PowerWater

Program Business Need Identification

Power and Water Corporation

CONTROLLED DOCUMENT

NMF / PRD33440 / PRD33451

Poorly Performing Feeder Improvement Program (Repex & Augex Components)

Proposed:

Stephen Vlahovic
Group Manager Network Assets
Power Networks
Date: 15/2/2018

Approved:

Michael Thomson
Chief Executive
Power and Water Corporation
Date: 23/02/2018

Djuna Pollard
Executive General Manager
Power Networks
Date: 15/2/2018

Refer to email D2018/72353

Finance Review
Date: 06/02/2018

Refer to email D2018/69621

PMO QA
Date: 14/02/2018

1 Program Summary

Program Name:	Poorly Performing Feeder Improvement Program (Repex & Augex)		
Program No:	NMF / PRD33440/ PRD33451	**SAP Ref:**	
Financial Year Commencement:	2019/20		
Business Unit:	Power Networks		
Program Owner (GM):	Djuna Pollard	**Phone No:**	08 8985 8431
Contact Officer:	Stuart Eassie	**Phone No:**	08 8924 5214
Date of Submission:	23-02-2018	**File Ref No:**	D2017/373841
Submission Number:		**Priority Score:**	
Primary Driver:	Service Improvement	**Secondary Driver:**	Compliance
Program Classification:	Capital Program of Works		

2 Recommendation

It is recommended that Chief Executive note the proposed five year Poorly Performing Feeder Improvement Program for an estimated budget of $6.8M, and approve the inclusion of this Program into the SCI for this amount, with a corresponding completion date of June 2024.

The forecast for this program of work extends beyond the current SCI period. The first two years of this program aligns with the last two years of the 2017-18 SCI. This program will be included in the 2019-24 Regulatory Proposal to the Australian Energy Regulator (AER).

Note that individual projects within the program will be documented in Business Case Category C to be approved by the Executive General Manager Power Networks.

3 Description of Issues

3.1 Meeting Customer Reliability Expectations

This program is targeted to achieve the “capital expenditure objective” to maintain reliability performance for customers under clause 6.5.7 of the National Electricity Rules. Significant achievements in reliability have been achieved over the past two regulatory control periods. This improvement has been largely derived due to the significant capex program. This improvement

has been experienced by the majority of customers, however some feeders that are significantly below the average service standards have not seen the same level of improvement.

Analysis indicates that focussed remedial efforts will be required with respect to identified poor performing feeders to prevent a projected deterioration in reliability performance. Current trends show that performance for the Rural Short category (both SAIDI and SAIFI) are deteriorating, and are projected to exceed specified thresholds (set by the jurisdictional technical regulator, the Utilities Commission) within the regulatory period.

Customer feedback received during community forums conducted demonstrates willingness for customers in areas of acceptable performance to share funding the cost of improvements in performance for poorly served customers. Customer bill impact figures were used to communicate the likely impact on the network tariff of a $1.5M annual improvement program and this was accepted by the majority of forum participants. Only 13% of participants indicated that they would be unwilling to pay additional charges to improve reliability for customers in other areas. This is summarised in Figure 1 below which has been extracted from the customer focus group research report, performed by an independent service provider[1].

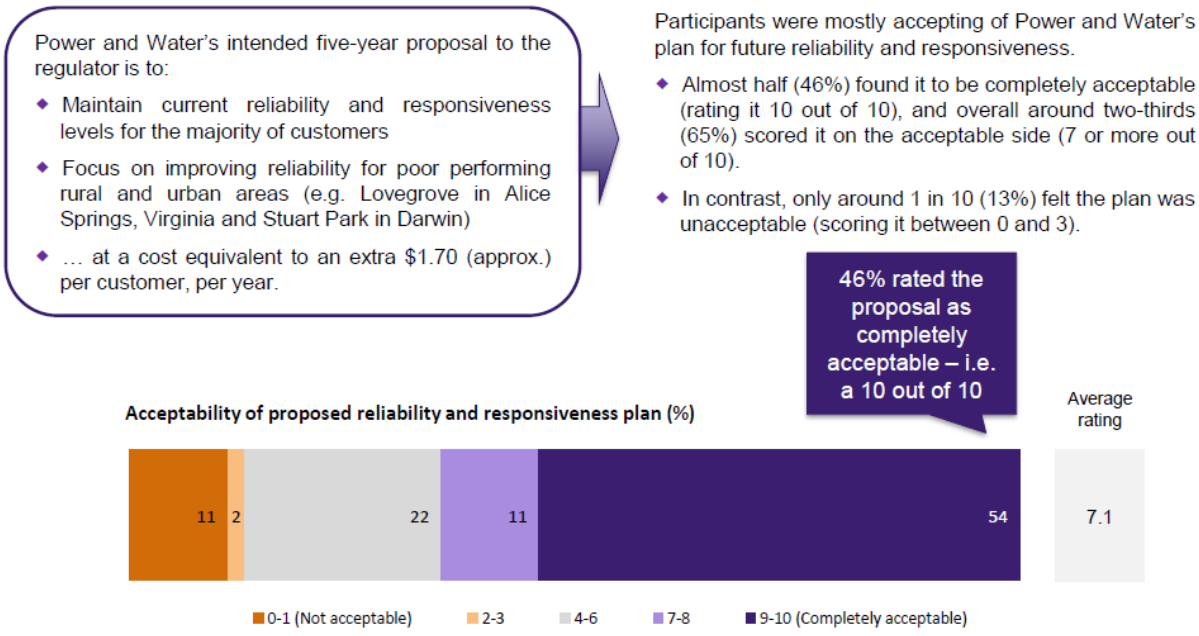

Figure 1 Customer Feedback on Proposed Poorly Performing Feeder Program

An overview of poorly performing feeders based on 2014/15 to 2016/17 data is shown in Appendix B. While it is expected that the feeders will change from year to year it provides an indication of the poorly performing feeders at this current time.

The National Electricity Rules (NER) state that: *"A building block proposal must include the total forecast capital expenditure for the relevant regulatory control period which the Distribution*

[1] Attachment 1.4 PWC01.4 - Engagement Overview - 31 Jan 18 - CONFIDENTIAL

Network Service Provider considers is required in order to achieve … [compliance] with all applicable regulatory obligations or requirements associated with the provision of standard control services."

The Utilities Commission ("the UC") is the jurisdictional technical regulator, and sets requirements with which PWC's standard control services are required to comply.

These regulatory requirements include the UC's Electricity Industry Performance Code[2] ("the Code"), which specifies Standards of Service and Guaranteed Service Levels (GSL).

The requirements within the Code include:

- Reliability targets for Feeder Category performance – different targets are set for System Average Interruption Duration Index (SAIDI) and System Average Interruption Frequency Index (SAIFI) across the four feeder categories of Central Business District (CBD), Urban, Rural Short and Rural Long.
- Poorly Performing Feeders – a requirement for the worst five performing feeders (measured by SAIDI performance) within each Feeder Category to be reviewed with actions taken to address poor performance as appropriate.
- Guaranteed Service Levels (GSL) for individual customers – a maximum allowable single outage duration and number of outages per financial year is set for any individual customer.

3.2 Historical Reliability Performance

Prior to the 2009-14 regulatory period PWC did not implement a strategically targeted reliability program and relied on asset renewal programs to manage underlying network performance. Consequently expenditure on asset replacement programs did not achieve optimal performance improvements in areas of poor reliability and the programs included expenditure in areas of good reliability. Since the current program's development and implementation during the 2009-14 period reliability metrics have significantly improved and stabilised and the trend under the current program[3] (since 2013/14) is considered reflective of underlying reliability performance.

Figure 1 below shows the NT SAIDI and SAIFI performance. The projected trends show underlying performance deteriorating over the coming regulatory period. It should be noted that there are no regulated targets for whole of state SAIDI and SAIFI; the target shown is the weighted average of the feeder category targets by customer numbers.

[2] Utilities Commission, Northern Territory of Australia – Electricity Industry Performance Code – Standards of Service and Guaranteed Service Levels, July 2017

[3] 2014 NPD - Power Networks Feeder Upgrade Program BNI

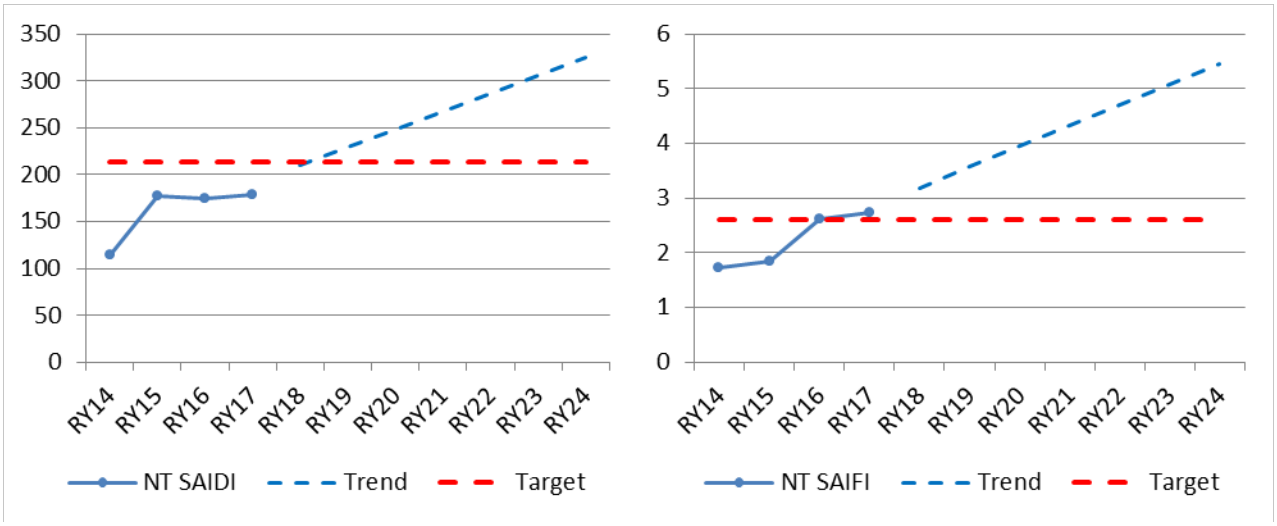

Figure 2 NT SAIDI and SAIFI Trends

3.2.1 Feeder category trends

Feeder category targets are set by the UC under the Code. The UC is yet to determine the targets for the 2019-2024 regulatory period, but it is anticipated that at a minimum they will be based on performance improvements against the past 5 year average actual performance. Table 1 UC EIS Code Feeder Category Targets outlines the targets proposed by PWC, which the UC may decide to tighten further.

Table 1 UC EIS Code Feeder Proposed Category Targets

Feeder category	SAIDI Target	SAIFI Target
CBD	12.31*	0.14*
Urban	138.42	1.97
Rural Short	252.80*	2.87
Rural Long	1,663.12	19.84

** Based on 5-year average of ESAA median which is higher than PWC 5-year average*

Reliability trends for each of the feeder categories indicate that continuation of the current program can be generally expected to result in:

- Stable performance against the CBD and Urban feeder category;
- Deteriorating performance against the Rural Short feeder category; and
- Improving performance against the Rural Long feeder category

The Rural Short feeder category reliability trends are shown in Figure 5.

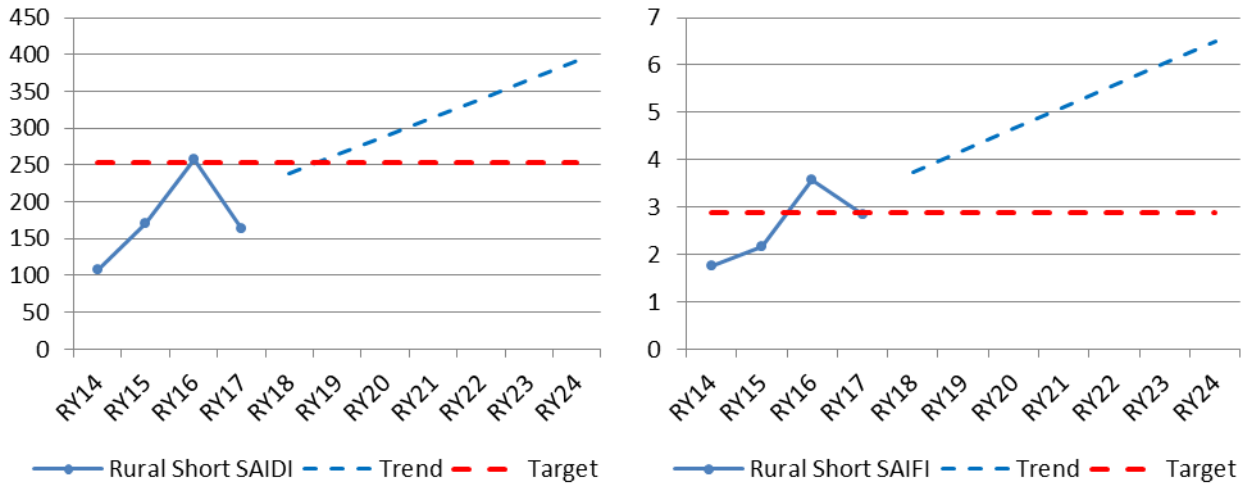

Figure 3 Rural Short feeder category SAIDI and SAIFI trends

3.2.2 Poorly performing feeders

The Code requires that the five worst performing feeders and associated remedial actions be reported on for each category. Whilst feeders can be identified as the worst performing in the feeder category the overall performance against the category target can be good (meeting the targets). Therefore feeders that are identified as worst performing in the Code may not actually be poorly performing in the context of the actual target and the overall network performance. In this situation there is no justification for the reliability improvement works for these 'worst' performing feeders.

To overcome this situation Power Networks employs performance ratios which relate the performance of the feeder to it contribution to the feeder category target. Where a feeder exceeds its category target by a multiple of more than 2.5 it would be identified for additional analysis and potential remedial action. Typically analysis will look at how the feeder has performed over a 3 year period to identify consistent poor performance and common causes for this including asset type failures, animals and vegetation impacts, overloads or restoration times.

Using this methodology an average of thirteen feeders have been addressed each year, comprising 15% Urban feeders, 75% Rural Short feeders, and 10% Rural Long feeders.

A summary of the feeders exceeding their performance ration in 2016/17 is in Table 2 below.

Table 2 Number of Feeders Exceeding Threshold FPR

Feeder Category	Total Number of Feeders	Number of Feeders Exceeding threshold performance ratio
CBD	21	3
Urban	65	1

Rural Short	85	6
Rural Long	3	0

The 5 worst performing feeders in each category based on 2016/17 analysis are listed in Table 3 below. It is clear that in terms of overall network performance, a large majority of rural short feeders are performing consistently poor, while other categories have varied performance but few feeders that exceed the ratio. Exceptions do occur, as reflected by the CBD 2016/17 performance which was the result of a single cable joint failure and a ring main unit protection relay malfunction in that year. Table 4 provides a clearer demonstration of category performance against target by showing only feeders that exceeded the performance ratio in each year, again highlighting the generally poor performance of a significant proportion of rural short feeders.

Table 3 2016/17 Poorly Performing Feeders

Feeder category / Target	Feeder name	2016/17 Ratio	Feeder name	2015/16 Ratio
CBD 12.31	11WB01 PARLIAMENT	**16.848**	11AK02 KNUCKEY ST	0.561
	11MS10 SHADFORTH	**5.199**	11WB09 ESPLANADE 2	0.517
	11FB06 FB-MS 1	**4.144**	11WS12 KITCHENER	0.507
	11AK02 KNUCKEY ST	0.444	11AK08 STATE SQUARE	0.300
	11WS04 LINDSAY 1	0.165	11AK07 SEARCY	0.139
Urban 138.42	11WN02 FANNIE BAY	**6.184**	11RG08 CBD	**6.060**
	11WN29 BAYVIEW	2.159	22SY13 MCMINNS PUMPS	**4.653**
	11DA27 STUART PARK	2.099	11WN02 FANNIE BAY	**2.639**
	11PA22 PALM CIVIC	1.965	11FB10 CAREY STREET	2.391
	11CA12 MARRARA	1.756	11BE19 HIDDEN VALLEY	2.348
Rural Short 252.80	22HD402 LAMBELLS	**4.300**	22MT06 LAKE BENNETT	**5.085**
	22HD403 MIDDLE POINT	**4.000**	22MT07 ACACIA	**4.832**
	22SY02 MCMINNS	**2.922**	11WN12 WINNELLIE	**4.343**
	22RG13 BREWER 1	**2.662**	22HD403 MIDDLE POINT	**4.030**
	22SY12 NOONAMAH	**2.547**	22KA03 FLORINA	**3.972**
Rural Long* 1,663.12	22SY04 DUNDEE	**1.367**	22SY04 DUNDEE	0.528
	22KA10 MATARANKA 1	0.229	22KA10 MATARANKA 1	0.477
	22TC01 ALI CURUNG	0.226	22TC01 ALI CURUNG	0.067

*Note there are only 3 Rural Long feeders in the network.

Table 4 Feeders Exceeding 2.5 Times Category Target in 2015/16 and 2016/17

Feeder category / Target	Feeder name	2016/17 Ratio	Feeder name	2015/16 Ratio
CBD 12.31	11WB01 PARLIAMENT	16.85	None Identified	N/A
	11MS10 SHADFORTH	5.20		
	11FB06 FB-MS 1	4.14		
Urban 138.42	11WN02 FANNIE BAY	6.18	11RG08 CBD	6.06
			22SY13 MCMINNS PUMPS	4.65
			11WN02 FANNIE BAY	2.64
Rural Short 252.80	22HD402 LAMBELLS	4.30	22MT06 LAKE BENNETT	5.09
	22HD403 MIDDLE POINT	4.00	22MT07 ACACIA	4.83
	22SY02 MCMINNS	2.92	11WN12 WINNELLIE	4.34
	22RG13 BREWER 1	2.66	22HD403 MIDDLE POINT	4.03
	22SY12 NOONAMAH	2.55	22KA03 FLORINA	3.97
	22PA202 HOWARD SPRINGS	2.51	11BE04 MCMILLANS	3.65
			22SY11 HERBERT	3.2
			22MR103 MT BUNDY	2.94
			22BR104 HERMANNSBURG	2.84
			22KA18 GORGE	2.57
Rural Long 1,663.12	22SY04 DUNDEE	1.37	None Identified	N/A

It is expected that poorly performing feeders will continue to be identified through analysis of feeders that exceed the performance ratio multiple times over several years. This is expected to result in expenditure being weighted towards the Rural Short category where a high proportion of feeders are performing poorly. This also aligns with customers' expectations in relation to addressing areas of poor performance, while maintaining current levels of reliability in other areas.

3.2.3 Guaranteed service levels (GSL)

Guaranteed Service Levels (GSL) are considered in addition to poorly performing feeders. This ensures that individual customers are not overlooked because the poor performance of their feeder segment does not supply enough customers to push the feeder into the poor performance category.

Table 3 shows the number of customers who qualified for GSL payments in 2016/17, including the associated feeder category and type of GSL breach. As outlined below the majority of customers with GSL breaches are supplied by Rural Short and, in particular, Rural Long feeders.

Table 5 Number of Customers receiving GSL payments in 2016/17 by Feeder Category

Feeder category	> 12 interruptions	Cumulative interruptions > 20 Hrs	Single interruption >12 Hrs	Single interruption >20 Hrs
CBD	0	0	0	0
Urban	0	0	0	0
Rural Short	213	8	0	1
Rural Long	579	545	0	0

It should be noted that while the GSL analysis gives an indication of feeders with performance issues, each feeder will be individually investigated in detail to identify specific issues and suitable actions. Actions may include monitoring, non-network solutions, operational works, or capital works.

Rural long feeders have an inherently greater exposure to faults from weather events, animals and vegetation. This is reflected in category targets that are more than 6 times that of other categories. It is not efficient to target significant expenditure at reducing the performance of these feeders to a similar level as other categories. However GSL payments and customer feedback do provide some justification to develop low-cost Capex solutions to improve the performance of these feeders. Solutions to reduce fault finding and restoration times are considered the most efficient solution for such long feeders which are subject to significant access issues during the wet season.

3.3 Maintaining Reliability in Other Areas

The Rural Short, and to a lesser extent Rural Long, categories will be a focus of reliability driven investment in the next regulatory control period, which aligns with both the evidence of ongoing poor performance and customers' expectations to improve reliability to poorly served customers. While performance in other categories will also be monitored and actioned if required, it is expected that investment in other risk and condition based asset replacement programs will achieve the objective of maintaining current levels of reliability. While not primarily driven by reliability, current and proposed programs and projects that are in progress or proposed will achieve this objective in the CBD and Urban categories include:

- Oil ring main replacement program (current)
- Darwin northern suburbs high voltage cable replacement program (current and proposed)
- Darwin coastal crossarm corrosion replacement program (proposed)
- Distribution substation replacement programs (current and proposed)
- Darwin major switching station replacements (current)
- Berrimah Zone Substation replacement (current)

3.4 Project Drivers

Compliance
The UC outlines requirements in the Electricity Industry Performance Code with which PWC's standard control services are required to comply. Among these requirements are reliability targets for each feeder category. In accordance with the Code, PWC is compelled to "use its best endeavours to meet the target standards". Accordingly, this program is intended to ensure that reliability targets continue to be met, particularly with respect to the Rural Short feeder category.
Reliability (if not compliance obligation)
The Code requires that PWC identify consistently poorly performing feeders, with actions taken to address poor performance as appropriate. While this program is intended to maintain reliability performance at a category level, specific poor performing feeders will be identified and targeted for improvement to achieve this goal. Guaranteed service levels for customers will also be considered to identify feeders with performance issues. This ensures that the dual requirement of meeting feeder category targets and addressing poorly performing feeders can be met.
Customer consultation or other benefits (if not compliance obligation)
Customer feedback received during community forums conducted demonstrates a willingness for customers in areas of acceptable performance to pay for improvements in performance for poorly served customers. Customer bill impacts were used to communicate the likely impact on the network tariff of a $1.5M annual improvement program and this was accepted by the majority of forum participants. Only 13% of participants indicated that they would be unwilling to pay additional charges to improve reliability for customers in other areas. It is also clear from the engagement work performed that customers are generally unwilling to accept a reduction from current levels of reliability even for lower costs, preferring to maintain the status quo in terms cost, but continue to improve reliability through better use of technology and innovation.

4 Potential Solution

Option 1 – Discontinue program

There may be a case to discontinue the program given that the 2014-19 program has stabilised the substantially fluctuating reliability performance of prior years. However, under this option PWC's reliability performance can be expected to deteriorate, with substantial performance fluctuations over the next period. In particular, the performance of the Rural Short feeder

category would be expected to rapidly deteriorate such that targets specified within the Code would be breached.

Further, this option would not meet the NER capital expenditure objective - i.e. to meet jurisdictional requirements (poorly performing feeders would not be addressed and category targets would not be met) or maintain performance (performance would be allowed to deteriorate).

This option would also not address the concerns raised by customers during PWC engagement program.

Option 2 – Consider the Code defined "poorly performing feeders" only

The Code defines poorly performing feeders as the worst five feeders from each category based on SAIDI. PWC is required to report these and the action that PWC intends to take to improve their SAIDI performance.

Limiting reliability consideration to these feeders only would not maintain performance:

- Feeders with performance issues and the total number of feeders are weighted towards the Rural Short category. If only the worst five SAIDI feeders are considered then the performance of the category can be expected to deteriorate.
- Considering performance purely based on feeder SAIDI is a limited view of supply reliability. It does not consider number of outages (SAIFI), or individual customers whose supply reliability is not meeting guaranteed service levels. Customer responses through PWC's 2017 deliberative forums show that participants had more accepting attitudes to longer duration outages than higher frequency outages.

Further, this option would not meet the NER capital expenditure objective i.e. to meet jurisdictional requirements (poorly performing feeders would not be addressed and category targets would not be met) or maintain performance (performance would be allowed to deteriorate).

Option 3 – Continue with the existing program

The existing program has stabilised the substantially fluctuating reliability performance of prior years. However, continuing with the current program without calibrating the decision criteria is projected to improve the performance of the Rural Long category and allow the performance of the Rural Short category to deteriorate. As such, this option would not meet the NER capital expenditure objective i.e. to meet jurisdictional requirements (Rural Short category targets would not be met) or maintain performance (performance would be improved for the Rural Long category and allowed to deteriorate for the Rural Short category).

Option 4 – Calibrate the existing program to maintain performance (Preferred Option)

Calibrating the existing program to maintain performance will meet the NER capital expenditure objective i.e. to meet jurisdictional requirements or maintain performance. Further, it will ensure that individual customers whose supply reliability is not meeting guaranteed service levels will be addressed.

4.1 Preferred Option

The preferred option is to calibrate the existing program to maintain performance (option 4). This is the optimal solution that meets the NER capital expenditure objective i.e. to meet jurisdictional requirements or maintain performance.

The individual projects chosen to address specific feeder issues vary based on the characteristics of the affected feeder or portion of a feeder. Factors include the operational environment, asset age, construction type and standards applied at the time of construction. The configuration of the surrounding network is also applicable in areas where the network is meshed or interconnected.

Projects will generally fit into the following categories:

- *Asset Replacements:* Replacement of poletops and conductors to improve insulation levels and reduce risk of vermin causing outages. The typical outcome from this is fewer outages but at a high cost due to the effort required to replace poletops and conductor.
- *Asset Upgrades*: Installation of bat-guards on insulators to make the poletop more resilient to animal-related failures. Other upgrades may include the installation of fault indicators to reduce restoration time, or conductor spacers to increase resilience to weather and vegetation faults.
- *Feeder Sectionalising:* Feeder sectionalisation provides greater flexibility in fault finding and restoration using a combination of automatic reclosers and switches. The typical outcomes are fewer customers being affected by permanent and transient faults and shorter duration outages. The effectiveness is high for areas with limited or no automation but there are diminishing returns for additional automation over time. Some additional OPEX is incurred to manage additional devices in the network, including SCADA and Communications.

The performance of individual feeders will be analysed annually to identify the poorly performing feeders, or feeder areas with poorly served customers. Projects that provide the highest level of improvement to SAIDI and/or SAIFI for the lowest cost will be prioritised. This approach also allows for consideration of the impact of other asset replacement programs on reliability, ensuring solutions are delivered as efficiently as possible.

Analysis of outage causes in Figure 6 Outage Cause Breakdown shows that asset failures, weather, third party impacts, and unknown (typically weather, animals or vegetation) are the primary causes.

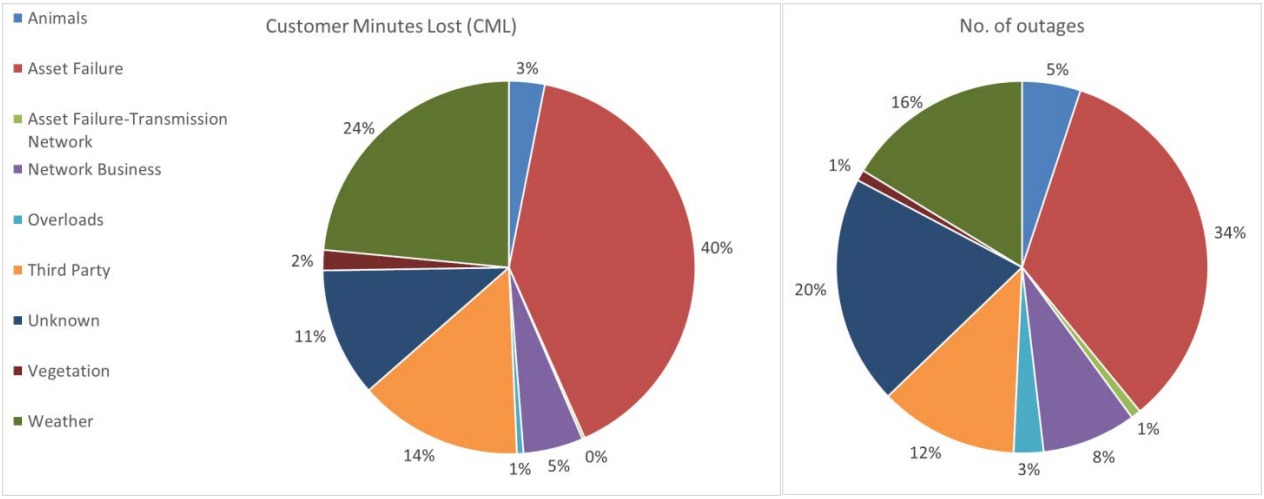

Figure 4 Outage Cause Breakdown

Generally, the preferred solutions for primary causes:

- *Asset Failure*: Where poor performance is caused by asset failures, defect remediation is the preferred option. Once the defect remediation solution is exhausted, asset replacements would be preferred capital solution to address poor performance.
- *Weather* and *Unknown*: Where poor performance is caused by weather, feeder sectionalising would be preferred capital solution to address poor performance and assist in identifying problem areas to be targeted with other solutions such as vegetation management and conductor spacers,
- *Third Party*: Where poor performance is caused by third party actions, solutions such as defect remediation and public awareness are the preferred option. These solutions are not captured within this program.

4.2 Non-Network alternatives

Each feeder is assessed based on individual performance to identify the direct causes of reliability. Where opportunities exist to perform non-network solutions to address reliability issues these will be prioritised. PWC's primary non-network solution for addressing reliability issues is the public awareness program.

4.3 Capex/Opex substitution

Capex/Opex substitution will be considered as part of assessing individual feeder performance. For example, typically a vegetation management and defect remediation, and other operational solutions will be exhausted prior to asset renewals.

Of the primary outage causes, asset failures (and subsequent replacements) are typically the most capital intensive. Figure 7 below shows that the contribution of asset failures to poor performance is increasing. This suggests that an increasing proportion of the feeders that are identified as poor performers will require a capital solution (and hence included under this BNI).

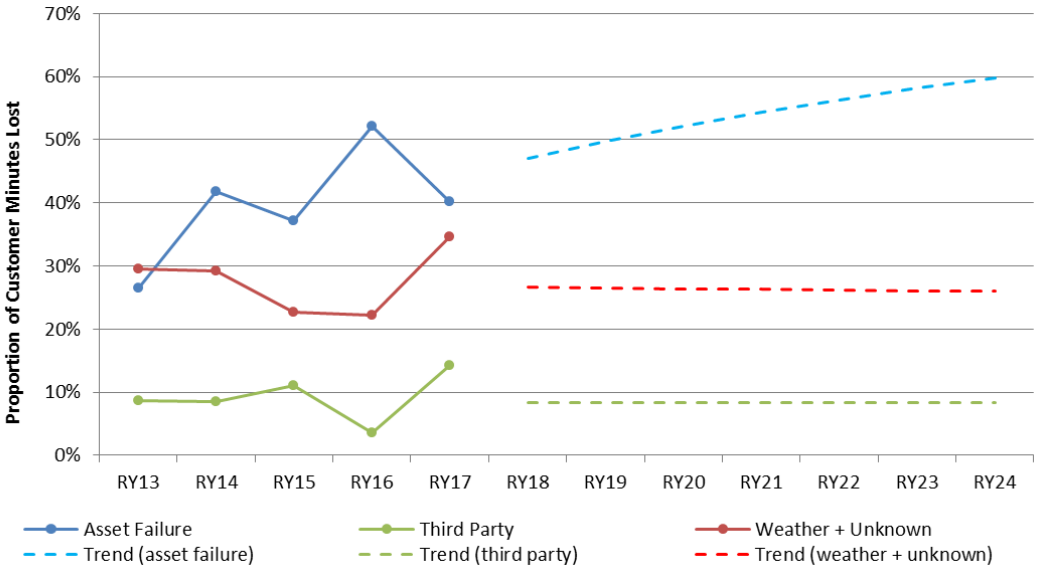

Figure 5 Asset Failure Contribution to Reliability Performance

4.4 Contingent Project

The expenditure does not meet the criteria for a contingent project as outlined in the Northern Territory National Electricity Rules, section 6.6A.1.

5 Strategic Alignment

This program aligns with the Asset Objectives defined in the Strategic Asset Management Plan (SAMP), Asset (Class) Management Plans (AMP) and Power Networks Reliability Strategy. The capital investment into feeder performance improvements in this program will contribute to the Corporation achieving the goals defined in the boards Strategic Directions and SCI Key Result Areas of Operational Performance and Customer.

6 Timing Constraints

The program is calibrated to ensure that regulatory reliability targets continue to be met. Deferral of this program increases the compliance risks to the business, and would negatively impact customer service.

It is intended to deliver the program consistently over the regulatory years to minimise the delivery risks associated with internal resourcing.

7 Expected Benefits

Driver	Benefit	Measure
Service Improvement	Improved reliability to poorly served customers.	SAIDI and SAIFI performance of individual feeders.
Asset Renewal	Aged assets affecting reliability will be identified as part of performance analysis and replaced prior to failure.	SAIDI and SAIFI performance of individual feeders.
Compliance	Meet UC reliability targets and address worst performing feeder requirements.	SAIDI and SAIFI performance of individual feeders.
Social / Environmental	Improved reliability to poorly served customers.	SAIDI and SAIFI performance of individual feeders and VCR impact of reliability improvements.
Commercial	Reduction in GSL payments to customers	GSL payments

8 Milestones

Investment Planning	Project Development	Project Commitment	Project Delivery	Review
01/2018	NA	07/2019	06/2024	09/2024

The program delivery is scheduled to run over 5 years from July 2019 to June 2024. A program review will be held at the end of the 5 year program as well as interim reviews at the end of each Financial Year.

9 Key Stakeholders

Stakeholder	Responsibility
Internal governance stakeholders	Executive General Manager Power Networks
	Group Manager Service Delivery
	Chief Engineer
Internal design stakeholders	Senior Manager Network Development and Planning
	Senior Manager Contracts and Projects
	Senior Manager Asset Management

Stakeholder	Responsibility
	General Manager System Control
	Manager SCADA and Communication Services
External – Unions and public	Local Residents
	ETU
	Ministers
External regulators	Utilities Commission
	Australian Energy Regulator

10 Resource Requirements

Resource requirements for this project are considered business as usual. Part of the annual planning process includes assessment of current feeder performance against requirements of the code and identification of targeted projects to address performance of those feeders.

11 Delivery Risk

No specific delivery risks have been identified. Works are undertaken through a combination of internal and external resources, dependent on the skills required to perform identified improvement work.

12 Financial Impacts

Expenditure forecasted is for Capex and minimal direct change to Opex is expected.

12.1 Expenditure Forecasting Method

The investment required to meet the requirements of the Code and maintain performance going forward has been estimated based on consideration of:

- Historical averages for replacement and augmentation activities typically performed under the current program.
- Projected trends based on continuing the approach from the previous regulatory period;
- Forecast asset replacement and augmentation that will improve reliability across various categories and regions; and
- Analysis of current performance issues, whereby:
  - An individual feeder has exceeded its category thresholds; and

- Service to individual customers has not met the minimum GSLs.

It is not expected that targeted improvements to poorly served customers will lead to improvements to overall network performance, but rather, contribute to addressing deteriorating performance or maintaining current performance.

Each feeder's performance will be individually assessed in detail each year to determine the most efficient solutions to reliability issues on poorly performing feeders. Other replacement and augmentation work planned will be taken into consideration when assessing poorly performing feeders to ensure investment is efficient.

12.2 Value of Customer Reliability

The program forecast cost has been assessed against the Value of Customer Reliability (VCR) achieved by the corresponding SAIDI improvement. A VCR for the NT has not been calculated by AEMO as has been done for other states. The unique nature of PWC's disparate minor grids is expected to make this complex and difficult to represent as a single figure. While the industrial and commercial sector is relatively small in the NT, potentially reducing VCR as compared to other states, the isolation of Darwin, Katherine, Alice Springs and Tennant Creek from other major centres would need to be considered. As such for this program, the NT VCR has been estimated conservatively by using the average residential value from the other states.

Using average Rural Short customer loads, this corresponds to a VCR for improving Rural Short reliability of approximately $32k per SAIDI minute. The program expenditure therefore needs to achieve a gross reliability improvement of 42 minutes per year in order to be justified solely based on VCR.

It is challenging to estimate the SAIDI impact of delivering the proposed program, however insight can be gleaned from reviewing the previous and current regulatory period performance. The establishment of a reliability-focussed program in 2008/09 led to a clear down-trend until around 2013/14, when the trend began to reverse. The average Rural Short SAIDI has decreased by more than 200 minutes from the previous period to the current period. Taking into account that underlying reliability will naturally decrease over time, and that not all historical expenditure was on Rural Short feeders, the historic expenditure appears to be justified by the net reliability improvement.

Based on current trends, the Rural Short SAIDI is forecast to exceed regulatory targets by approximately 140 minutes and 16/17 levels by 240 minutes at the end of the next regulatory period. Therefore it can be inferred that the forecast program expenditure is supported on a VCR basis.

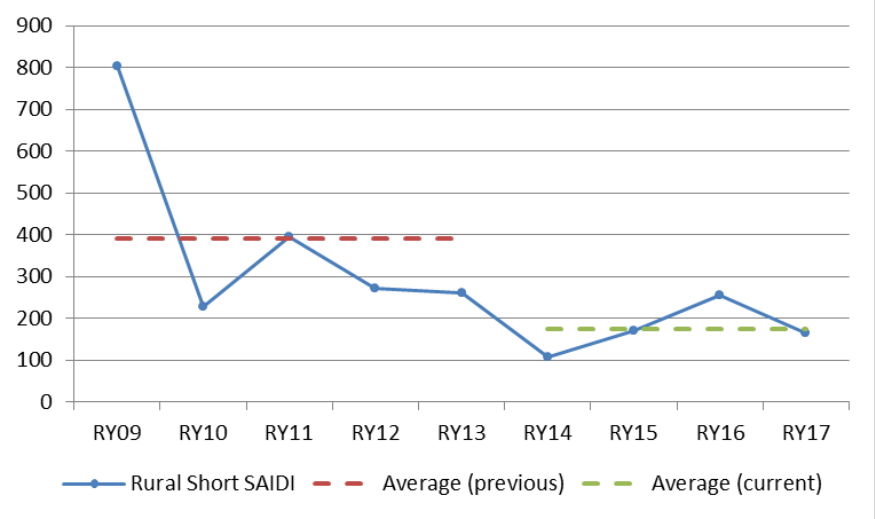

Figure 6 Rural Short Historical Performance

12.3 Historical and Forecast Expenditure

The proposed forecast expenditure is $0.13M, or 10%, lower than historical expenditure as shown in Figure 9 below. This reflects an improved performance in reliability generally across the period which appears much more stable than in prior years. However more onerous reliability targets and investment required in the Rural Short and Rural Long categories, as well as some localised issues in the Urban category, do require a minimum level of expenditure over the period. The forecast proposed represents what is considered this minimum level of expenditure based on current network performance trends.

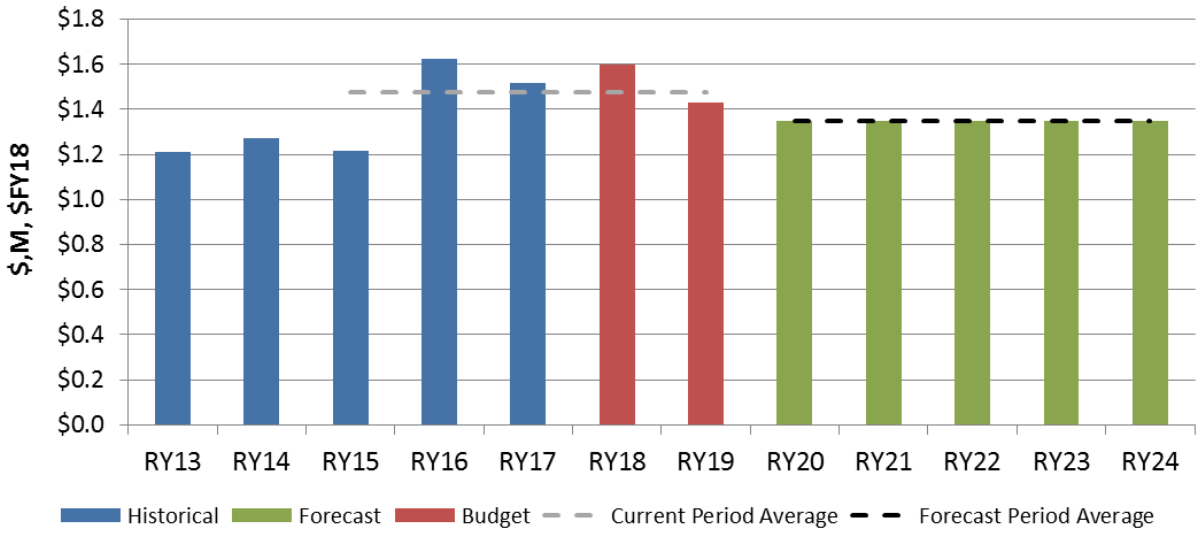

Figure 7 Historical and Forecast Expenditure

12.4 Validation

Forecasts have been validated through analysis of historical costs and benchmarking, where possible, with other NEM participants.

12.5 Capex Profile

The capex in the table below is in $2017-18, and is excluding capitalised overheads and cost escalation.

Phase	2019-20 ($M)	2020-21 ($M)	2021-22 ($M)	2023-24 ($M)	2024-25 ($M)	Total ($M)
Investment Planning						
Project Development						
Project Commitment						
Project Delivery	1.35	1.35	1.35	1.35	1.35	6.75
Review						
Total	1.35	1.35	1.35	1.35	1.35	6.75

12.6 Opex Implications

It is not expected that Opex changes as a direct result of maintaining reliability will be material.

While underlying reliability will be improved on some feeders, it is expected that other feeders with limited or no upgrade works will also experience poorer reliability over the period. Only improvements that result in avoidance of outages, such as hardware upgrades, will reduce the need for crews to attend to faults. As sectionalising and automation are the lowest cost options to improve reliability it is difficult to determine the potential reduction in field crew attendance. Sectionalising does not avoid the need for crews to attend to permanent faults.

12.7 Variance

The forecast for this program of work extends beyond the current SCI period. The first two years of this program aligns with the last two years of the 2017-18 SCI.