335	264	21%	239	190	21%

Table 8 Average annual USAIDI by region

Region	SAIDI (average per annum)					
	Including MEDs			Excluding MEDs		
	current (minutes)	improved (minutes)	improved (%)	current (minutes)	improved (minutes)	improved (%)
Urban	240	218	9%	165	151	8%
Rural Short	464	409	12%	329	282	14%
Rural Long	410	286	30%	299	214	28%
Total	335	264	21%	239	190	21%

Table 9 Average annual USAIDI by feeder categories

The service level improvement expected to be achieved by the various solutions differs across the low reliability feeders. Figure 4 below shows the distribution of the scale of improvements by identified solutions across the low reliability feeders (as measured by SAIDI including MEDs). This figure shows that the mean improvement in this service level measure across the set of solutions is 221.0 minutes, ranging between 0.3 minutes and 873.4 minute. This distribution is however tail-ended, and the median improvement of the solutions is 176.4 minutes.

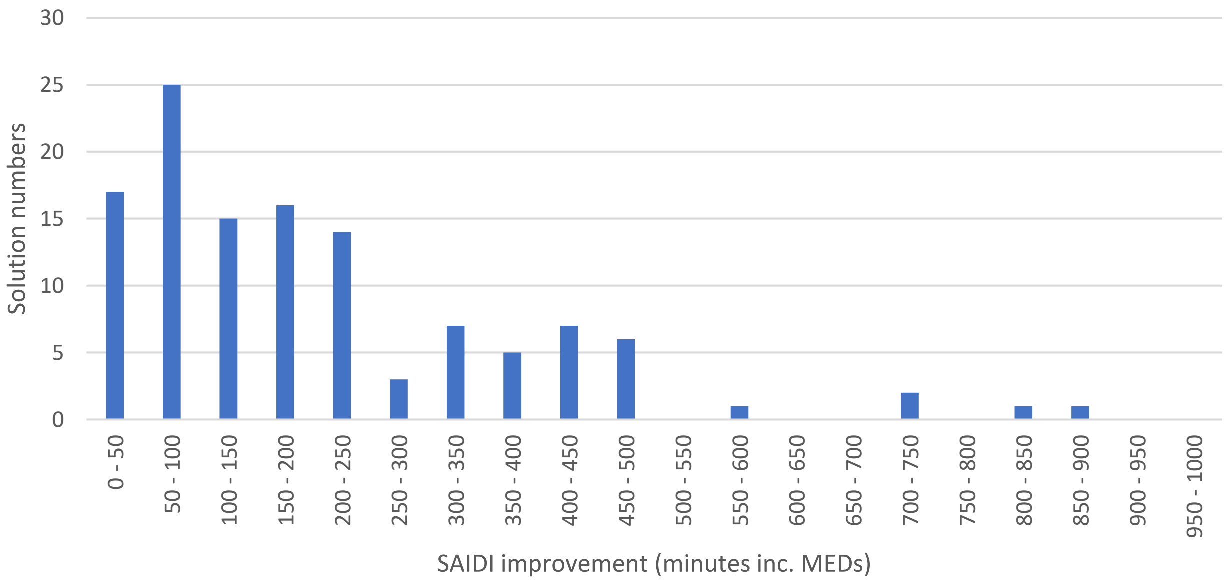


Figure 4 Distribution of USAIDI improvement across low reliability feeders

The range of improvements is shown in Figure 5 below, which show a scatter plot of individual solutions with the cost of the solution plotted against its expected customer minute improvement. Based on this data, we calculate that the median cost per customer minute improved across all solutions is a very modest $6.8 per customer minute improved, and ranges between $0.7 per customer minute and $372.0 per customer minute with a similar tail-ended distribution.

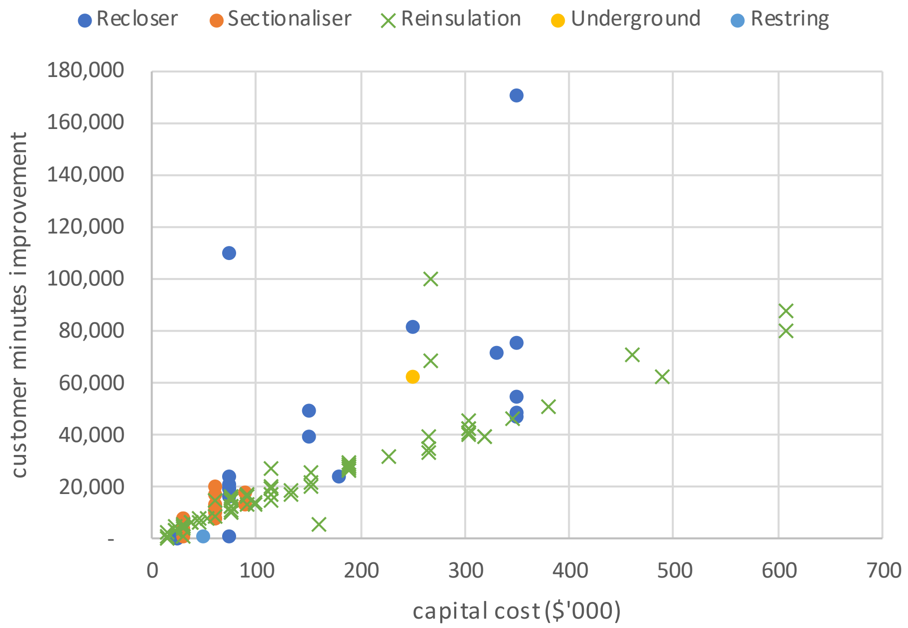


Figure 5 Solution costs vs customer minute improved

Economic benefits and net benefit of the program

In the sub-section above, we have discussed all possible improvements available by implementing all the identified solutions. Importantly, these improvements are not limited to only the solutions that could be economic. In this section, we examine this issue further.

To undertake this analysis, we have estimated the economic cost of the resulting feeder performance, assuming a solution is implemented, using the same VCR methodology used to define the economic cost of the current performance. The reliability economic benefit of implementing the solution is defined as the difference between these two measures (ie the reduction in the economic cost or avoided economic cost). We have also added our estimate of avoided outage response and repair costs to the reliability economic benefit to define a total economic benefit for each solution.

Using this method, we estimate that the total economic benefit due to implementing all solutions would be $2.2 million per annum.

This economic benefit is shown further in Table 10 below, which shows the economic benefit broken down by region and feeder category. This table indicates that most of the economic benefit is due to improvement to Rural Long feeders, particularly those in the Riverland, Murraylands, South East, Barossa, Mid-North, Yorke Peninsula, Eyre Peninsula and Upper North regions. There is also a significant economic benefit associated with improvements to a number of the Urban feeders in the Adelaide Metropolitan Area.

Region	average economic benefit (per annum) - $'000			
	Feeder categories			Total
	Urban	Rural Short	Rural Long	
Adelaide Metropolitan Area	348.1	5.7		353.7
Riverland and Murraylands		17.5	264.9	282.4
South East			207.1	207.1
Barossa, Mid-North, Yorke Peninsula		8.7	302.6	311.4
Eyre Peninsula		6.6	486.3	492.9
Upper North		2.9	399.5	402.4
Eastern Hills				0.0
Fleurieu Peninsula		85.5	77.9	163.3
Rural Metropolitan Centres	1.3			1.3
Total	**349.4**	**126.9**	**1,738.3**	**2,214.6**

Table 10 Average annual economic benefits by region and feeder category

Similar to the above, the economic benefit provided by individual solutions can differ considerably. Figure 6 below shows the distribution of the economic benefit across all the solutions. This chart indicates that the median economic benefit of a solution is $12,093, ranging between $244 and $149,988.

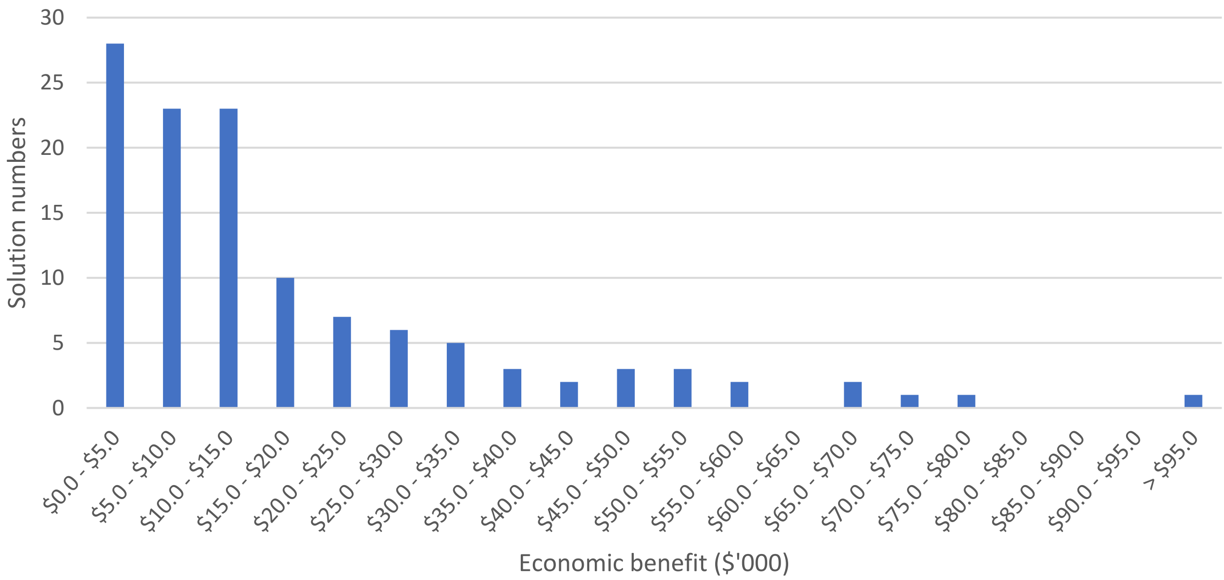


Figure 6 Distribution of economic benefit by solution

The net benefit for each solution has been calculated as the economic benefits associated with that solution less the solution costs, using discounted cash flow techniques. For this analysis, we have used the equivalent annual cost[23] of the solutions to allow comparisons between the annual benefits and the solution capital cost.

[23] The equivalent annual cost is a method of defining an annual cost stream that is equivalent to a capitalized cost in present value terms. This approach uses the capital cost of an asset, its life and a discount rate to calculate the equivalent annual cost.

The range of net benefits is shown in Figure 7 below. This chart shows the number of solutions in different net benefit bands, ranging from positive net benefits (ie benefits exceed costs – the green area) to negative net benefits (ie costs exceed benefits – the red area). These results indicate that there are 102 solutions, costing $15.5 million, that should have a positive net benefit. These solutions cover 95 of our 156 low reliability feeders. The remaining 16 solutions identified, costing $2.0 million, have a negative net benefit.

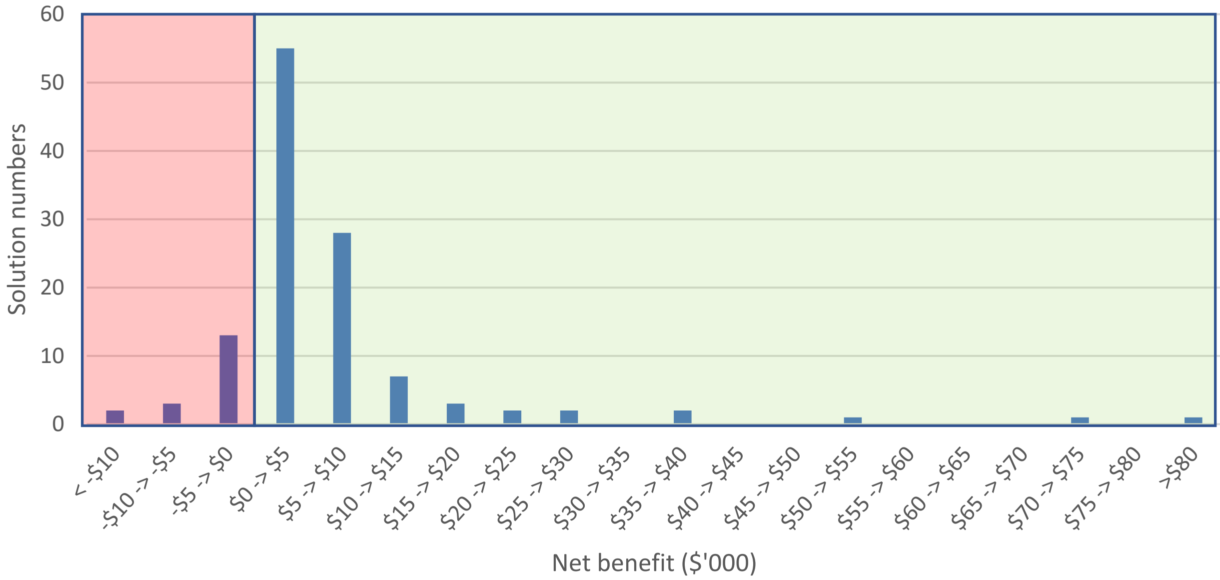


Figure 7 Number of solutions by economic net benefit

The range of net benefits is shown further in Figure 8 below, which indicates the benefit-cost ratio for each solution by plotting the equivalent annualised cost of each solution against its annual economic benefits provided by the solution. This charts also indicates the threshold when benefits should exceed costs (the dashed line). This chart shows that most of the identified solutions are above that threshold (ie benefits exceed costs). Most recloser solutions sit well above this threshold, indicating the typically good benefit-cost ratio achieved by this solution, when it is feasible. Re-insulation solutions typically sit closer to the threshold, but still on average have benefits that exceed costs by approximately 35%[24].

[24] Note, reinsulation solutions are preferred over a recloser solution (or other solution type) where outage causes can be related to existing asset insulation deficiencies and other solutions are likely to have less an impact in alleviating future outages of this type or the effects on customer supplies from these outages. The preferred solution is determined from our detailed investigation of historical outages on each low reliability as discussed previously.

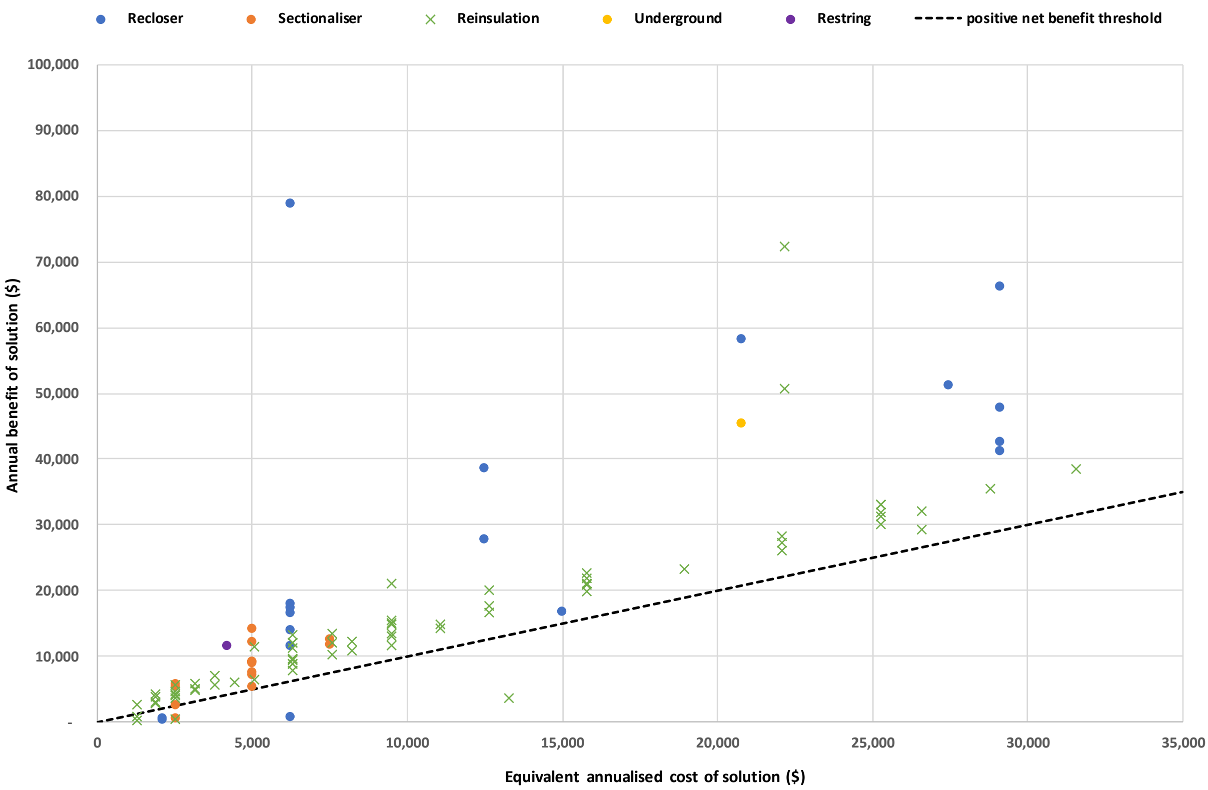


Figure 8 Annualised solution costs vs annual economic benefit

7. Customer support for the program

This section discusses the customer and stakeholder engagement we have conducted on matters associated with the low reliability program. Importantly, we consider that the findings from this engagement strongly support us implementing a Low Reliability Feeder program where it is economic to do so.

To ensure that expenditures are prudent, efficient, and in the long-term interests of customers, service levels should reflect customer preferences and priorities. Customer engagement provides an opportunity for customers to be made aware of service and cost implications that relate to providing a certain level of reliability performance and provide feedback accordingly.

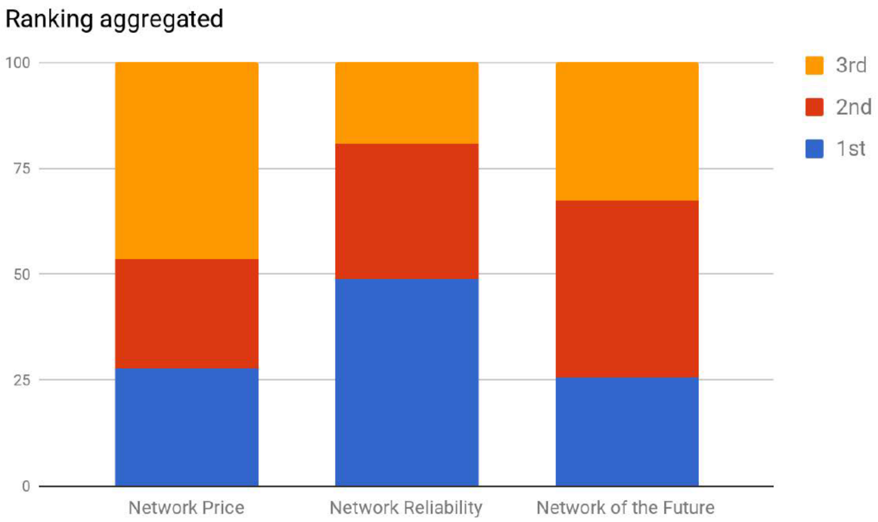
The National Electricity Rules (NER) requires SA Power Networks to engage with its customers directly and demonstrate how customer concerns have been taken into account in developing its revenue proposal for the AER. SA Power Networks has subsequently undertaken a comprehensive stakeholder engagement program to obtain a greater understanding of the concerns, issues, wants and needs of our customers now and in the future. This engagement program involved extensive customer research, conducting focus groups, engagement with targeted groups such as vulnerable and culturally diverse customers, online engagement and workshops in a number of locations across the State. Early in the engagement program, the reliability and resilience of the network emerged through research as an important priority for customers and become one of the central themes of the engagement program. It was subsequently discussed through all engagement activities.

The Original Proposal engagement program was developed in consultation with the Essential Services Commission of South Australia (ESCoSA), which had representatives attend several workshops, and engagement outcomes were shared with ESCoSA to inform its Reliability Standards Review for 2020-2025.

In a series of 'Directions' workshops held around the State in the early stages of engagement in 2017, customers were provided with detailed information on key topics and were asked to prioritise what was most important to them. The results, summarised below, are included in Supporting Document 0.7 MDC Planning and Directions Workshops Report.

- *Network reliability and resilience is a very high priority for customers, particularly regional and rural customers, especially those in the Adelaide Hills and on the Eyre Peninsula*
- *Reliability standards should not be lowered*
- *It is important to ensure acceptable levels of reliability for all customers, and regional customers would benefit from having reliability standards more aligned to metropolitan customers*
- *Different sectors have different expectations and needs in terms of reliability of supply and customers are looking for a system that can accommodate this.*

The table below shows the priorities of the 134 customers that attended the workshops across South Australia. After aggregating the data (where all participants had an equal weighting), the results show that 'Network reliability and resilience' was ranked first preference by half of the participating customers.

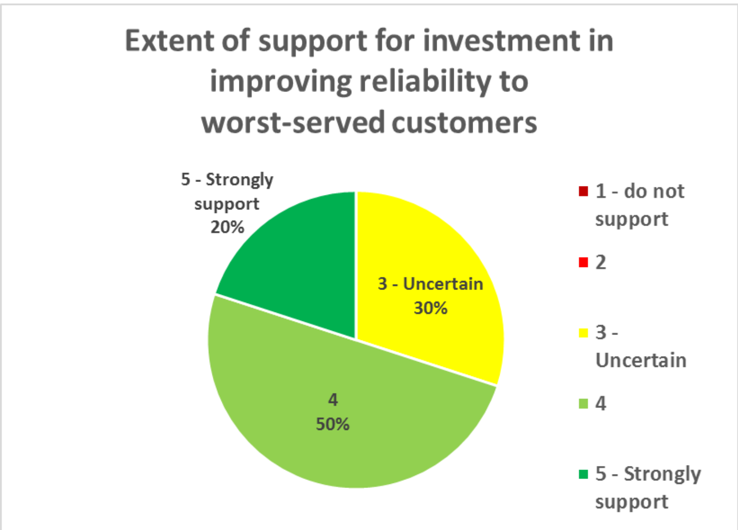


The order of priority was:
1. Network reliability and resilience
2. Network price
3. Network of the future

The key reasons participants gave for ranking 'Network reliability and resilience' at number one can be summarised as:

- *Reliability underpins price and future network*
- *Electricity is an essential service*
- *For business it is central to risk management and confidence and protecting assets, maintenance and upgrades to secure supply, needs to be a priority, especially in regions.*

This early feedback, which showed a strong customer preference toward reliability, informed our preliminary expenditure forecasts which were discussed with customers and stakeholders during our series of Deep Dive workshops held in early-mid 2018. At these workshops, 70% of participants supported or strongly supported the proposed LRF Program (full details can be found in Supporting Document 0.13 Ann Shaw Rungie Capex Deep Dive Workshops Report).



Following the Deep Dive workshops, the forecasts were refined and included in our Draft Plan, which was released for consultation in August 2018. While two organisations representing vulnerable customers didn't support the three proposed reliability programs in our 2020-2025 Draft Plan consultation (including the LRF Program), these programs were supported by:

- Business SA
- SA Wine Industry Association
- Nine regional councils.

Engagement on our Revised Proposal has centred around discussions with the SAPN CCP and members of other SAPN reference groups, largely focussing on proposed capital expenditure programs, including the LRF Program. In these discussions the notion of equity was raised, in the context that there are some customers who experience very poor reliability – significantly worse than the average customer experiences.

Following those conversations there was general agreement amongst the SAPN CCP and other stakeholders that it was unacceptable for some customers to experience such a vastly different level of service, and that SAPN should be working to improve reliability for those customers to have experienced significantly lower levels of electricity supply reliability for sustained periods. There was unanimous support for including the Low Reliability Feeder Program in our Revised Proposal.

Oakley Greenwood Report - Economic Efficiency of Improving Reliability on Low Reliability Feeders
We consider that the findings of the Oakley Greenwood survey commissioned by ESCoSA and referred to in the AER Draft Decision, are not an indication of the customer willingness to pay for the proposed 2020-2025 Low Reliability Feeders program as:

- **The survey was not conducted on our specific 2020-25 LRF program** but on different scenarios from information provided to ESCOSA in 2017 of simply improving overall SAIDI and SAIFI by 1%, 5% and 10% on LRF's, **without a detailed viability assessment**.

- The survey presented costs to customers that was based on **a more expensive 2017 plan that delivers a lesser benefit.**

- **The cost scenario presented to customers surveyed was customers whom would benefit directly from the program and would carry the full cost of the program** which is **not in accordance with the state-wide pricing regulation** of government provision for state-wide pricing meaning the costs of distribution services are shared amongst all customers as per Section 35B of the Electricity Act[25].

As stated in section 3.1.2 of the Essential Services Commission of South Australia, SA Power Networks reliability standards review (page 13): *The Commission acknowledges Business SA's observation that customers on low reliability feeders may have responded differently (for example, been willing to pay more) if they were presented with costs as the bill increase that would arise given state-wide pricing, rather than being presented with the full cost of improvements spread only across low reliability feeder customers.*

The ESCoSA Oakley Greenwood report did find that anywhere from about a third to over 60% of customers were willing to provide some level of subsidy to help fund an improvement in reliability areas that have a materially lower level than their own (Oakley Greenwood report, pg. 36) with the average amount that the residential customers would be willing to pay annually for those improvements (this is the average across all residential customers in each group) was:

- $3.21 among the metropolitan residential customers surveyed and
- $3.84 among the non-metropolitan residential customers surveyed.

[25] State-wide pricing applies for customers with annual consumption less than 160 MWh. Section 35B of the Electricity Act provides for the Treasurer to make an Electricity Pricing Order. State-wide pricing provisions were established in the Electricity Pricing Order implemented on 11 October 1999, as summarised in the South Australian Government Gazette, p. 1471

The LRF program SAPN is proposing would increase the reliability of customers on a smaller number of these feeders and would require the annual bill of an average residential customer to increase of about 40 cents.

In light of this information, SA Power Networks commissioned Oakley Greenwood to review and compare the findings of the ESCOSA survey with the proposed SAPN LRF program to determine whether the SAPN LRF Program was economically efficient. The results of this analysis are contained in Supporting document 5.18 - Oakley Greenwood - The Economic Efficiency of Improving Reliability on Low Reliability Feeders, and are summarised below:

Table 11: Key features of the LRF reliability projects in SA Power Networks' revised regulatory proposal compared to those in the ESCoSA study

Features	LRF reliability improvement projects in	
	Revised regulatory proposal	ESCoSA study
Number of affected customers		
Residential	10,590	23,865
Business	5,132	3,219
Total	15,772[26]	27.084
Capital cost	$15.6 million	$30.6
Improvement in reliability		
- Reduction in minutes off supply	116	25
- Percentage improvement	38%	10%

"As can be seen the LRF reliability program in SA Power Networks' revised regulatory proposal, as compared to that tested in the ESCoSA survey:

- *Provides a significantly larger improvement in reliability for LRF customers: 116 less minutes off supply, over 4 times the reduction provided in the reliability package assessed in the ESCoSA survey and representing a 38% improvement for affected customers as compared to a 10% improvement in the projects tested in the ESCoSA survey;*
- *Delivers benefits to fewer customers – about 58% of the number that would have been affected by the projects discussed in the ESCoSA survey;*
- *But would be significantly more cost effective given that although the costs and overall number of customers affected have both reduced, the reduction in minutes off supply would increase by a factor of a bit more than four.[27]"*

Further:

"Table 12 below reiterates the figures calculated in the ESCoSA survey for the average LRF customer's willingness to pay for improved reliability in their own areas and the average willingness of customers in other areas to subsidise those improvements. In each case, the figure is the weighted average across all customers within that category – including the customers that were not willing to pay anything.

Table 12: Average willingness to pay for and willingness to subsidise reliability improvements in LRF areas

LRF	Average per-customer WTP[28]
Residential	$11.15

[26] There is a difference between the customer numbers in the Oakley Greenwood report and referred to in our Low Reliability Feeder Program. Oakley Greenwood report refers to customers detailed in Customer Management System for 2018/19.

[27] 5.18 - Oakley Greenwood - The Economic Efficiency of Improving Reliability on Low Reliability Feeders, p.06

[28] Includes those respondents who were not willing to pay anything at all.

Business	$30.96
Metropolitan & non-metropolitan	Average per- customer WTS[29]
Metro – residential	$3.21
Metro – business	$5.43
Non-metro – residential	$3.84
Non-metro – business	$6.33
Annualised cost per customer of the revised LRF reliability improvement projects[30]	
Residential	$0.40
Business	$2.95

As can be seen, the average willingness of all customer segments outside the LRF areas to subside reliability improvements for customers on low reliability feeders exceeds the annualised cost per customer of the revised LRF reliability improvement projects. In fact, even the lowest of the willingness to subsidise figures – that of residential metropolitan customers, who represent the largest of the customer segments – is about eight times the amount required to fund the projects on a per residential customer basis.
On this basis, it is our view that the revised LRF reliability program is economically efficient."[31]

In its report, Oakley Greenwood also reference the favourable feedback received from stakeholders about the Low Reliability Feeder Program:

"This reinforces the quantitative outputs of the study; namely, that customers are prepared to subsidise these improvements. Further, it suggests that a case can be made that customers would prefer that reliability improvements be prioritised for customers on LRFs where doing so would reduce the difference between the average and poorest levels of reliability across the customer base, and assist in increasing the reliability on LRFs to a community-acceptable level."

Given:

- the feedback from customers that the theme 'Network reliability and resilience', and specifically, 'an acceptable level of reliability for all,' was the highest priority during early customer engagement on our Original Proposal;
- the consistent support from stakeholders for the LRF program, during both 2018 Deep Dive sessions and the 2018 Draft Plan;
- the demonstrated customer willingness to pay and economic efficiency of the proposed program; and
- the unanimous support of the SAPN CCP and other stakeholders;

we re-submit the Low Reliability Feeder program in our 2020-25 Revised Proposal.

[29] Includes those respondents who were not willing to pay anything at all.
[30] Calculated by SA Power Networks.
[31] 5.18 - Oakley Greenwood - The Economic Efficiency of Improving Reliability on Low Reliability Feeders, p.07

8. The preferred program and program scope

Rationale for selecting the preferred low reliability program

In appreciating our rationale for selecting our preferred low reliability program, it is worthwhile recapping important matters discussed in previous sections:

- In the section 'Our obligations', we discussed how we have obligations to monitor and report on our low reliability feeders, which supply our worst served customers. We also noted that although there is no strict obligation for us to undertake corrective actions on these feeders, there is an expectation through these obligations that we will undertake corrective actions where it is economic to do so. Importantly, ESCoSA have stated in its final decision on the service standard framework to apply to us for the 2020-25 regulatory control period, that low reliability feeder reliability levels should be maintained.

- Furthermore, in sections 'The drivers and need for this program' to 'Cost benefit analysis of the program', we discussed the performance of those feeders, noting that performance has been worsening since around 2010 due to storm events, and the latest BOM / CSIRO reports suggest that the frequency and intensity of storm events is only likely to worsen. We also explained the rigorous process we have applied to develop a set of solutions to address the poor performance, and importantly, presented the results of a formal cost-benefit analysis that we have applied to these solutions. This cost-benefit analysis found that a significant portion of these solutions had a positive net benefit.

- Finally, we also noted in the section 'Customer support for the program' that through our engagement with our customers, they have indicated a strong preference for us to improve the supply reliability to our worst served customers, where we have a cost benefit analysis to demonstrate that there is a net benefit in improving the supply.

Given these views and findings, we consider it reasonable to propose a Low Reliability Feeder program, which is built up from the solutions that we have determined will have a positive net benefit (i.e. the benefits exceed the costs). We consider that a program that consists of components that meet this criterion will be in accordance with our obligations and our customers' preferences.

The low reliability program cost and scope

Given the above rationale, the low reliability feeder program we propose here represents a $15.5 million ($ 2017) capital program, which will reinforce the low reliability feeders over the 2020-25 regulatory control period. This program includes all the solutions that we have evaluated through our cost-benefit analysis to provide positive net benefits.

This program will address the reliability performance of 95 of the 15 feeders identified as long-term low reliability feeders, improving service to 16,481 of our worst served customers.

This program will cover a combination of strategies, aimed at addressing the specific causes of the poor performance of the feeders, including:

- re-insulating vulnerable sections of overhead lines to minimise the possibility of insulator failures due to lightning;

- alternative network asset configuration / standards to minimise the chance of vegetation outages from outside the prescribed vegetation clearance zone; and

- installing mid line switches (e.g. reclosers and sectionalisers) to reduce the number of customers interrupted by storm related interruptions.

Table 11 below provides a summary of the scope and cost of the various strategies.

Option	No. of -Feeders	Total solution units	Total Cost ($ millions)
Re-insulations of poor performing line sections	71	6,633 poles	$11.2
Underground of critical line sections	1	5 spans	$0.3
Installation of reclosers and sectionalisers	14 (sectionalisers) 16 (reclosers)	26 sectionalisers and 18 reclosers	$4.0 ($26.0 sectionalisers and $18.0 reclosers)

Table 13 Mitigation options - Low reliability feeder program

Further information on the relationship of this program to our business strategies is provided in Appendix A. Additionally, our corporate risk assessment of this program and a summary of its financial appraisal are contained in Appendix - Project risks and financial evaluation summary.

The customer service level benefits achieved by the low reliability feeder program

Tables 12 and 13 below summarise the expected benefits in the service levels achievable through the proposed low reliability feeder program, for the 95 feeders addressed by this program. Additional information on SAIFI and other reliability measures is provided in the LRF Regulatory model.

These tables indicate that this program will improve the service levels to our worst serviced customer by, on average, 170 SAIDI minutes including MEDs (and 117 SAIDI minutes excluding MEDs). This represents a 40% improvement from their current service levels including MEDs (and 38% excluding MEDs).

- The greatest improvement will be to 13,010 of our customers served by 82 Rural Long feeders addressed by this program, who will on average receive 173 minutes improvement in SAIDI (including MEDs).

- 1,158 customers served by 8 Rural Short feeders will receive, on average, a 128 minute improvement in SAIDI (including MEDs).

- 2,314 customers served by 5 Urban feeders addressed by this program will receive, on average, a 171 minute improvement in SAIDI (including MEDs).

With regard to scale of the improvements to our customers in the various regions served by our low reliability feeders:

- The customers served by low reliability feeders in the Upper North region will receive the greatest improvement, with a 254 SAIDI minute improvement including MEDs.

- Customers served by low reliability feeders in the Riverland and Murraylands; Barossa, Mid-North, Yorke Peninsula; and Eyre Peninsula regions will also receive significant improvements, with an average SAIDI improvement (including MEDs) of 187 minutes.

- Other regions (other than the Rural Metropolitan Centres) will still receive significant improvements, ranging between 0 minutes for the Eastern Hills to 88 minutes for Adelaide Metropolitan Area (including MEDs).

- We have found no viable solutions for the Rural Metropolitan Centres. However, it is worth noting that there are only 3 feeders identified as long term low reliability in this regional category, all of which are Urban.

Region	SAIDI (average per annum)					
	Including MEDs			Excluding MEDs		
	current (minutes)	improved (minutes)	improvement (%)	current (minutes)	improved (minutes)	improvement (%)
Adelaide Metropolitan Area	323	164	51%	217	104	48%
Riverland and Murraylands	565	189	33%	358	122	34%
South East	378	100	27%	344	89	26%
Barossa, Mid-North, Yorke Peninsula	410	188	46%	269	124	46%
Eyre Peninsula	460	185	40%	370	134	36%
Upper North	536	254	47%	333	150	45%
Eastern Hills	n/a	0	n/a	n/a	0	n/a
Fleurieu Peninsula	275	116	42%	225	88	39%
Rural Metropolitan Centres	n/a	0	n/a	n/a	0	n/a
Total	421	170	40%	309	117	38%

Table 14 Average annual SAIDI by region due to LRF program

Category	SAIDI (average per annum)					
	Including MEDs			Excluding MEDs		
	current (minutes)	improved (minutes)	improvement (%)	current (minutes)	improved (minutes)	improvement (%)
Urban	329	171	52%	223	108	48%
Rural Short	423	128	30%	316	111	35%
Rural Long	438	173	40%	323	119	37%
Total	421	170	40%	309	117	38%

Table 15 Average annual SAIDI by feeder category due to LRF program

The service level improvement expected to be achieved by the various solutions differs across the feeders addressed through this program. Figure 9 below shows the distribution of the scale of improvements across these 95 low reliability feeders (as measured by SAIDI including MEDs). This figure shows that the improvement in SAIDI for the feeders addressed by this program will range between 36 minutes and 873 minute, with 80% of the feeders having an improvement greater than 94 minutes.

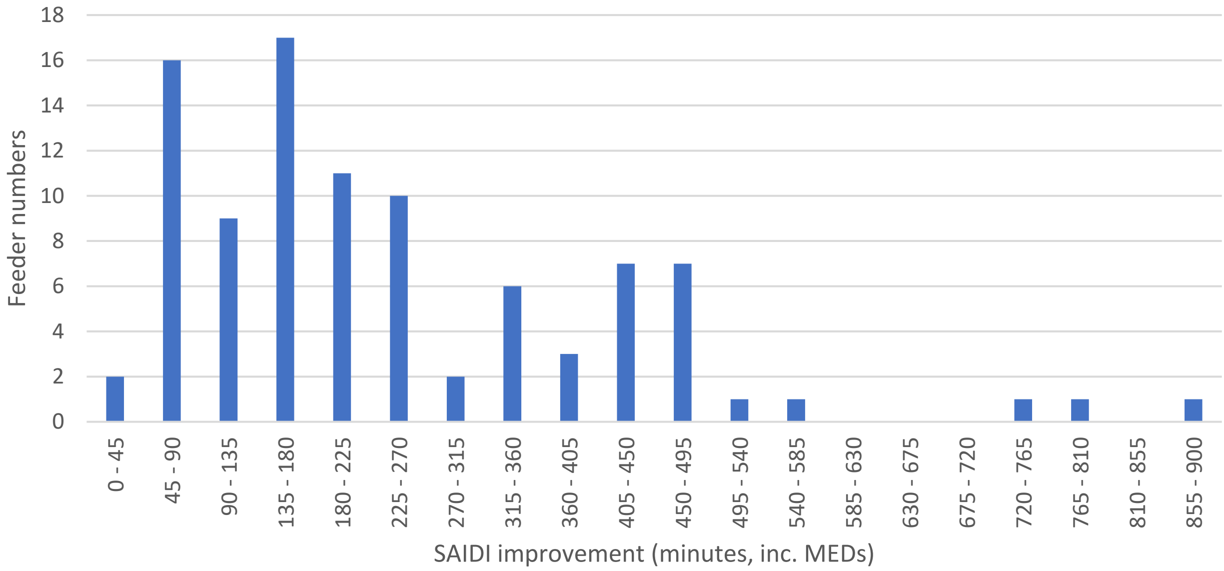


Figure 9 Distribution of SAIDI improvement due to all solutions in program ie economically viable solutions

The economic benefits achieved by the low reliability program

Our low reliability program, in total, will provide an average annual net economic benefit to the SA community of $0.89 million and a total average annual economic (VCR) benefit of $2.18 million. The majority of this economic benefit (approximately 95%) is due to the value of the improved reliability provided by this program.

The breakdown of this economic benefit to regions and feeder categories is shown in Tables 14 and 15 below. These tables show that the greatest portion of the economic benefit is associated with improving the performance of the Rural Long feeders. However, a significant portion (approximately 23% by net benefit) is associated with improving the performance of Urban feeders.

Region	annual net benefit ($'000)	economic benefit ($'000)	avoided fault response costs ($'000)
Adelaide Metropolitan Area	$204.0	$353.2	$0.7
Riverland and Murraylands	$91.2	$276.5	$17.4
South East	$82.4	$206.2	$9.1
Barossa, Mid-North, Yorke Peninsula	$127.6	$293.2	$17.0
Eyre Peninsula	$138.1	$490.1	$35.2
Upper North	$179.0	$397.9	$17.0
Eastern Hills	$0.0	$0.0	$0.0
Fleurieu Peninsula	$69.7	$163.3	$4.6
Rural Metropolitan Centres	$0.0	$0.0	$0.0
Total	**$892.1**	**$2,180.4**	**$100.9**

Table 16 Economic benefit due to LRF program – regional

Category	annual net benefit ($'000)	economic benefit ($'000)	avoided fault response costs ($'000)
Urban	$202.7	$348.1	$0.0
Rural Short	$50.4	$122.5	$5.0
Rural Long	$639.1	$1,709.7	$95.9
Total	**$892.1**	**$2,180.4**	**$100.9**

Table 17 Economic benefit due to LRF program – feeder category

The economic benefit and net benefit due to the performance improvement varies across the feeders addressed through this program. The chart below shows the distribution of the economic net benefit across the feeders covered by the program. Figure 10 shows that the economic net benefits by individual low reliability feeders are all positive and range between $54 per annum and $120,902 per annum. The average (mean) net benefit per improved feeder is $8,746 per annum, with 80% of the feeders having a net benefit of $2,333 per annum or greater.

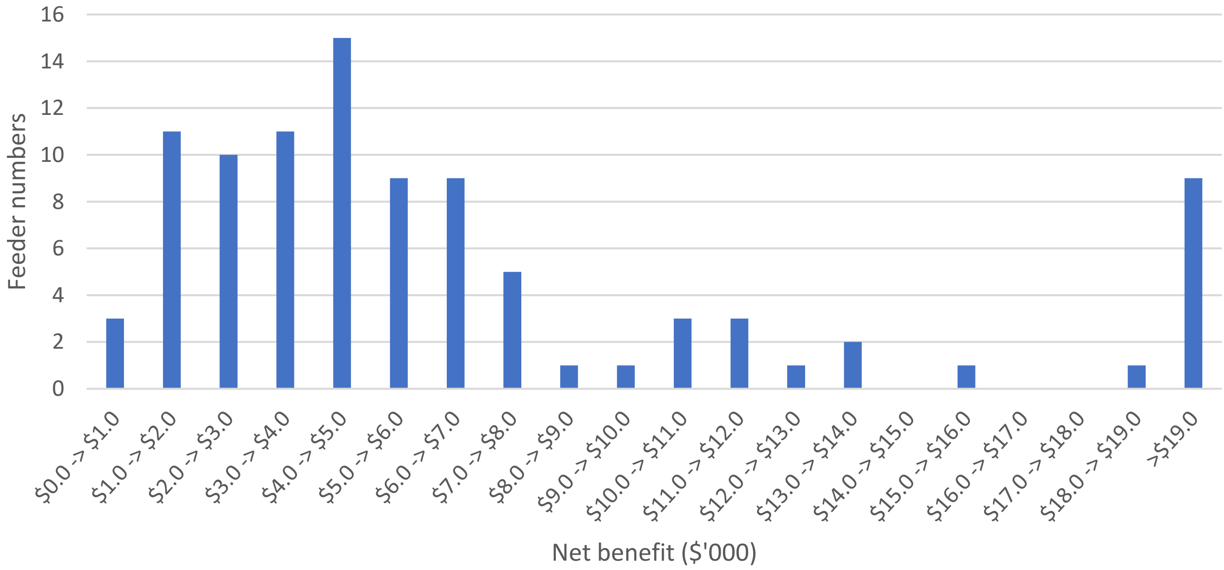


Figure 10 Distribution of net benefit of program ie all economically viable solutions

Program timescale

The program is planned to be undertaken over the entire 2020-25 regulatory period, as shown in the table below. Therefore, its benefits will be felt progressively as each part of the program is delivered.

Timescale Activity	Start Date	End Date
Start and end dates of the project	1/07/2020	30/6/2025
Period/Date when business can first expect to accrue the benefits	1/07/2021	Ongoing

Table 16 below is a summary of the program delivery costs. We plan to implement the proposed 2020-25 Low Reliability Feeder program smoothly over the 5-year regulatory period to allow for a consistent internal program of works. This approach should reduce the need to ramp resourcing levels up and down at an additional cost. The order of the specific projects and feeders will be prioritised in the work plan based on the economic benefit and historical customer experience, and other work planned in the relevant areas.

Cost component	Financial year ($'000 2017)				
	2020/21	2021/22	2022/23	2023/24	2024/25
Total Costs	$3,100	$3,100	$3,100	$3,100	$3,100

Table 18 - Delivery costs

Relationship of the low reliability feeder program to other programs

We do not consider that the works in this program or the anticipated benefit will overlap or be "double counted" with other programs that will form our capital plan. Table 17 below lists the key programs where there is the potential for overlap and provides an overview of the relationships and key aims of the various programs.

Reliability Programs	Maintains Underlying Performance to ESCoSA Targets	Improves performance to Worst Served Customers	Hardens the Network against Storms
Underlying	Yes	No	No
Worst Served	No	Yes	No
Hardening	No	No	Yes
Other Programs			
REPEX Refurbishment & Replacement	Yes	No	No
Network Augmentation	Yes	No	No

Table 19 Relationship of low reliability feeder program with other planned programs

Other reliability programs

Our low reliability feeder program seeks to address the continuing deterioration of the specific feeder classified as long-term low reliability. As discussed here, we have identified these specific feeders and developed solutions that are specific to the causes of outages on these feeders.

We have confirmed that these feeders and our solutions do not overlap with solutions we have identified for our other main reliability improvement program, the hardening the network program. Our hardening the network program is aimed at making our network (supplying the majority of customers) more resilient to major storms, which results in the very poor performance on Major Event Days. Our low reliability feeder program should also help make the associated feeders more resilient to storms. However, we have used a different method to identify problematic feeders and appropriate solutions for the hardening the network program, and so have verified that they do no overlap with the low reliability feeders.

Based on our bottom up build-up of all Reliability and Resilience programs and cross referencing over all other SA Power Networks activities we have ensured the programs do not overlap each other. Feeders identified as part of the Low Reliability and Hardening the Network programs are specifically excluded from the underlying reliability program.

Other plans - asset replacement programs

Asset performance-related issues are addressed through the asset replacement programs. These are discussed elsewhere in our set of asset management plans. Our low reliability feeder program is predominantly focused on addressing causes impacting low reliability feeders such as storm events, and not asset condition.

Furthermore, the primary goal of replacement programs is to maintain the overall asset risk, and hence, there is typically minimal reliability improvement expected through these programs. In effect, any localised improvements that could occur due to specific replacements will be offset by the ongoing deterioration of other assets as they age further.

Therefore, we do not anticipate a material overlap between replacement programs and the low reliability feeder program. Moreover, we do not consider that there can be re-prioritization between these programs without either materially affecting asset risk (e.g. safety risk) or customer service levels.

Other plans - network augmentation and other recloser/sectionaliser installation programs

We have a number of planned programs that will install new reclosers on the network, replace old slower devices, or provide SCADA facilities to existing manual devices. The most significant of these programs is our bushfire mitigation program and our protection program.

To ensure there is no overlap with these programs, we have determined the likely locations of all reclosers being added, replaced or enhanced across all programs to ensure there is no overlap between programs.

9. Regulatory treatment

In this section we will explain why the STPIS is not an appropriate mechanism to incentivise and fund the Low Reliability Feeder program and explain why we consider it should be allowed for in the capital expenditure forecast allowance of our building block proposal to the AER.

The limitations of the STPIS as an appropriate revenue mechanism

The Low Reliability Feeder program is a reliability program that arrests declining reliability performance, and so the reliability benefits can affect the STPIS outcomes in the future (i.e. the revenue reward or penalty provided by the scheme). However, we do not consider that the existing STPIS mechanism provides the appropriate incentives to fund the types of work identified for feeders under this program.

Across the range of reliability projects that we may undertake, the works necessary to improve supplies to our worst served customers tend to have the poorest cost to benefit/reward ratio. This is very much due to the same factors that tend to cause them to be our worst served customers, namely they are typically our lowest density customers and supplied by the greatest distances. Therefore, outages can affect fewer customers (i.e. there is a lower overall benefit in improving the supply) and the reinforcement costs tend to be higher due to the longer distances that need to be upgraded.

The consequence of these factors on the STPIS is twofold:

- Often the STPIS will not provide sufficient marginal revenue reward to justify incurring the investment (i.e. the appropriate return on and of the capital investment over the regulatory period would be below the revenue provided by the STPIS).

- In circumstances where the STPIS rates may appear to be sufficient to fund the improvement work for a low reliability feeder, the work itself would rank so low compared to other reliability projects that the STPIS will typically reach its cap before the work would be prioritised

For example, typically we find that reliability projects that rank high enough to be prioritised under the STPIS will provide a STPIS reward over five years that exceeds the capital cost of the project. However, none of the solutions that make up the Low Reliability Feeder program exceed this criterion.

As such, the existing STPIS mechanism will not provide the appropriate incentive or revenue mechanism to undertake the Low Reliability Feeder program. The AER also appeared to accept this view when it made its final decision on our previous regulatory proposal[32].

It is also worth noting that, as we have shown in the section 'Cost benefit analysis of the program', the avoided operating costs achieved by the program (i.e. avoided costs associated with response and repair) are significantly lower than the costs of this program (in an equivalent annual cost sense). Therefore, this program cannot be funded through the Efficiency Benefits Sharing Scheme (EBSS) ether.

Our reasoning for including in the cost of this program in our capex forecast

Given the above reasoning, for our 2020-25 regulatory proposal to the AER, we propose to include the total capital cost of this program ($15.5 million) in our capital expenditure forecast of our building block revenue proposal. However, this program should have some beneficial effect on other incentive mechanisms, and therefore, we are also proposing step change adjustments to the SPTIS targets to allow for the improvements we expect to achieve through these programs. We discuss this view further here.

[32] Attachment 6 – Capital expenditure, SA Power Networks determination 2015-20, pg 6-46

The NER capex objectives

We consider that the costs associated with this program are in accordance with the NER capex objectives[33].

In the context of how we have assessed and developed this program, we consider it reasonable to find that the costs are necessary to comply with applicable regulatory obligations or requirements[34]. In support of this view - and noting the discussion in the section 'Our obligations' - we consider that even though we do not have a strict obligation to undertake corrective action on all feeders identified under the state-based low reliability feeder regime, in circumstances where corrective action is economic then we are obliged to undertake that the corrective action (subject to appropriate regulatory funding being provided). Importantly, ESCoSA have stated in its final decision on the service standard framework to apply to us for the 2020-25 regulatory control period, that low reliability feeder reliability levels should be maintained. Given we have shown that all elements of our program have a positive net-benefit, then we consider it appropriate to accept this interpretation as a regulatory requirement.

Should the AER disagree with this view and consider that the program, as defined here, is not required to comply with regulatory obligations or requirements, then we still consider it reasonable to find that this program is required to maintain the reliability of supply of standard control services[35].

As we have discussed in the section 'The drivers and need for this program', the reliability of supply to our worst served customers has been worsening over the recent period and is predicted by the BOM and CSIRO (refer footnotes 10 and 11) to worsen further due to predicted increases in severe weather events (frequency and intensity). Given the current performance is significantly worse than our typical customers, we consider it appropriate to accept that this program meets that objective in circumstances where the NER prudency and efficiency capex criteria are met.

The NER capex criteria

We consider that the costs associated with this program are in accordance with the NER capex criteria[36].

We consider it is reasonable for the AER to accept that the cost underpinning this program's forecast reflect prudent and efficient costs that reflect a realistic expectation of the cost inputs, given the following:

- we have applied a detailed and thorough analysis to assess and develop the individual solutions that form this program, and estimate the economic benefits we expect from each solution;
- the cost and benefit assumptions have been developed from analysis of our historical costs and performance; and
- we have undertaken a formal cost-benefit analysis on each solution included in this program and ensured that all solutions that form this program have a positive net-benefit.

[33] NER 6.5.7 (a)
[34] NER 6.5.7 (a)(2)
[35] NER 6.5.7 (a)(3)(iii)
[36] NER 6.5.7 (c)(1)

The NER factors and our consumer preferences

We consider that the costs associated with this program are in accordance with the NER capex factors[37]. Most notably:

- we believe that our low reliability program is in accordance with our customer's preferences to address the supply to worst served customers, where it is economic do so, and use cost-benefit analysis to test this;

- we have explained above why the STPIS and EBSS are not the appropriate mechanisms to fund this program, but we are proposing some adjustments below on these mechanisms to ensure we are not inappropriately rewarded through them; and

- we have explained in the section 'The preferred program and program scope' why we consider that there are not appropriate substitution possibilities, particularly between other programs allowed for in the capex forecast.

The capex forecast and other adjustments

Based on the above reasoning we have included $15.5 million in our capex forecast to cover the costs for the Low Reliability Feeder program over the 2020-2025 regulatory control period.

However, given this program will result in some modest improvements to overall reliability, we are also proposing the following adjustments to allow for these effects. We propose that the STPIS targets be adjusted by half the ultimate improvement to reflect that the program will be progressively implemented over the 2020-25 RCP and as such will have minimal impact in 2020/21 and nearly full impact in 2024/25.

- STPIS – To allow for the anticipated improvements in supply reliability, we propose the following adjustments to the STPIS targets:

    - SAIDI targets (ex. MEDs) - 1.34 minutes at the state level, 6.76 minutes to Long Rural feeders, 0.63 minutes to Short Rural feeders, and 0.22 minutes to Urban feeders; and

    - SAIFI targets (ex. MEDs) – 0.005 interruptions at the state level, 0.0182 interruptions to Long Rural feeders, 0.0026 interruptions to Short Rural feeders, and 0.0021 interruptions to Urban feeders.

It is important to note that both the STPIS target adjustments changes will occur incrementally over the next five-year regulatory period as the program is rolled out over this period.

It is also noted that the proposed LRF program may potentially reduce GSL payments. This would result in a potential opportunity to gain a reduction in operating expenditure. Detailed modelling will need to occur to forecast the potential GSL offset for the period 2020- 25, taking into account the revised 2020-25 GSL scheme.

Therefore, SA Power Networks will consider adjusting the GSL potential operational savings if the potential GSL payment reductions can be accurately modelled.

We would be happy to work with the AER and other stakeholders, such as ESCoSA, to define the appropriate mechanisms to ensure that this program is implemented in-line with our plans.

[37] NER 6.5.7 (e)

Concluding statements on why we believe the AER should accept our treatment of this program

SA Power Networks considers the Low Reliability Feeder Program is necessary to address its implied regulatory obligation to address and maintain performance of Long-Term Low Reliability feeders.

In summary, we believe that we believe the AER should reconsider the 2020-25 low reliability feeder program in our regulatory proposal as:

- The willingness of all customer segments outside the LRF areas to subside reliability improvements for customers on low reliability feeders exceeds the annualised cost per customer of the revised LRF reliability improvement projects
- The proposed 2020-2025 LRF program – which focusses on a smaller set of LRFs and delivers a greater level of improvement than the program assessed in the ESCOSA study – is economically efficient
- We have undertaken a detailed cost-benefit analysis on these possible solutions to develop a program that includes only the solutions that should provide a net economic benefit (i.e. the benefits will outweigh the costs) and demonstrated the proposed 2020-2025 LTLRF program is prudent and efficient and is economically (VCR) viable.
- We have implied obligations (or an expectation) to maintain Low Reliability Feeders performance and address the declining reliability of their supply where it is economic to do so (subject to appropriate regulatory funding being provided), and we have developed this program to address these obligations.
- We have undertaken detailed analysis to identify our low reliability feeders, the causes of their poor performance and the most cost-effective credible (and demonstrated) solutions to improve their performance.
- We have engaged with our customers on programs of this type, and they have indicated a preference for us to improve the supply to our worst served customers when it is economic to do so.
- there is general agreement amongst the CCP that it was unacceptable for some customers to experience such a vastly different level of service, and that SAPN should be working to improve reliability for those customers to have experienced significantly lower levels of electricity supply reliability for sustained periods
- We have demonstrated that the STPIS (and EBSS) is not an appropriate incentive mechanism to provide the revenue necessary to fund this type of program.
- We have demonstrated that under these circumstances, the costs of this programs are in accordance with the capex objectives and criteria in Rule Ch6, and the NEL objective.
- We have proposed **adjustments to the STPIS targets** to ensure that we are not rewarded for implementing this program.
- LTLRF customer service and performance is significantly worse than regional targets and continues to deteriorate and these customers will receive reduced GSL payments (due to the proposed GSL changes in 2020-25) the proposed Low Reliability feeder program will partly offset future disbenefits these customers will receive.

A. Appendix - Relationship to business strategies and other programs

The project contributes to achievement of strategic objectives as described below.

Table 20 - Contribution to corporate strategic objectives

Corporate Strategic Objective	Contribution
Providing customers with safe, reliable, value for money electricity distribution services, and information that meets their needs	This program is expected to manage / reinforce reliability performance of the selected feeders and is the least cost means of arresting the continued poor network performance experienced by our worst served customers. The proposal includes NPV positive projects only where the economic benefit of program exceeds cost, based on the Value of Customer Reliability (VCR) benefit (over 15 years).
Maintaining our business standing in the community as an exemplary corporate citizen of South Australia	This program is expected to support SA Power Networks standing in the affected feeders / communities by helping to return the reliability performance of specific feeders closer to the average regional (or feeder category) service standards.
Ensuring that our workforce is safe, skilled and committed, and that our resourcing arrangements can meet our work program needs	This program will reduce the frequency that our employees operate in relatively hostile and difficult working conditions (i.e. severe storms).
Maintenance and development of key capabilities that will help sustain our success into the future	Not applicable.
Maintain the business' risk profile, and protect the long term value of the business	This program is expected to maintain SA Power Networks' risk profile.

Table 21 - Contribution to corporate core areas of focus

Corporate Core Areas of Focus	Contribution
Energised and responsive customer service	Positive
Excellence in asset management and delivery of service	Positive
Growth through leveraging our capabilities	Not applicable
Investing in our people, assets and systems	Not applicable

B. Appendix - Project risks and financial evaluation summary

Based on our corporate risk assessment methodology, the major business risks of not proceeding with this project are as follows.

Table 22 - Major business risks of not proceeding with the project

Risk ID	Risk Description (Risk Line Item)	Consequence Description	Inherent Likelihood	Inherent Consequences	Risk Rating
1.1	Reliability performance not meeting EDC targets	• Poor customer service • Regulatory intervention • Customer complaints • Media attention	Likely	Minor	Medium
1.2	Detriment to customer service reputation	Negative focus on and additional scrutiny of SA Power Networks' performance	Likely	Minor	Medium

The residual business risks of this preferred option are as follows.

Table 23 – The residual major business risks associated with the Low Reliability Feeder Program

Risk ID	Risk Description (Risk Line Item)	Consequence Description	Inherent Likelihood	Inherent Consequences	Risk Rating
2.1	Detriment to customer service and reputation caused by poor reliability performance	Partly return / restore performance closer to average reliability levels and minimise the likelihood of customer complaints	Unlikely	Minor	Low
2.2	Safety of field crews responding to outages, often in adverse weather conditions, and safety of the public	Fewer outages reduce the safety risk to crews and the public (eg, by reducing the number of wires down)	Possible	Minor	Low

The key results of the investment analysis of the Low Reliability Feeder program are summarised in the Table 12 below (assuming that the STPIS targets will be adjusted by half the ultimate improvement to reflect that the program will be progressively implemented over the 2020-25 RCP and as such will have minimal impact in 2020/21 and nearly full impact in 2024/25).

Table 24 – Investment appraisal – key results

Low reliability feeder program – key result	Value
CAPEX (5 year) ($million)	$15.5
Overall State USAIDI improvement (mins.) p.a.	1.65
Overall State USAIFI improvement (int.) p.a.	0.005
Underlying State USAIDI improvement (mins.) p.a.	1.29
Underlying State USAIFI improvement (int.) p.a.	0.005
STPIS Benefit ($M) p.a.	$0.77
VCR Benefit to Customers ($M) p.a.	$2.1
NPV ($M) p.a.	$0.9
NPV ($M) (over life of program, assuming 15-year life of program)	$10.7

C. Appendix - Relationship to National Electricity Rules Chapter 6 requirements

National Expenditure Objectives	Contribution
Meet or manage expected demand over the period	Not applicable.
Comply with regulatory obligations	In submitting its regulatory proposal, SA Power Networks must satisfy the AER of the extent to which the capital expenditure forecast includes expenditure to address the concerns of electricity consumers as identified in the course of engagement with electricity consumers. This program seeks to directly address this requirement to the develop a program that arrests the declining reliability performance of supply to our worst served customers where it is beneficial to do so The proposal includes NPV positive projects only where the economic benefit exceeds cost, based on the Value of Customer Reliability (VCR) benefit (over a 15 year period).
Maintain the quality, reliability and security of supply of services provided by SA Power Networks	This program will manage/reinforce the reliability and security of supply of services provided by SA Power Networks on the selected feeders for our worst served customers.
Maintain the reliability and security of the distribution system i.e. the electricity networks	This program will manage/reinforce the reliability and security of supply of services provided by SA Power Networks on the selected feeders for our worst served customers.

The costs estimated to achieve this project represent efficient and prudent expenditure as detailed below.

National Expenditure Criteria	Activity
Efficient cost of achieving the objective(s)	All reliability mitigation options have been considered with the most cost-efficient solutions included in the proposed program. Estimated costs have been calculated based on actual historical costs of other programs. Where possible competitive prices have been obtained. Costs are considered to be efficient based on historical expenditure and returns on investment. The proposal includes NPV positive projects only where the economic benefit exceeds cost, based on the Value of Customer Reliability (VCR) benefit (over a 15-year period).
Cost of a prudent operator	The planned scope of works incorporates a set of highly targeted and prioritised strategies from which optimised cost-effective solutions are selected. SA Power Networks' personnel also have regard to industry developments to ensure our practices are in line with good industry practice.
Realistic expectation of forecast and cost inputs	Forecast reliability outcomes and benefits are based on an ongoing independent statistical review of the effectiveness of previous network reliability improvements on the SA Power network. Analysis of individual projects within this proposal has been carried out using reliability performance information since July 2010 through to June 2018) and assessing the improvement benefit that would have occurred if the proposed programs had been in place across this period.

D. Appendix – Evidence of program efficiency

Following the AER's suggestion in the Draft Decision that SA Power Networks has 'overestimated' the effectiveness of our reliability solutions, the following examples are provided to further demonstrate how we have calculated the effectiveness of our reliability solutions (which is consistent with our current successful hardening program).

This methodology is also explained under Section 5 "Options considered and our methodology to identify the optimal solutions" in both SA Power Networks – 2020-2025 Reliability & Resilience Programs:

- Hardening the Network program; and the
- Low Reliability Feeder program.

Detailed information regarding the outages mitigated and the solutions for each project is contained in both the program models provided with the programs.

Each project benefit was calculated based on mitigation of historical faults in each **targeted section** had the solution been in place and **not on other faults at other locations on a feeder.**

The following examples are provided including fault location mark ups for proposed 2020-2025 projects:

- HH386C Beaumont 11kV feeder – 2020-2025 Hardening the Network- IUC project
- G31 Mannanarie SWER feeder – 2020-2025 Low Reliability Feeder - Re-insulation project

Examples are also provided for completed projects to demonstrate "real life" actual effectiveness of implemented solutions for:

Insulated Unscreened Conductor (IUC) project effectiveness

- SM350D – Springfield 11kV Feeder

and

Re-insulation project effectiveness

- LC06 – Copley – Nepabunna 33kV Feeder

These projects demonstrate the effectiveness of fault reduction of these solutions in the sections targeted and customer minutes off supply reduction for feeders and customers targeted by the projects.

2020-2025 Hardening IUC Project - HH386C Beaumont feeder

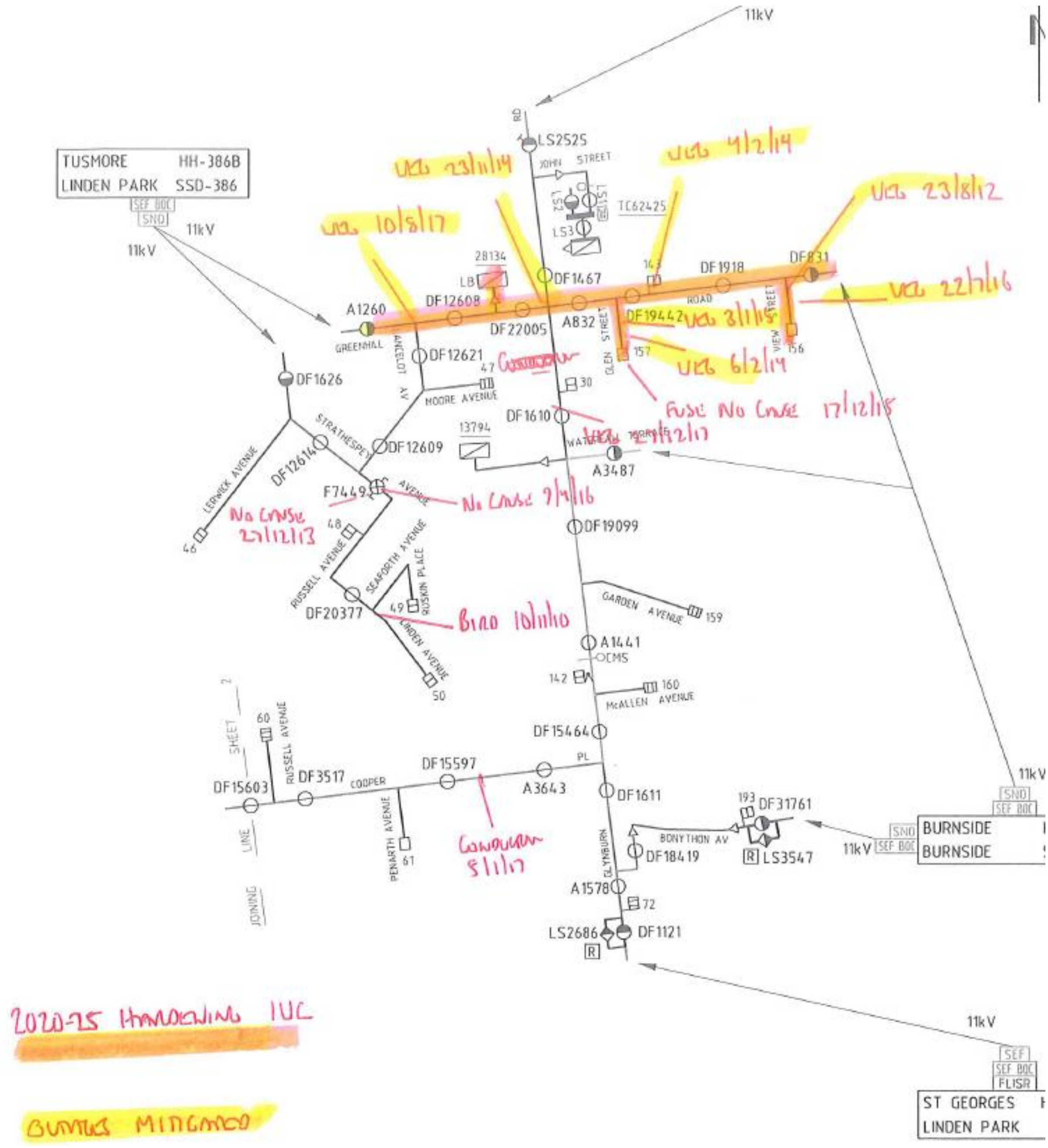
List of faults on HH386C Beaumont feeder mitigated by 2020-2025 Hardening IUC Project (as per Hardening model)

Date	Outages Mitigated by Viable plan	Time	Feeder	Area Affected	Restoration Time (Final)	HV Daily Customers Affected	HV Daily Description
06-Feb-14	Y	10:00	HH386C	BEAUMONT	11:57	54	2x11kV Fuse operated (TF157) - Vegetation
23-Aug-12	Y	10:34	HH386C	BEAUMONT	11:19	1,372	11kV Circuit breaker locked out (CB1927) - Vegetation (tee-off to TF156)
04-Feb-14	Y	05:34	HH386C	BEAUMONT	14:43	1,360	11kV Circuit Breaker lockout (CB1927) - Vegetation (Green St & Greenhill Rd)
23-Nov-14	Y	21:34	HH386C	BEAUMONT	22:12	1,366	11kV Circuit Breaker lockout (CB1927) - Vegetation (Cnr Green Hill Rd & Glynburn Rd)
03-Jan-15	Y	11:09	HH386C	BEAUMONT	12:32	0	1 x 11kV fuse operated (TF157) - Quality of supply affected (54 customers) - Vegetation near TF157 Note: CB1927 reclosed affecting 1364 customers
22-Jul-16	Y	18:32	HH386C	BEAUMONT 11kV	23:10	1,436	Vegetation (tee-off to TF156)
10-Aug-17	Y	15:14	HH386C	BEAUMONT 11kV	16:46	1475	Vegetation Tree branch on conductors Greenhill Rd near tee off to Lancelot Ave
							Total (8 years of Data)
							Per Annum
ated							
10-Nov-10	Not mitigated	07:45	HH386C	BEAUMONT	09:40	147	2 x 11kV Fuses operated (F7449) - Bird (between TF49 & TF49 tee)
23-Dec-12	Not mitigated	21:25	HH386C	BEAUMONT	22:58	1,372	11kV Circuit breaker locked out (CB1927) - Cable fault (feeder exit)
27-Dec-13	Not mitigated	07:24	HH386C	BEAUMONT	08:25	0	1x11kV Fuse operated (F7449) - Quality of supply affected (162 customers) - Nothing found - Weather fine
14-Mar-14	Not mitigated	20:30	HH386C	BEAUMONT	22:15	54	Forced Interruption (TF52) - HV isolation to replace oil leaking transformer
17-Dec-15	Not mitigated	00:41	HH386C	BEAUMONT	01:51	49	2x11kV Fuse operated (TF157) - Nothing found - Weather hot Note: CB1927 was opened during restoration affecting 1416 customers
09-Apr-16	Not mitigated	19:27	HH386C	BEAUMONT 11kV	20:29	166	Blown H phase HV fuse at F7449, have patrolled nothing found
24-Nov-16	Not mitigated	14:02	HH386C	BEAUMONT 11kV	15:05	33	Repair floating insulator at tee-off to TF102
5/01/2017	Not mitigated	05:41:00	HH386C	BEAUMONT 11kV		60	Vibration
27-Dec-17	Not mitigated	02:08	HH386C	BEAUMONT 11kV	03:53	1494	Vegetation Found tree branch across H & J phase near DF1610 will
10-Jun-18	Not mitigated	08:48	HH386C	BEAUMONT 11kV	08:57	1416	Operational issue

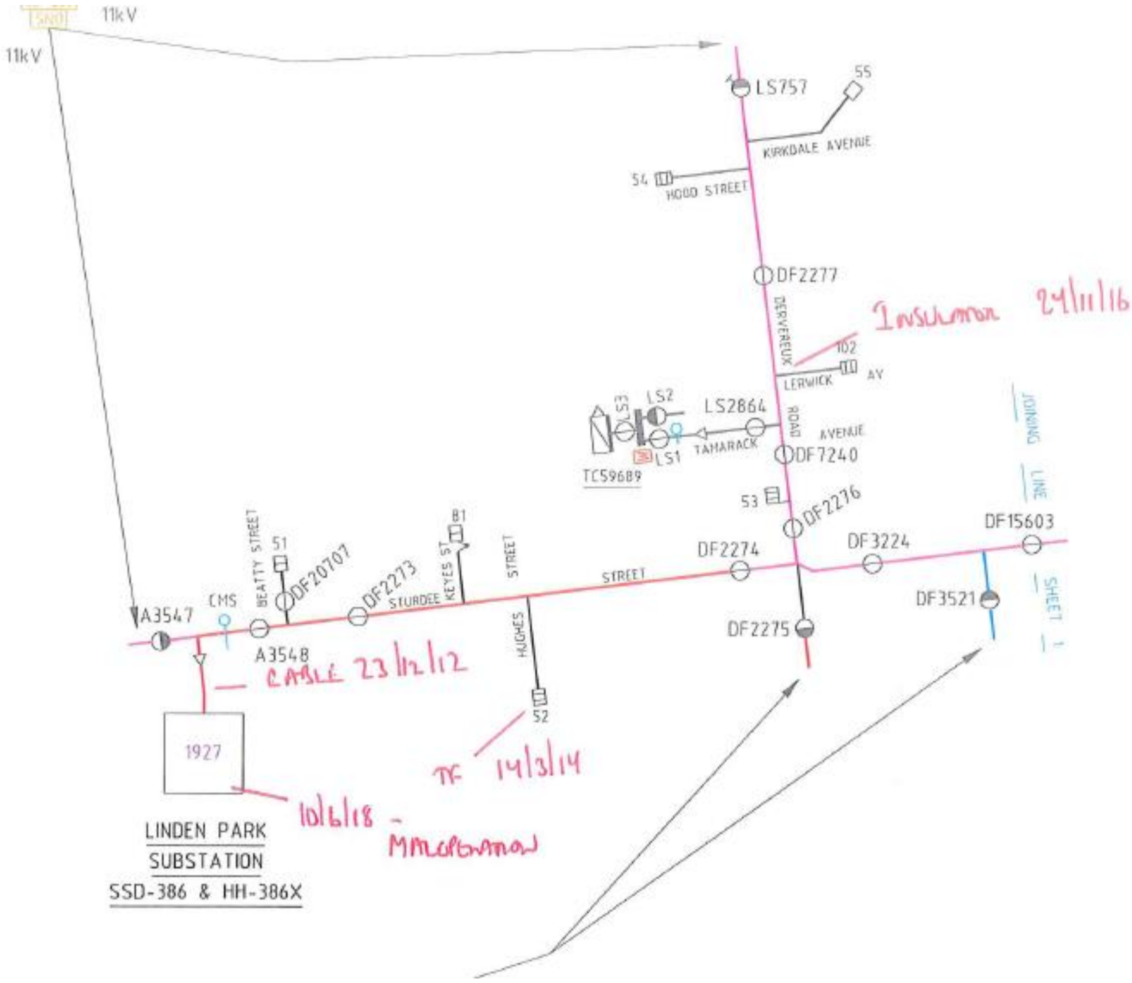
Fault locations and proposed IUC section for HH386C Beaumont feeder (Sheet 1)

- The section of feeder highlighted in orange represents the section where IUC is proposed to be installed
- Faults highlighted in yellow represent the faults that would have been mitigated by the proposed IUC had it been in place (and aligns with the faults in the first table above)

- Faults that are not highlighted in yellow represent the faults that would **not** have been mitigated by the proposed IUC had it been in place (and aligns with the second table above) i.e. these have **not** been included in the viability assessment



Faults locations and proposed IUC section for HH386C Beaumont feeder (Sheet 2)



HH386C Beaumont - 2020-2025 Hardening- IUC Project – NPV Calculation summary (only includes the mitigation of those faults highlighted in yellow above and **not** the unhighlighted faults)

Feeder	Feeder Name	Proposed Improvement	Solution	Solution Units	FS Est Cost	Call outs reduced from 1/7/10	Forecast Customer Minutes Improvement PA	Feeder Category Forecast SAIDI Improvement (mins.)	VCR benefit PA	SPS benefit PA	NPV (VCR)	NPV (SPS)	Discount Rate
HH386C	BEAUMONT 11kV	IUC between A1260 and DF831 with tee-offs	IUC per span	27	$ 405,000	7	81,602	0.13	$ 71,877	$ 11,265	$459,930	-$353,248	2.89%

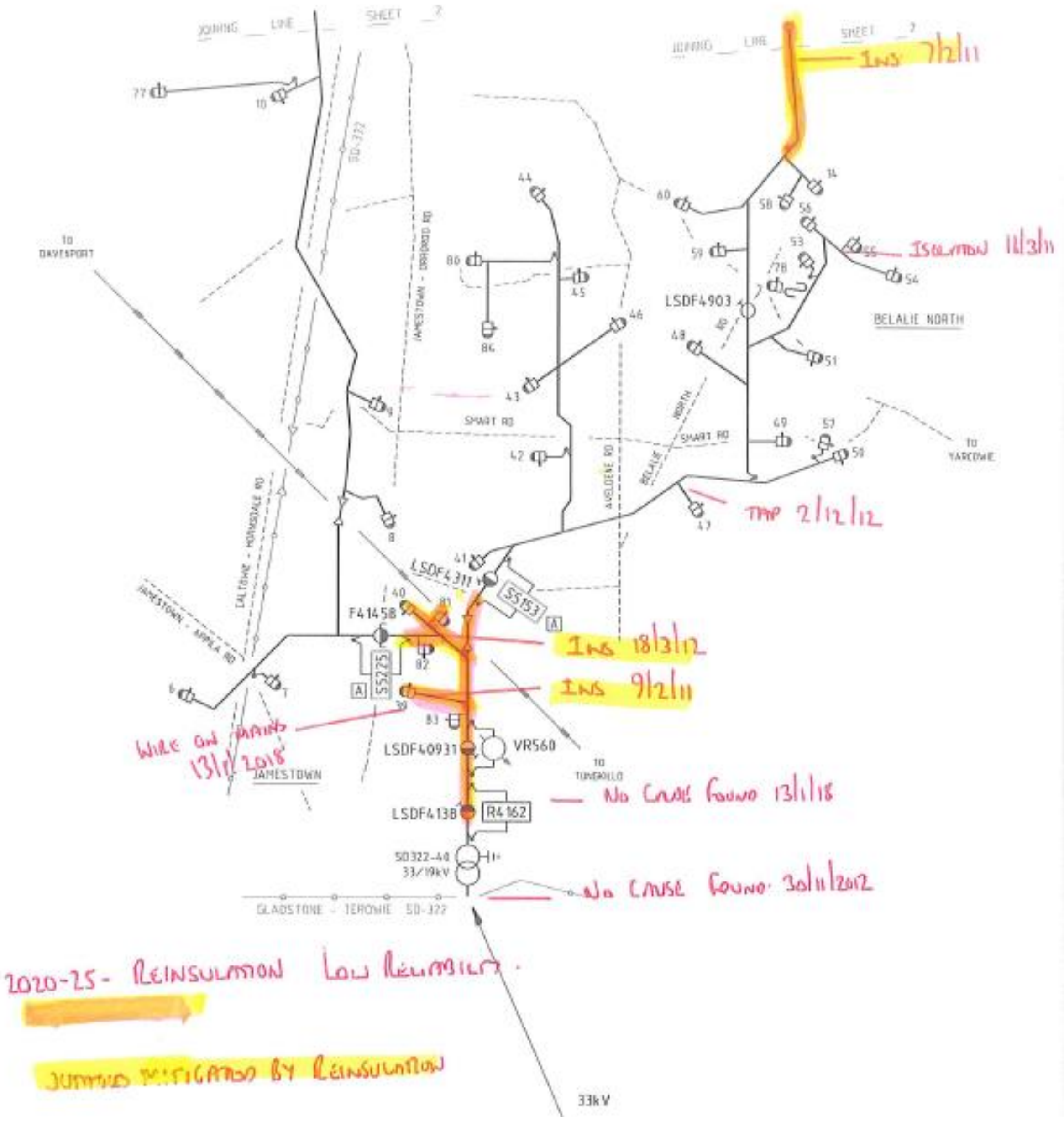
2020-2025 – Low Reliability Feeder- Re-insulation Project - G31 Mannanarie SWER feeder

List of faults on G31 Mannanarie SWER feeder mitigated by 2020-2025 – Low Reliability Feeder- Re-insulation Project (as per LRF Model)

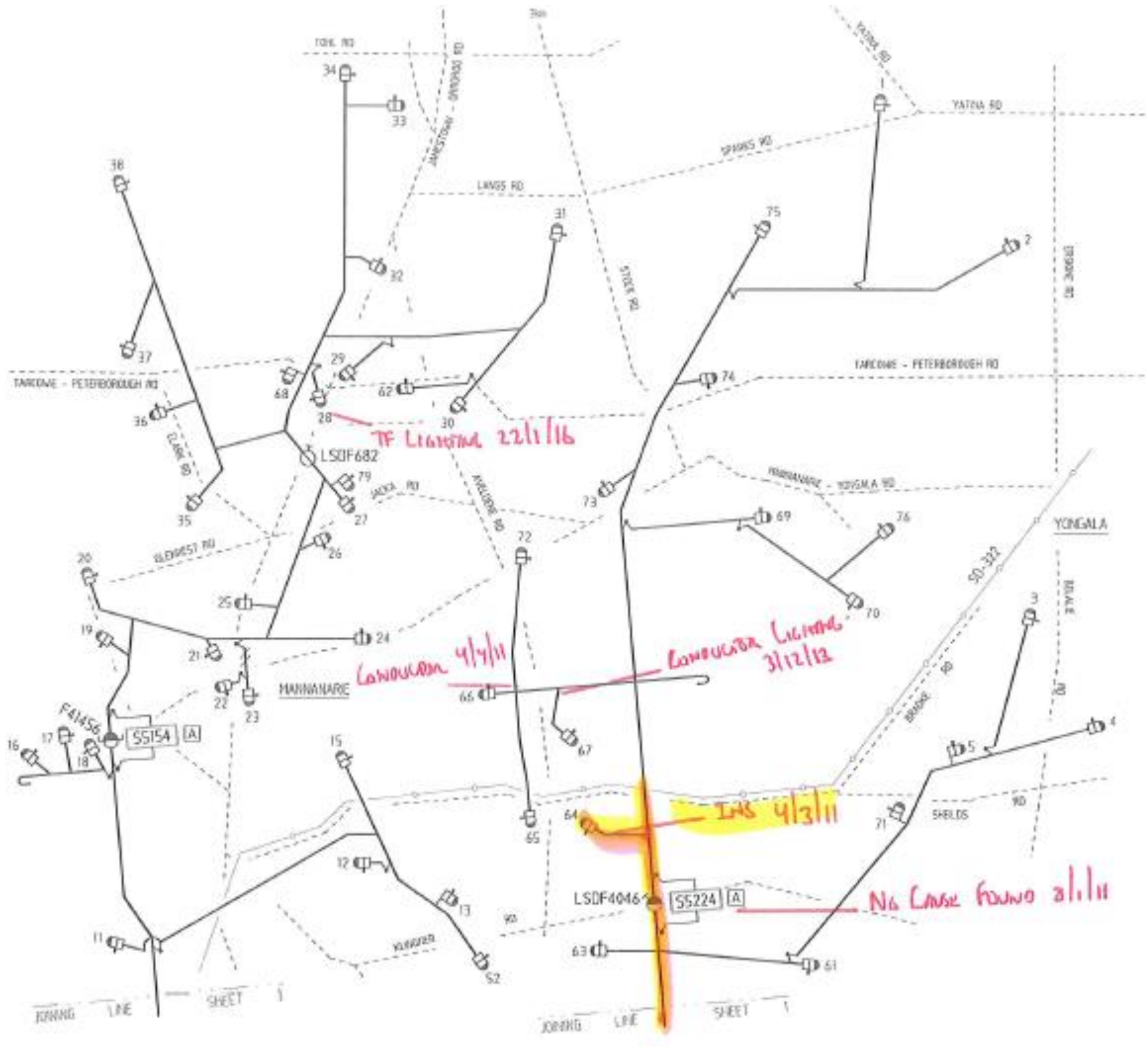
HV Daily Date	Feeder	Area Affected	HV Daily Customers Affected	HV Daily Cause	Mitigated	HV Daily Description	MED
7/02/2011	G31	MANNANARIE	40	Weather	Yes	19kV Fuse operated (LSDF4311) - Insulator (between TF14 & TF63 tee) - Suspect damage due to recent storms	
9/02/2011	G31	MANNANARIE	125	Weather	Yes	19kV Recloser lockout (R4162) - Insulator (near TF39) - Suspect damage due to recent storms	
18/03/2012	G31	MANNANARIE	122	Weather	Yes	19kV Recloser lockout (R4162) - Insulator (tee off to TF81) - Conductor down (tee off to TF81) - Suspect damage due to recent storms	
4/03/2011	G31	MANNANARIE	13	Weather	Yes	11kV Sectionaliser operated (S5224) - Insulator (Tee off to TF64) - Weather cool and windy	
8/01/2011	G31	MANNANARIE	13	Unknown	Not mitigated	19kV Sectionaliser operated (S5224) - Nothing found - Weather showers	
16/03/2011	G31	MANNANARIE	1	Other	Not mitigated	Forced interruption - HV isolation to replace LV fuses (TF55)	
4/04/2011	G31	MANNANARIE	13	Equipment	Not mitigated	19kV Sectionaliser operated (S5224) - Conductor failed (near TF66) - Corrosion	
30/11/2012	G31	MANNANARIE	124	Unknown	Not mitigated	1x 33kV Fuse operated (F43189 SWER ISO TF) - Nothing found - Weather storms	MED(LN)
2/12/2012	G31	MANNANARIE	2	Equipment	Not mitigated	19kV Tap failed (TF47) - Hot joint	
3/12/2013	G31	MANNANARIE	13	Weather	Not mitigated	19kV Sectionaliser operated (S5224) - Conductor on ground (near TF67) - Lightning	
22/01/2016	G31	MANNANARIE	121	Weather	Not mitigated	19kV Recloser locked out (R4162) - TF28 damaged - Lightning	
13/01/2018	G31	MANNANARIE 19k	123	Unknown	Not mitigated	Nothing found	
13/01/2018	G31	MANNANARIE 19k	123	Third Party	Not mitigated	Foreign object (Wires on Mains TF39)	

Fault locations and proposed re-insulation sections for G31 Mannanarie SWER feeder (Sheet 1)

- The section of feeder highlighted in orange represents the section where re-insulation is proposed
- Faults highlighted in yellow represent the faults that would have been mitigated by the proposed re-insulation had it been in place (and aligns with the faults in the first table above)
- Faults that are not highlighted in yellow represent the faults that would **not** have been mitigated by the proposed re-insulation had it been in place (and aligns with the second table above) i.e. these have **not** been included in the viability assessment



Fault locations and proposed re-insulation sections for G31 Mannanarie SWER feeder (Sheet 2)



G31 Mannanarie SWER feeder

Low Reliability Feeder- Re-insulation Project NPV Calculation summary (only includes the mitigation of those faults highlighted in yellow above and **not** the unhighlighted faults)

Feeder ID	Feeder name	Solution description		Affect on network outage	Solution Units	Capital cost	VCR benefit PA	SPS Benefit PA	Economically viable (benefit cost ratio)	SAPN SPS viability test (5-year)
G31	MANNANARIE 19kV SWER	Insulator Upgrade - SWER porcelain to Cyclo per pole	Reinsulate approx 12 KM	reduce likelihood of outage by 95%	60	$ 91,159	$ 9,426	$ 7,660	✓ 1.36	✗ -$ 55,968

Insulated Unscreened Conductor (IUC) project effectiveness case study

SM350D – Springfield 11kV Feeder

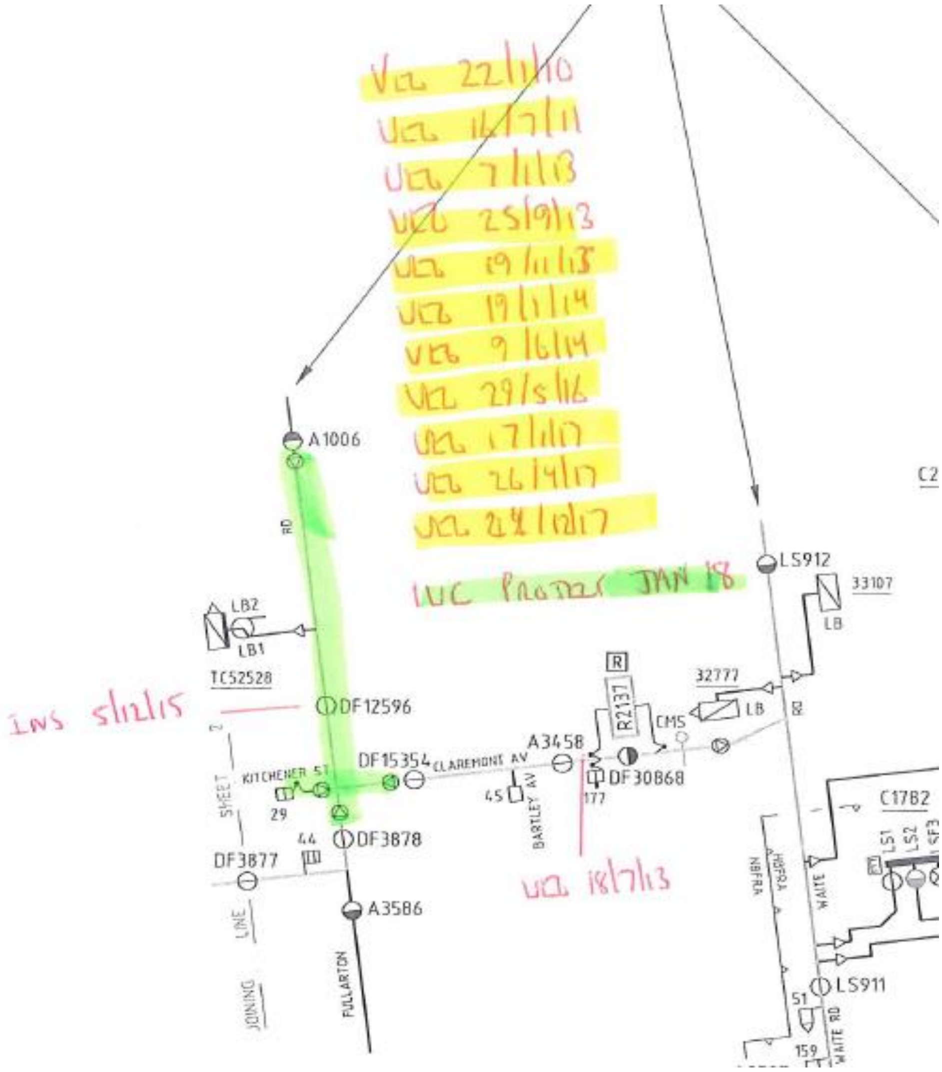
22 spans of bare 11kV overhead conductor was replaced with Insulated Unscreened Conductor (IUC) – Completed January 2018

11 feeder outages caused by vegetation occurred between 1/1/10 to 31/12/17 in the previous bare conductor section.

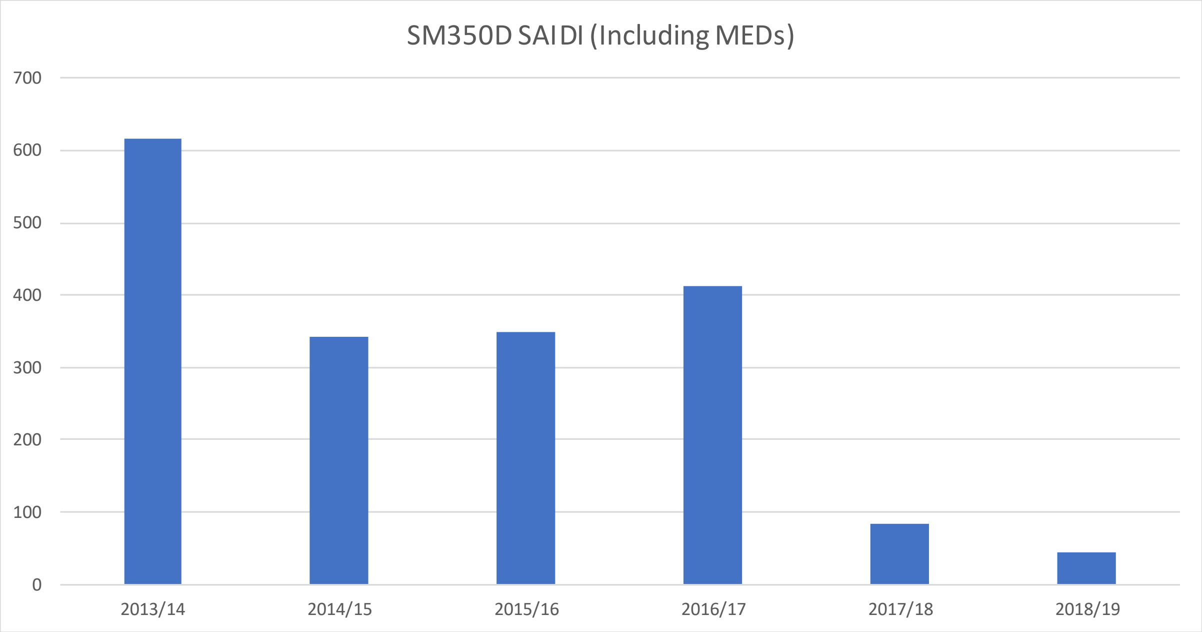
<u>No feeder outages due to vegetation have occurred in the IUC section since the project was completed</u>

This project demonstrates the effectiveness of replacing bare overhead conductor with insulated conductor at targeted locations.

SM350D fault locations 1/1/10 to 4/12/19 (highlighted in yellow) and IUC installation location (highlighted in green)



SM350D – Springfield 11kV Feeder – SAIDI Performance



SAIDI minutes off supply has significantly reduced since the IUC project was completed.

This project demonstrates the effectiveness of replacing bare overhead conductor with insulated overhead conductor at targeted locations.

Re-insulation project effectiveness case study

LC06 – Copley – Nepabunna 33kV Feeder

Insulators upgraded on approx. 160 poles on lightning prone sections

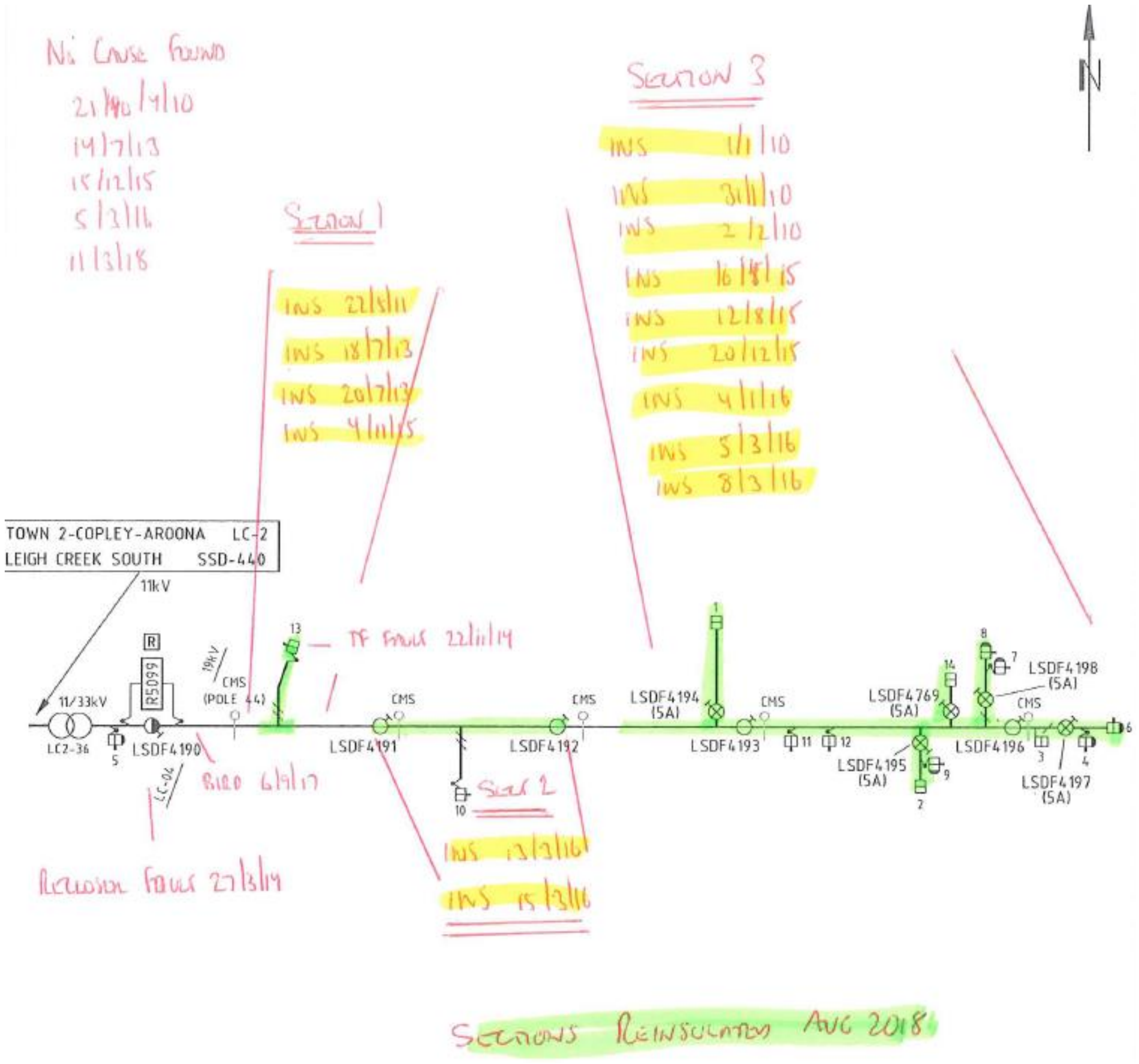
- Completed August 2016

15 feeder outages occurred between 1/1/10 to 1/08/16 caused by lightning damaging porcelain insulators in the sections that were upgraded.

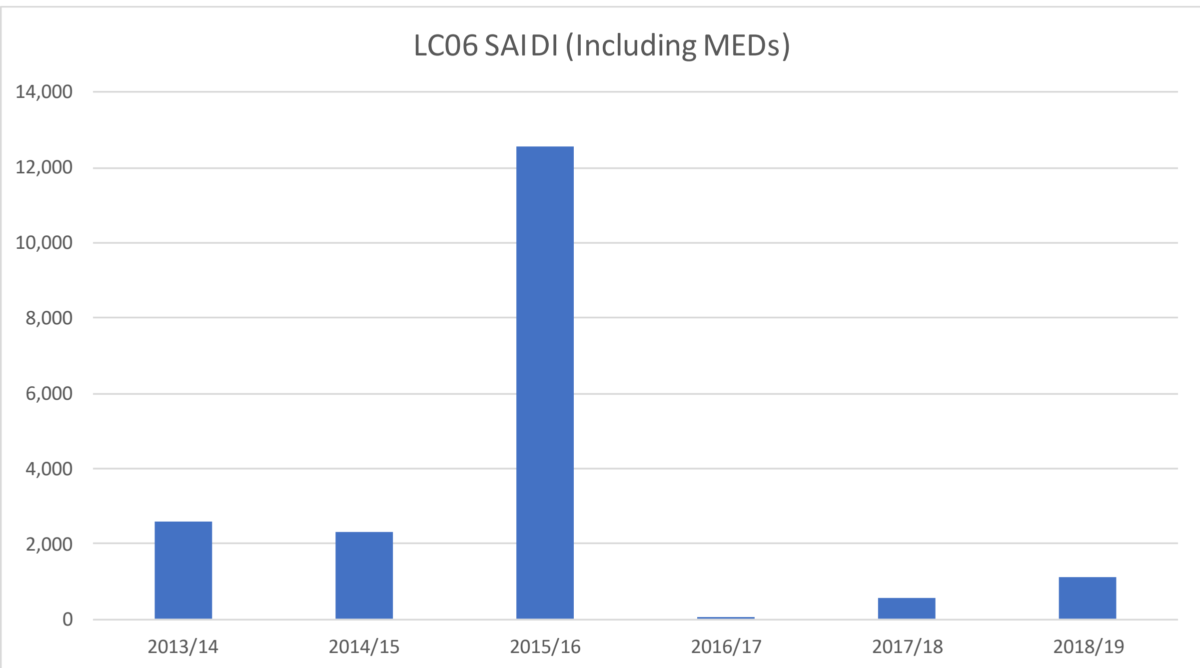
No feeder outages due to lightning damaging insulators have occurred since the project was completed.

This project demonstrates the effectiveness of upgrading porcelain insulators to resin insulators at targeted locations.

LC06 fault locations 1/1/10 to 4/12/19 (highlighted in yellow) and sections where insulators were upgraded (highlighted in green).



LC06 – Copley – Nepabunna 33kV Feeder – SAIDI Performance



SAIDI minutes off supply has significantly reduced since the re-insulation project was completed.

This project demonstrates the effectiveness of upgrading porcelain insulators to resin insulators at targeted locations.