Grid Comms DC Systems Replacements Ergon

Justification Statement

10/ 10/ 2024

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DOCUMENT VERSION

Version Number	Change Detail	Date	Updated by
1.0	Approved Version	15/11/2024	General Manager Grid Technology

1 SUMMARY

Title	Grid Comms DC Systems
DNSP	Ergon Energy
Expenditure category	☒ Replacement ☐ Augmentation ☐ Connections ☐ Non-network
Identified need *(select all applicable)*	☐ Legislation ☒ Regulatory compliance ☒ Reliability ☐ CECV ☐ Safety ☐ Environment ☐ Financial ☐ Other This ongoing program to replace communication DC systems addresses the need to ensure costs and risk remain manageable by replacing higher risk component of the asset base in a timely fashion before the cost of inservice failures and associated issues escalate to unmanageable levels in terms of costs and risk.
Expenditure	(see table below)
Benefits	This proactive program will reduce costs associated with moving to a reactive program, will reduce risks associated with increased outages of in service equipment and has a range of other advantages compared to the a fail fix asset strategy.

Expenditure:

Year	2025-26	2026-27	2027-28	2028-29	2029-30	2025-30
direct 2022-23	$0.99M	$0.99M	$0.99M	$0.99M	$0.99M	**$4.94M**

2 PURPOSE AND SCOPE

This document recommends the optimal capital investment necessary for communication DC System replacements. This is a preliminary business case document has been developed for the purposes of seeking funding for the required investment in coordination with the Ergon Regulatory Proposal to the Australian Energy Regulator (AER) for the 2025-30 regulatory control period. Prior to investment, further detail will be assessed in accordance with the established Energy Queensland investment governance processes. The costs presented ($4.94M) are in (2022/23) direct dollars.

3 BACKGROUND

3.1 Asset Population / Site Summary / Capability

Ergon Energy currently operates a large number of communication sites to meet legislative requirements for operation of the electricity network. The DC Systems provide the DC supply to all of the communication systems that support protection communication and SCADA, while catering for number of other services such corporate computing, substation voice, in field mobile voice comms and a range of miscellaneous network related services. The DC Systems are employed to ensure on-going function of telecommunications sites in the event of mains outage. The size of the DC system is typically sized based upon the criticality of the site to ensure that critical services are available for sufficient lengths of time. Critical telecommunications sites will often have duplicate DC systems to ensure reliable and secure operation.

The communication DC Battery Systems are separated into three levels categorised below based on size:

- Large – Battery systems with 32 or more cells
- Medium – Battery systems with between 9 and 31 cells.
- Small – Battery systems with 8 or less cells.

The batteries are controlled and charged by a variety of types of battery chargers. These contain rectifiers that scale with the battery quantity and type.

At the time of preparing this documented, it is estimated that Ergon Energy has the below distribution of assets:

Asset Class / Technology Type	Total Quantity
DC Systems	
Small Battery Bank	133
Medium Battery Bank	53
Large Battery Bank	83
Battery Charger	260

Table 1: Asset Summary

3.2 Asset Management Overview

Ergon Energy typically replaces assets based on age, condition or a combination of both, below shows a table detailing the category of assets, install base and number of assets at critical sites that are expected to exceed their design and/or operational life as of 2030. This program will replace assets that are end of life based on age or condition to ensure reliable operation of the telecommunications network.

Asset Class / Technology Type	Total Quantity	2025-30 End of Life Quantity	Driver
Small Battery Bank	133	42	**Age/Condition Based Replacement**
Medium Battery Bank	53	23	**Age/Condition Based Replacement**
Large Battery Bank	83	32	**Age/Condition Based Replacement**
Battery Charger	260	78	**Age/Condition Based Replacement**

Table 2: Asset Summary

EQL monitors the condition of the DC Systems through monitoring, alarm management, field assessments and programmed inspections. The information provided can identify the deterioration or degraded state of the DC systems. This information is used to inform proactive replacement programs.

Where deemed sufficiently critical to on-going reliable operation of Ergon Energy telecommunications sites, Ergon Energy employs an age-based replacement program to ensure in-service failure is minimised. This is evident in the approach to battery replacement programs to ensure operation of telecommunications sites in events where mains power is lost to the site and reliable and secure function of the radio equipment is most valuable.

This proposal addresses the approaching need to replace a number of Aged and poor performing batteries and chargers within the next regulatory period.

3.3 Asset Age Distribution

The DC systems in service were installed between 1990 and 2023. A significant program of replacement was undertaken in the Ergon network from 2010 to 2014 as part of the development of an internal telecommunication infrastructure platform to deliver enhanced monitoring and control of the distribution network. The assets that were installed through this program are now reaching the end of their useful life, experiencing degradation or in-service failure. It is noted that some sub components have been replaced across this time with smaller failures that are experienced.

Of particular interest in this program are battery banks and chargers, where the observed failure rates start increasing at 7 years with an average life around 10 years for Batteries.

The graph below highlights the age of the rectifiers in the battery charger racks:

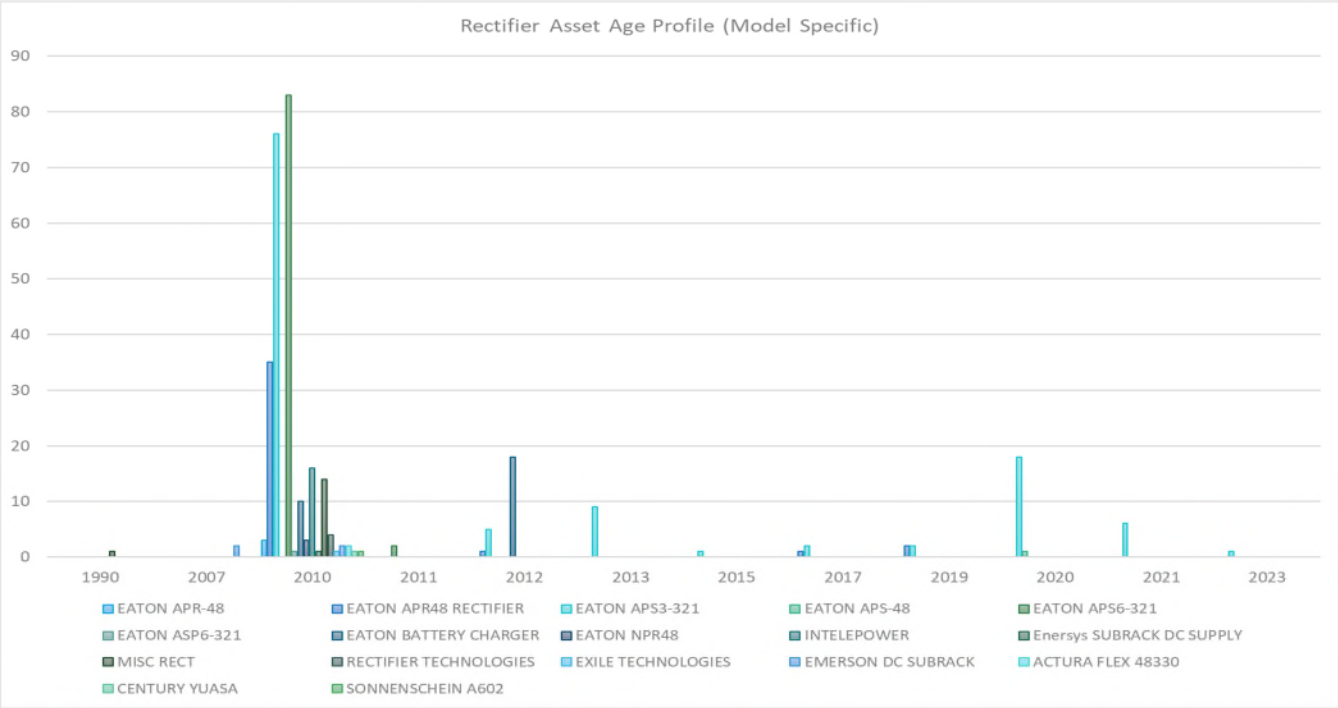

Figure 1: Age Distribution Rectifier

The graph below highlights the age of the batteries in service:

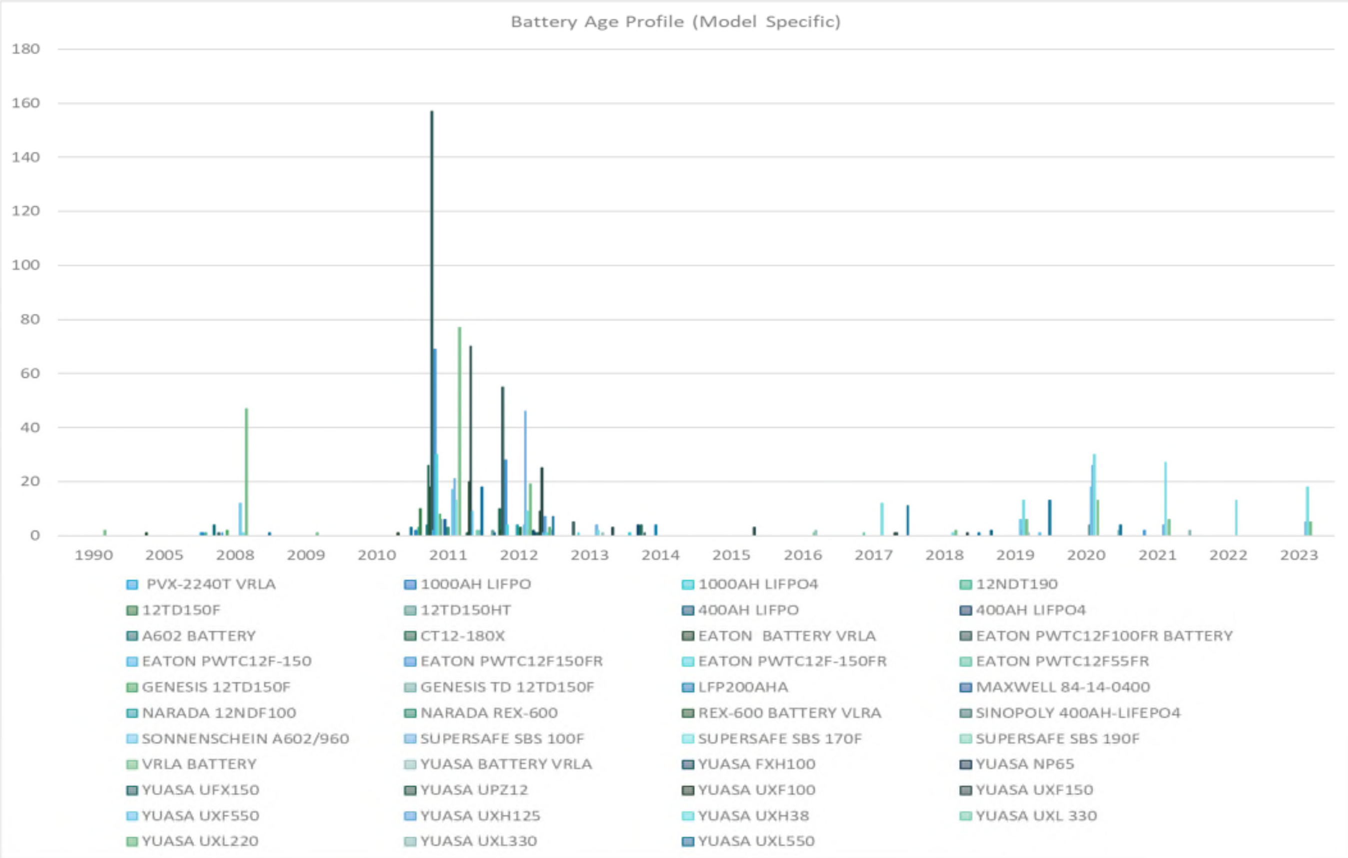

Figure 2: Age Distribution Battery Strings

3.4 Asset Failures

The majority of the battery chargers and rectifiers were installed between 2000 and 2022. Failure rates for batteries as seen in figure 3, are increasing. A conservative failure rate is assumed at 6% for Batteries and rectifiers.

The graph below highlights the failure rate of the rectifiers that are installed in battery chargers.

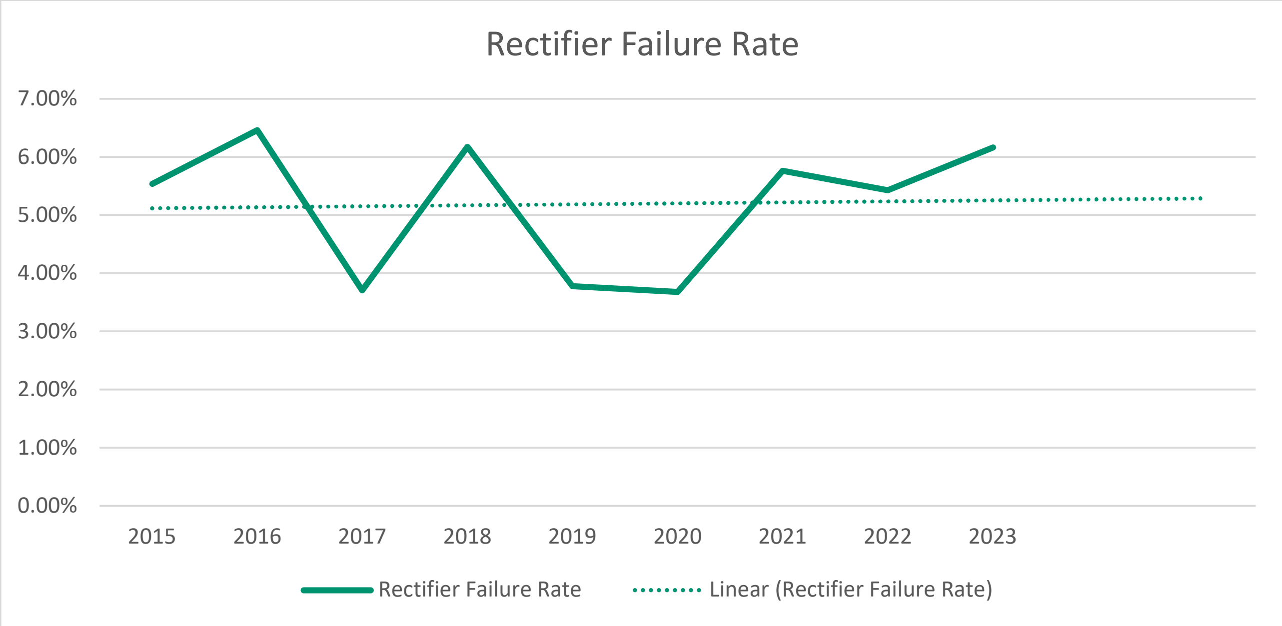

Figure 3: Rectifier Failure Rates

The graph below highlights the failure rates of Battery Cells that are installed in battery banks. The batteries are replaced under an Aged Asset program, or reactively when a failure is identified and are typically under 15 years old.

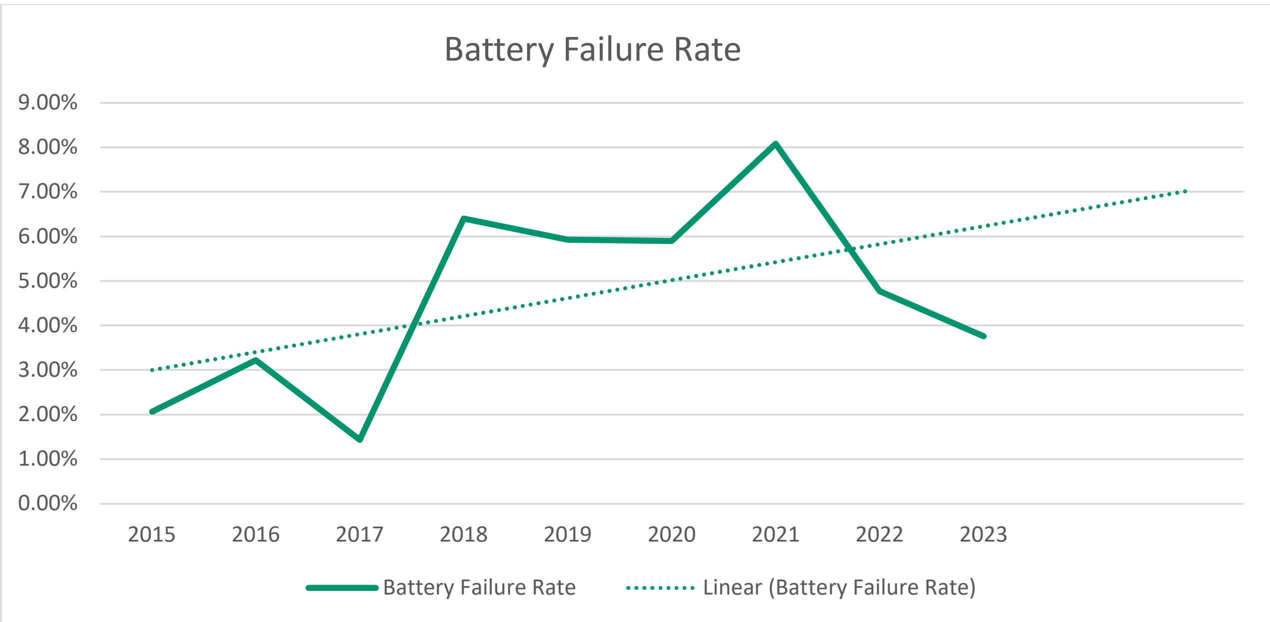

Figure 4: Battery Failure Rates

3.5 Technical considerations

Below are the current and future considerations for replacement of the battery systems

- Change to AS 2676.2:2020 - Guide to the Installation, Maintenance, Testing and Replacement of Secondary Batteries in Buildings – Sealed Cells standard, relating to the installation of battery systems, including ventilation and load requirements, resulting in significant changes to required infrastructure to meet the safety.
- Within the network there are numerous non standard and legacy chargers, rectifiers and battery types. Many of these are not capable of being managed effectively or provide the standard control and alarm functions. Increasingly these are no longer supported by the manufacturer, as they are end of life and spares are unable to be obtained. As a result, if any issues arise, Ergon may experience prolonged downtime and difficulty in troubleshooting and resolving power-related problems.
- Fix on fail is difficult with the battery systems, as procurement lead times are typically at least 4-6 weeks, depending on the equipment required. There are logistical challenges to storing batteries in warehouse arrangements, as they need to be kept on charge whilst meeting the ventilation requirements. The vast geographical spread of the Ergon area results in a high cost to store numerous types of spares batteries around the state.
- Design effort is required in almost all replacements, due to the significant number of differing battery cell types, like for like is rarely possible, coupled with the new battery standard that requires civil and electrical input to ensure the installations meet the standards.

4 IDENTIFIED NEED

4.1 Summary

This program seeks to manage costs and risks associated with provision communications services by replacing DC systems used to power communications equipment ahead of in service failure. Not proceeding with the program will require expensive reactive replacement when units fail Inservice and no spares are available.

Ergon aims to minimise expenditure in order to keep pressure off customer prices, however understands that this must be balanced against critical network performance objectives. These include network risk mitigation (e.g. safety, bushfire), regulatory obligations (e.g. safety), customer reliability and security and preparing the network for the ongoing adoption of new technology by customers (e.g. solar PV). In this business case both safety and reliability are strong drivers, based on the need to address known issues with communications buildings and external cabinets that will otherwise increase the rate of communications outages.

DC Systems support the communication devices that provide the primary or secondary communication paths for the communication network which includes the transmission of protection, SCADA, and field voice services. These assets experience conditional issues which can impact their expected operational life or result in in-service asset failure and outages. Failure to address these known conditional issues with appropriate asset management practices could result in the loss of critical services that are provisioned for safety and the support of basic services for the efficient completion of operational and supervisory activities.

Some of the potential consequences which can occur because of telecommunications site asset failure include:

- Loss of control and visibility of Ergon Energy substation(s)
    - Increased outage duration due to lack of SCADA functionality.

- Loss of interrogation/control of Energex protection relays
- Loss of communications capacity required for emergency situations where conventional voice comms (i.e. Telstra) is not available.
  - o Increased outage duration due to limited communications capacity.
- Reduction of security across the power network
- Reduction of network reliability and loss of contingency communications resulting in cascading network outages.
- Loss of diverse high-speed telecommunications for NER governed protection systems
- Damage to public infrastructure

4.2 Options Analysis

Ergon Energy evaluated multiple options as follows to determine the most prudent asset management approach for the battery assets.

These options are summarised in the table below and detailed further in each subsequent section.

Option	Proactive Replacement Small Batteries	Proactive Replacement Medium Batteries	Proactive Replacement Large Batteries	Proactive Replacement Battery Chargers	Total Proactive Cost	Qty Reactive (small, medium, Large Batteries and chargers	Total Reactive Cost	Total Cost	NPV
Option 1 – Replace critical systems at nominal EOL (10 years old for batteries and 15 for Chargers) (preferred)	42	23	32	78	$4.94M	0,0,0,0	$0	$4.94M	$81K
Option 2 – Replace critical systems at 150% of nominal life (15 years for batteries and 22 for Chargers) *Match AER proposed 37% reduction*	27	15	20	50	$3.11M	13,1,5,28	$4.50M	$7.61M	$28K
Option 3 – Replace 70% of	93	37	57	104	$9.66M	0,0,0,0	$0	$9.66M	-$13K

all Batteries and 40% of Chargers *Assumes failure rate will rise inline with observed trend.*									
Option 4 Replace units on fail fix only	0	0	0	0	0	40,16,25,78	$9.90M	$9.90M	-$4.09M

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4.3 Option 1 (Proposed) – Replace critical DC systems at or before 10 years (batteries) and 15 years (chargers).

This option presents an optimised replacement scenario in order to balance risk of asset failure with efficient investment principles and prioritised against site criticality measures such as service impacts, site performance monitoring, site autonomy, site access and site proximity to network support services. This program provides proactive cover of the assumed 6% failure rate.

Aged Battery Banks and Battery Chargers: All critical units near the end of their useful life (10 years old for batteries and 15 for Battery Chargers) will be monitored closely and planned for replacement in line with other geographically bundled programs. A risk based assessment is undertaken to identify the critical systems with the greatest risk of network disruption if a fail in service was to occur, these units are targeted first.

Known defective battery banks and battery chargers: battery banks and battery chargers with known defects will be replaced over the next regulatory period based on risk assessments that include condition assessment and criticality of the specific services, resulting in a more prudent and efficient program of investment than an accelerated replacement program. The replacement of batteries and battery chargers where feasible will be bundled with other work at the specific site locations, to reduce associated labour and operating costs.

Optimised Investment: The replacement of battery banks and battery chargers where feasible will be bundled with other work at the specific site locations, to reduce associated labour and operating costs.

The failure rate is expected to continue to rise as the age of batteries and chargers in service increases, and it is imperative proactively replace these units to ensure the network continuity. Where Large and Medium battery assets are replaced, the battery charger will also be proactively replaced to ensure conservate management of the failure rates.

Total cost of this program $4.94M.

4.4 Option 2 - Replace critical DC systems at or before 15 years (batteries) and 22 years (chargers).

This option approximately matches the cut that the AER proposed (37%) and is risk-based rolling replacement program, with maximum risk, under which only assets at the most critical locations are replaced proactively. The key focus is sites as they reach 150% of their nominal asset life (15 years old for batteries and 22 for Battery Chargers) or when defects are identified through alarm monitoring or during regular maintenance checks. This program does not proactively cover the assumed 6% failure rate.

Aged Battery Banks and Battery Chargers: All critical units near 150% of their useful life (15 years old for batteries and 12 for Battery Chargers) will be monitored closely and planned for replacement in line with other geographically bundled programs. Aged assets will be allowed to run to failure to maximise in-service life and will only be reactively replaced when high failure risks or in-service failures are identified by scheduled preventive maintenance at critical site locations.

Known defective battery banks and battery chargers: Replace only those assets at core critical sites, where the impact of in-service failure would be much greater. Battery banks and battery chargers with known defects at will be replaced over the next regulatory period.

The replacement of fewer assets in a proactive program will reduce the efficiency gains of bundling replacements in geographical groupings, increasing associated labour and operating costs.

It is anticipated that we will require approximately 82 total reactive replacements across the asset groups.

Total cost of this program is $7.61M

4.5 Option 3 - Replace 70% of all batteries and 40% of all chargers

This option considered a proactive replacement of 70% of the batteries and 40% of charger assets across the network. Due to the significant age of the assets in service, this accelerated approach would target the increasing failure rate of the batteries and rectifiers, and compliance to standards to be managed within this AER regulatory period, and a significant reduction in fail in service repairs would result.

Total cost of this program is $9.66M

4.6 Option 4 – Counterfactual (Reactive replacement only).

In a 'Do Nothing' counterfactual approach, these instances of degradation or imminent failure might not be identified by routine maintenance, causing DC systems to fail in-service and the associated loss of service with risk and cost impacts as detailed below.

- **Remote access on cost:** If assets are run to failure and require emergency restoration significant on-cost can be incurred due to difficult site access conditions and environmental considerations..
- **Increased Risk of Plant Damage and Larger than Necessary Outages:** For periods when voice comms, or protection circuits are not operating there are potential risks to of damage or premature ageing to plant equipment due to longer periods before backup protection systems clear faults. There are also increased outage impacts should a fault occur during the period of communication issues. The network may be not be controllable if SCADA is unavailable resulting is field crew having to attend a network device on site to operate.
- **Loss of Contingency Capability:** When issues occur, various indirect consequences can increase the risk to the organisation. For example, the failure of a battery bank or DC charger can result in the loss of back up routes for further cable failures and inability to utilise contingency feeders due to loss of associated protection services.
- **Loss of productivity:** due to Depot Communications being lost or having reduced bandwidth to operate corporate systems.
- **Larger cost for Reactive work:** Efficiencies of bunding work cannot be realised in fail fix reactive work, significantly more overtime is required, disruption to other scheduled works, and costs from the impacts listed above all result in larger costs for reactive replacement.

As well as the potential safety, reliability, and network impacts which may occur as a result of in-service degradation or failure of DC systems, a Do-Nothing approach does not represent prudent application of asset management principles. The counterfactual ignores newly emerging failure modes in DC systems and the fact that replacing or repairing assets after in-service failure carries significant emergency cost increases.

4.7 Costs of Counterfactual

The counterfactual option will mean that extra return to service projects will be required and each replacement projects will be significantly more costly than replacing the DC systems ahead of in-service failure.

It is estimated the Counterfactual case of moving to a reactive replacement program would result in a total cost over the period is of $9,903,278.

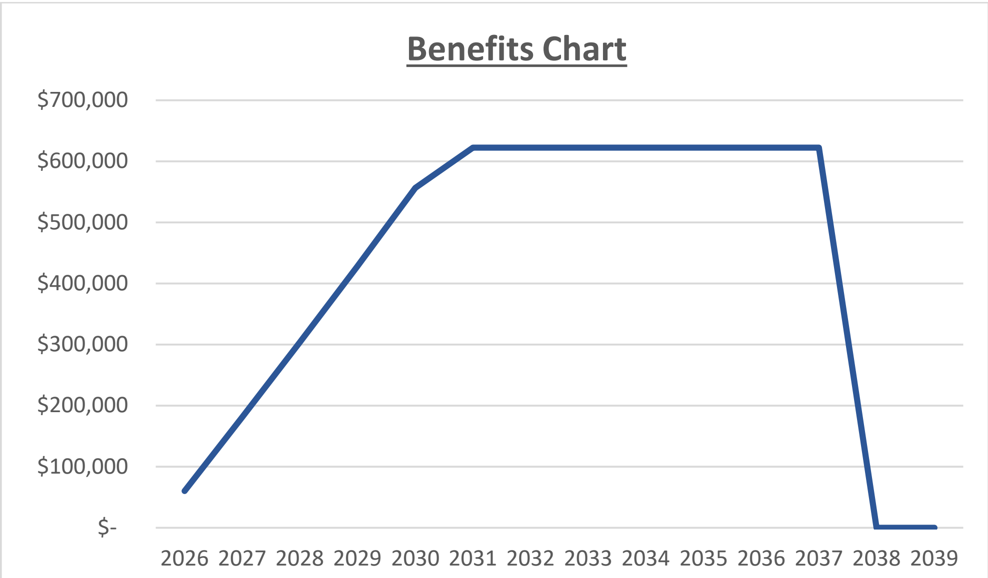
4.8 Risks

Table below outlines the risk assessment for the counterfactual scenario with no proactive program in place to address conditional issues (all work done as reactive).

Risk Scenario	Description of Risk
SCADA – Failure of communication DC power systems results in loss of visibility of SCADA derived data which leads to a reduced capacity to remotely control the network. A fault develops within the power network and restoration is delayed due to the issues with the DC systems.	With the continued use of poor preforming and/or aged DC systems the telecommunication network is at risk of an extend outage where SCADA services will be out of service for extended periods of time in the event of asset failure. The failure delays restoration of a fault. Delay totalling 4 hours restoring services an average MV feeder (2000 kW) with assumed VCR of $52 per kwh and a yearly probably of 5%
Protection – An unstable or failed communication DC power system results in delayed relay operation and the fault is unable to be cleared within specified timeframes, resulting in significant damage to equipment and plant and an inability to control ≥2 bulk supply substations supply area. . Additionally, an AC power systems failure could result in impaired protection services leading to a breach of National Electricity Rules	With the continued use of poor preforming and/or aged DC systems the telecommunication network is at risk of protection services being out of service for extended periods of time in the event of DC system failure
Corporate voice/data – Failure of corporate voice, data and internet communication due to failure of communications DC power systems results in inability to access corporate IT (Information Technology) systems and inability to remotely	With the continued use of poor preforming and/or aged DC systems the telecommunication network is at risk of Corporate voice/data being out of service for extended periods of time in the event of

control or manage the network across multiple sites.	DC system failure. Loss of productivity of 80 labour hours per year.
Field Voice - Inability to communicate with field crews via substation phones. Control Centre unable to transmit switching sheets impacting restoration and planned works.	With the continued use of poor preforming and/or aged DC systems the telecommunication network is at risk of field voice services being out of service for extended periods of time in the event of DC system failure. Note impacts included in the VCR calculation in the first risk.
An unstable or failed communication DC power system results in a reactive response to fix the failed equipment, costing double what the proactive program replacement would have cost.	Failed charger or battery fails requiring reactive replacement costing double the proactive replacement cost with a yearly likelihood of 6% for equipment operating beyond its nominal asset life.
Field Voice – Field crews operating out of cellular range but in locations where P25 voice comms has coverage, DC systems fail, making outbound comms from field staff unavailable, staff member involved in accident and failure of the P25 delays ability to report to emergency services with serious injury or a fatality.	DC systems failure and P25 coverage lost. Vehicle is involved in an accident which triggers the rollover location services in a remote area with no cellular coverage. Delay in response to incident until next journey plan check in time which delays emergency services response to incident, results in a fatality or a serious injury. Very Low likelihood.

Table below outlines the cost benefits over the program period and asset life.



5 ECONOMIC ANALYSIS

5.1 Cost summary 2025-30

Table 3 Cost summary 2025-30

Options	2025-26	2026-27	2027-28	2028-29	2029-30	Total 2025-30
Option 1 (Preferred)	$0.99M	$0.99M	$0.99M	$0.99M	$0.99M	**$4.94M**
Option 2	$1.52M	$1.52M	$1.52M	$1.52M	$1.52M	**$7.6M**
Option 3	$1.93M	$1.93M	$1.93M	$1.93M	$1.93M	**$9.66M**
Option 4	$1.98M	$1.98M	$1.98M	$1.98M	$1.98M	**$9.90M**

We have modelled the costs and benefits in our NPV in the way we would deliver the program absent of any deliverability constraints. The investments have been phased for deliverability in the capex model, and so there will be some differences in the capital cost phasing. This phasing does not change the preferred option for this investment.

5.2 NPV analysis

The NPV calculations have been modelled as a complete program, with benefits realised through proactive program delivery calculated.

The resulting NPV value calculated for the proposed program was $82,489.

Table 4 NPV analysis

Options	NPV	Discount rate		Benefits	
		2.5%	4.5%	125%	75%
Option 1 (Preferred)	$82,489	$283,533	-$88,817	$1,228,283	-$1,018,238
Option 2	$28,188	$328,078	-$226,926	$1,723,630	-$1,622,189
Option 3	-$13,453	$362,237	-$332,833	$2,103,483	-$2,085,323
Option 4	-$4,091,868	-$4,095,438	-$4,070,666	-$2,943,295	-$5,193,375

APPENDICES

Appendix 1: Alignment with the National Electricity Rules

Table 5 Recommended Option's Alignment with the National Electricity Rules

NER capital expenditure objectives	Rationale
A building block proposal must include the total forecast capital expenditure which the DNSP considers is required in order to achieve each of the following (the capital expenditure objectives):	
6.5.7 (a) (1) meet or manage the expected demand for standard control services over that period	
6.5.7 (a) (2) comply with all applicable regulatory obligations or requirements associated with the provision of standard control services;	As indicated in section 4, this proposal ensures that safety obligations, reliability obligations and protection requirements are met by providing an appropriate, economically efficient program of works to prevent in-service failure of comms DC systems. Without this program, these obligations would be at significant risk of being breached.
6.5.7 (a) (3) to the extent that there is no applicable regulatory obligation or requirement in relation to: (i) the quality, reliability or security of supply of standard control services; or (ii) the reliability or security of the distribution system through the supply of standard control services, to the relevant extent: (iii) maintain the quality, reliability and security of supply of standard control services; and (iv) maintain the reliability and security of the distribution system through the supply of standard control services	This program of work ensures the integrity of communications functions that support SCADA, protection, voice and data communications systems. They are critical in the provision of network reliability in support of MSS and safety net security and reliability targets.
6.5.7 (a) (4) maintain the safety of the distribution system through the supply of standard control services.	This program of work ensures the integrity of communications functions that support SCADA, protection, voice, and data communications systems. They are critical in ensuring safety through correct protection operation, and through the availability of voice and data communications.
NER capital expenditure criteria	**Rationale**
The AER must be satisfied that the forecast capital expenditure reflects each of the following:	
6.5.7 (c) (1) (i) the efficient costs of achieving the capital expenditure objectives	The options considered in this proposal take into account the need for efficiency in delivery. The preferred option has utilised a delivery approach that provides for bundling of work in terms of both timing and geography to enable a lower cost delivery compared to other options. It generally avoids emergency replacements that incur higher costs by enabling efficient use of labour resources in the delivery of the work programs. Specialised contractors are utilised as appropriate to ensure that costs are efficiently managed through market testing. Cost performance of the program will be monitored to ensure that cost efficiency is maintained.

NER capital expenditure objectives	Rationale
	The unit costs that underpin our forecast have also been independently reviewed to ensure that they are efficient (Attachments 7.004 and 7.005 of our initial Regulatory Proposal).
6.5.7 (c) (1) (ii) the costs that a prudent operator would require to achieve the capital expenditure objectives	The prudency of this proposal is demonstrated through the options analysis conducted. The prudency of our CAPEX forecast is demonstrated through the application of our common frameworks put in place to effectively manage investment, risk, optimisation and governance of the Network Program of Work. An overview of these frameworks is set out in our Asset Management Overview, Risk and Optimisation Strategy (Attachment 7.026 of our initial Regulatory Proposal).
6.5.7 (c) (1) (iii) a realistic expectation of the demand forecast and cost inputs required to achieve the capital expenditure objectives	NA

Appendix 2: Reconciliation Table

Table 6 Reconciliation

Expenditure	DNSP	2025-26	2026-27	2027-28	2028-29	2029-30	2025-30
Grid Comms DC Systems NS REPEX ($ Direct)	ERGON	$0.99M	$0.99M	$0.99M	$0.99M	$0.99M	**$4.94M**