Jemena Electricity Networks (Vic) Ltd

JEN – RIN – Support – Operational Technology Communications Network Upgrade – Business Case – 20250131

Jemena
bringing energy to life

Table of contents

List of tables

List of figures

List of appendices

1. Executive Summary

Synopsis

- This project is required to alleviate communications network infrastructure capacity constraints to support operation of existing and future pole top remote controllable devices.
- This project is part of a larger program to upgrade, strengthen and futureproof the existing communications network infrastructure through the critical areas of Sunbury, Craigieburn, Roxburgh Park, Somerton and Ivanhoe. The project supports the operation of existing and future pole top remote controllable devices.
- These sites form the high priority elements of the program, addressing operational risks with the existing remote controllable devices. Sites of lower priority will be addressed in future projects.
- The local Zone Substation Fibre Optic network will also benefit from this investment. It simplifies the scope of future works and upgrades, whilst enabling the forecast growth of remote-controlled field devices to meet JEN and regulatory initiatives.
- This project consists of new access point installations and upgrades, pole replacements, and the laying of approximately 14.5 km of fibre optic cables.
- It is proposed the works are completed by the end of 2031, with an estimated total capital expenditure of A$9.3 million (nominal) with a positive NPV.

1.1 Business need

There has been an unprecedented increase in the volume and rate of remote controllable pole top field devices such as Automatic Circuit Reclosers (ACRs), and Remote Controllable Gas Switches (RCGS), deployed as part of Network upgrades in recent years highlighting capacity constraints on the JEN Operational Technology Communications Network.

Our forecast anticipates increased risk of failure and reduced performance of remote-controlled devices on the existing inadequate communications network unless upgrades and expansion works are completed. This forecast is supported by ongoing data exchange issues and remote-control device failures based on the current number of remote devices installed on the inadequate communications network infrastructure. Operational risk will only increase if additional remote devices are installed and connected to this existing communications network infrastructure.

Issues associated with the current Operational Technology Communications Network assets are described below in Table 1-1.

Table 1-1: Current Issues with the Operational Technology Communications Network

Issue No.	Description of Issue
1	**Capacity –** The number of pole top devices has significantly increased. This increases the volume of data required to be exchanged between remote controlled devices and base station equipment. In addition, new, modern devices with improved functionality, will add considerably more data volume. The problem results from the current operational technology communications network not being able to manage the required data exchange volumes.
2	**Safety –** Due to the ineffective data exchange between remote-controlled devices, network condition may be unreported leaving remote device condition unknown until manual intervention occurs. During this unknown state, day-to-day business operations of the electricity network can be adversely affected as faulted equipment and other issues remain difficult to diagnose and resolve, resulting in increased safety risks.

Issue No.	Description of Issue
3	**Network performance –** Ineffective data exchanged can adversely impact the operation of the electricity distribution network. Ensuring customer obligations are met requires supply and network status to be accurately reported. Accurate reporting enables control room controllers to restore supplies to customer and essential services as soon as possible. Unplanned or planned network switching must also ensure outage times and affected customers kept to a minimum. This cannot be done without full visibility of remote-controlled device data.
4	**Asset risk** – Currently, data exchange between base station and remote-controlled devices intermittently fails. This results in some data exchange occurring. However, intermittent failures are increasing with access points highlighting constraints within the communications network infrastructure. Intermittent failures are currently problematic, but likely to become permanent as data rates increase which is driven by new installations or upgrade of remote-controlled devices aimed to meet regulatory initiatives.

The following options addressing these issues have been considered:

1. **Do nothing (base case)**
2. **Upgrade as a standalone project (proactive approach)**
3. **Opportunistic upgrade with other projects (reactive approach)**

The Operational Technology Communications Network sits behind the electricity distribution network as it enables the integration of remote and base station equipment that form part of the electricity distribution network. Any option of a non-network solution (e.g. demand management and/or embedded generation) would not address the asset condition issues and risks described herein. Furthermore, the non-network solution would also require new and upgraded Communications Network equipment essentially requiring additional investment to circumvent asset issues and JEN strategies. For these reasons, the non-network solution was not considered as a credible option.

As per the Risk Assessment in Appendix B the untreated risk ratings are High for the risks identified. This business case forms part of a larger action plan to address all issues and risks associated with the Operational Technology Communications Network in the suburbs of Sunbury, Craigieburn, Roxburgh Park, Somerton and Ivanhoe.

1.2 Recommendation

It is recommended that Option 2, Upgrade as a standalone project (proactive approach) - Capital investment in communications infrastructure is adopted. This option is the most economical, financially viable and prudent option to alleviate existing capacity constraint of the communication network and support future demands and network upgrades.

The use of fibre optic links as a replacement for radio backhaul links is a viable and practical solution as they can be applied in various applications. By using this approach, radio backhaul issues and constraints associated with existing Access Points can be reduced or eliminated. The proposed upgrades will:

- Improve the quality of the link
- Reduce communication link dropouts
- Increase in overall network reliability

This option requires an investment of $9.3M and provides customer net benefits of $11.4M. This option best meets the long-term interests of JEN's customers and is therefore consistent with the National Electricity Objective.

1.3 Regulatory considerations

The objective of the project is to determine the most appropriate strategy for the nominated assets to maintain customer supply reliability across the JEN network given their current condition.

Two options were explored in the options analysis outlined in Section 3.3**Error! Reference source not found.** of this document to identify a recommendation. The options have been benchmarked against the risk assessment in Appendix B to ensure that health, safety and reliability issues are addressed. Risks, costs and economic values remain primary drivers.

JEN's investment decisions are ultimately guided by the National Electricity Objective (NEO). Additionally, JEN is required to meet the requirements of the National Electricity Rules (NER), Victorian Electricity Distribution Code of Practice (EDCoP), and public and industry expectations for distribution system performance, which require capital expenditure objectives to be achieved as discussed and outlined in Section **Error! Reference source not found.**2.

This proposed investment plan will enable the upgrade of the communications network infrastructure and the expansion of its capacity, while also mitigating the risk of intermittent failures, which will only increase over time if left untreated.

1.4 Financial information

1.4.1 Forecast expenditure and budget summary

This business case proposes a total capital investment of $9.3 million.

The business case CAPEX is based on the project being commissioning by 30 June 2031. Table 1–2 provides the project budget by calendar year.

Table 1–2: Project Budget by Year, $2024

Year	Budget ($M)
2027	0.97
2028	0
2029	1.4
2030	3.4
2031	3.5
Total Budget	**9.3**

Results of the economic evaluation for the preferred option is provided below.

Table 1-3: Economic Analysis Results Summary, $2024

Recommended option	($M)
Total Project Cost:	9.3
NPV of Net Financial Benefit:	11.4

2. Background

Operational Technology Communications Networks play a critical role ensuring the reliable and efficient operation of electricity grids. These communication networks facilitate exchange of data between base station and remote devices deployed within the JEN.

Installations of remote controllable devices (such as Automatic Circuit Reclosers (ACRs) and Remote Controllable Gas Switches (RCGS) have increased based on numerous projects completing works requiring additional switching zones. These additional zones are a by-product of providing:

- effective protection
- improved fault response and maintenance works
- efficient network switching activities
- operation of a dynamic electricity network.

The installation of resonant earthed networks has also driven the requirement for network balanced zones and enhanced remote-control devices that are compatible with new earthing philosophies.

Due to the accelerated roll out of remote-controlled devices, the existing operational technology communications network is operating at or near capacity. This results in the communications network having increasing data exchange failures as the network exceeds the available bandwidth for data exchange with remote-controlled devices.

This Project upgrades the operational technology communications network infrastructure in the Sunbury, Craigieburn, Roxburgh Park, Somerton and Ivanhoe areas in anticipation of further installations of pole top remote controllable devices necessary for efficient operation of the electricity network.

In the event of a remote operation failure of a pole top devices (ACR, Gas switch) in the Sunbury supply area, one feeder providing up to 10.8 MVA of load (approximately 4,100 customers) would remain off supply for up to 90 minutes until the field device was manually operated or the fault repaired.

2.1 Business and socio-economic context

The proposed communication network upgrade target areas are mostly in bushfire prone areas. These areas require remote-controlled devices in greater numbers. They are also required to be of a contemporary standard providing high data exchange capability. Currently, around 40,000 customers supplied from Sunbury, Heidelberg and Coolaroo networks (covering the suburbs of Sunbury, Craigieburn, Roxburgh Park, Somerton and Ivanhoe) will benefit from the program.

In surveying 1,000 residential customers across Jemena's electricity network, reliability and the maintenance of the network was the most important priority to customers. Customers surveyed identified network reliability, defined as 'the ability of the electricity network to perform its function adequately for the period of time intended' as of high importance.

The People's Panel, a Citizen's Jury made of up to 50 residential customers, also provided a recommendation for Jemena to focus on network reliability, "Jemena needs to prioritise investing in reliability by assessing, building and maintain the network to meet changes in operating conditions and withstand network failures."

2.2 Asset risk (or opportunity) analysis

2.2.1 Short description of the affected assets

Over recent years, the number of pole top devices has increased significantly, increasing the network bandwidth requirements for these intelligent devices. This increase has led to the communications network being at capacity and experiencing intermittent failures, particularly in areas where Radio Access Points utilise a radio backhaul link. Of note is that these data failures have not been experienced by Radio Access Points with a fibre optic backhaul. There is currently no existing fibre optic backhaul infrastructure covering the Sunbury, Heidelberg and Coolaroo networks.

Root cause analysis has identified various factors contributing to the occurrence of this issue. These include the radio backhaul link signal quality and the amount of data that can be transmitted over the link. This is impacted by the increasing number of downstream devices. It is estimated that about fifteen downstream devices can use the current maximum data rate of 256 kbps.

The NOJA ACR Controller, for instance, uses significantly more data than the RCGS from NGK. As a result of the relatively small number of remote controllable switches, the lower data rates, and the previous deployment timeline, this has not been an issue to date. However, with the current number of pole top devices along with a change in network strategy and philosophy, it is anticipating that a four-fold increase in remote controllable field devices will result. Furthermore, several other projects have highlighted capacity constraints associated with the fibre optic zone substation network.

The use of fibre optic links as a replacement for radio backhaul links is a viable and practical solution for the entire industry as they can be applied in various applications. As a result, radio backhaul issues and constraints associated with Access Points can be eliminated, thereby removing the shortcoming permanently.

To address the issue and mitigate future risks, a maximum of 30 field devices will be permitted on each access point. The purpose of this is to reduce the number of field devices that would be affected in the event of a hardware failure at a particular access point. This approach will lead to additional access points.

It is also necessary to install additional access points in more areas to handle the projected increase in remote controlled pole top devices. As a result, coverage will be expanded and capacity will be increased, with one additional access point scheduled for every 30 proposed field devices.

2.2.2 Risk assessment

A risk assessment, conducted in accordance with JEN's Risk Management Framework, has been undertaken and is provided in Appendix B of this document.

A network asset risk assessment has been completed on JEN's Operational Technology Communications Network. The risk assessment results have highlighted that the capacity constraints encountered and current controls implemented exceed JEN risk appetite leading to further treatment. The current condition and limitations of assets are known with anticipation of data and equipment failures and mal-operations as the number of field devices installed increase. Further details of the network assets risk assessment are shown in Appendix B.

2.3 Project objectives and assessment criteria

2.3.1 Project objective

In line with the NEO, JEN's investment decisions aim to maximise the net present value to electricity consumers. The objective of this project is to maintain the reliability of supply to customers given the current condition of the assets. This strategy must align with other JEN strategies and plans and the project must comply with associated regulatory requirements.

The proposed capital expenditure will meet the following objectives.

- Improve the quality of the communication link, thereby reducing dropouts.
- Increase the available data link from 256 kilobits to 100 megabits.
- Improve the speed of the communications path, allowing for faster responses to SCADA.
- Eliminate any issues with the increased bandwidth requirements of newer device types.
- Allow for the doubling of the number of remote controllable devices that can be associated with each Access Point.

2.3.2 Regulatory considerations

JEN's investment decisions are guided by the NEO. Additionally, the capital expenditure objectives set out in the NER (clause 6.5.7) are particularly relevant:

a) A building block proposal must include the total forecast capital expenditure for the relevant regulatory control period which the Distribution Network Service Provider considers is required in order to achieve each of the following (the capital expenditure objectives):

(1) Meet or manage the expected demand for standard control services over that period

(2) Comply with all applicable regulatory obligations or requirements associated with the provision of standard control services

(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

(iv) Maintain the reliability and security of the distribution system through the supply of standard control services.

(4) Maintain the safety of the distribution system through the supply of standard control services. [1]

Additionally, the Victorian EDCoP sets out provisions relevant to JEN's planning, design, maintenance, and operation of its network, most notably section 19.2 (Good Asset Management) and section 13.3 (Reliability of Supply):

Section 19.2 – Good Asset Management

A distributor must use best endeavours to:

a) Assess and record the nature, location, condition and performance of its distribution system assets

b) Develop and implement plans for the acquisition, creation, maintenance, operation, refurbishment, repair and disposal of its distribution system assets and plans for the establishment and augmentation of transmission connections:

[1] NER, clause 6.5.6(a), 6.5.7(a).

- *To comply with the laws and other performance obligations which apply to the provision of distribution services including those contained in this Code*
- *To minimise the risks associated with the failure or reduced performance of assets*
- *In a way which minimises costs to customers taking into account distribution losses.*

c) *Develop, test or simulate and implement contingency plans (including where relevant plans to strengthen the security of supply) to deal with events which have a low probability of occurring, but are realistic and would have a substantial impact on customers.*

Section 13.3 – Reliability of Supply

A distributor must use best endeavours to meet targets determined by the AER in the current distribution determination and targets published under clause 13.2.1 and otherwise meet reasonable customer expectations of reliability of supply.

When making decisions to invest, JEN must comply with these obligations.

2.4 Consistency with strategy and plans

This section describes how this project is consistent with JEN's objectives and strategies:

- **Provision of Service Levels and Reliability**: Ensuring service levels and reliability that meet customer expectations.
- **Modern Capabilities**: Deployment of modern equivalent capabilities in the network to remain relevant to customers in the longer term.
- **Prudent and Efficient Expenditure**: Ensuring expenditure is prudent and efficient, aligning with customer expectations regarding affordability.

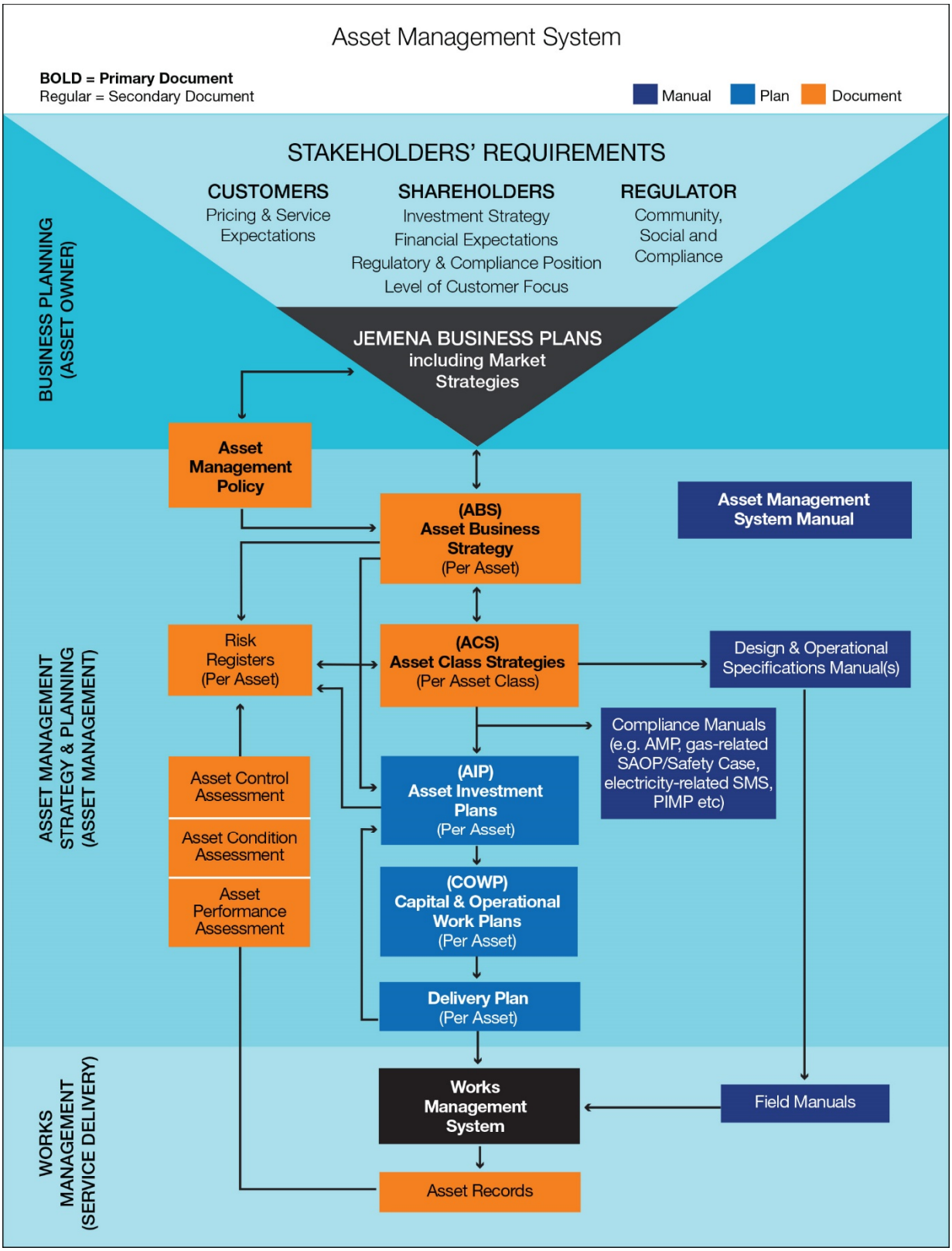
JEN seeks to ensure that lifecycle costs are both efficient and effective. This business case is consistent with this requirement and aligns with the long term vision of the network, as set out in the Asset Management Plan (AMP) and annual planning reports.

This proposal aligns with Asset Management Strategies, Plans and Policies contributing to a safe workplace for JEN employees and contractors. By addressing identified issues, JEN can reduce the risk of injury to its staff or members of the public.

Figure 2–1 outlines the Jemena Asset Management System and shows where the Asset Management Plan (AMP) is positioned within it. The AMP covers the creation, maintenance and disposal of assets, including investment planning to augment network capacity and replace degraded assets to maintain reliability of supply.

This strategic framework facilitates the planning and identification of business needs that require network investment documented via business cases.

Figure 2–1: The Jemena Asset Management System



3. Credible Options

3.1 Identifying credible options

The following options are considered feasible, and executable to address the business need, problem or opportunity.

- Option 1 - Do nothing (base case)
- Option 2 - Upgrade as a standalone project (proactive approach)
- Option 3 - Opportunistic upgrade with other projects (reactive approach)

3.2 Developing credible options

Table 3-1 shows the extent to which each option addresses the identified issues.

Table 3-1: Options Analysis

Issue	Option 1 Do nothing (base case)	Option 2 Upgrade as a standalone project (Proactive Approach)	Option 3 Opportunistic upgrade with other projects (Reactive Approach)
Issue 1 Data exchange capacity	○	●	◑
Issue 2 Adverse safety conditions	○	●	●
Issue 3 Deteriorated network resilience and reliability	○	●	◑
Issue 4 Asset failure risk	○	●	●

●	Fully addressed the issue
◑	Partially addressed the issue
○	Did not address the issue

3.3 Options analysis

3.3.1 Option 1: Do Nothing

The ‘do nothing’ option assumes business as usual, continuing current maintenance activities such as inspections, condition monitoring, preventive maintenance and defect repairs. However, this option does not address any of the identified condition issues. For instance, this option involves accepting the risk and consequence of a communications network that is unable to consistently facilitate data exchange between base stations and remote devices within Sunbury, Craigieburn, Roxburgh Park, Somerton and Ivanhoe. This option also assumes upgrades will occur upon asset failures of the communication network and does not address capacity constraints with current and future installations of remote devices in this area. Given the criticality of these issues and the lack of risk mitigation, this option is not considered credible.

3.3.2 Option 2: Upgrade as a standalone project

The ‘Upgrade as a standalone project’ is a proactive approach that invests in the communications network infrastructure for the affected areas. Upgrading the communications network in a targeted manner will alleviate the existing capacity and reliability constraints whilst enabling the deployment of new remote controllable devices in those areas.

Option 2 is the preferred option. This option resolves all identified issues while aligning with the JEN asset class and business strategies. The total cost of this option is outlined in Table 1–2 and has a positive Net Present Value (NPV) as outlined in Appendix A. This preferred solution is proposed to commence in with commissioning in 2031.

3.3.3 Option 3: Opportunistic upgrade with other projects

The ’Opportunistic upgrade with other projects’ option is a reactive approach that implements changes once new projects arise. Whilst this approach partially addresses the key issues it does not fully address capacity and performance issues. The communication network upgrades will be completely reliant on other project works occurring in the area which may not happen. The outcome in this scenario would be like the ‘do nothing’ option. In addition, no efficiencies can be realised with communication network upgrades as the individual projects are independent of communication network topology and schedule requirements.

Until upgrade works were completed, the performance constraints (with remote controllable devices) could continue to impact JEN’s ability to meet area capacity and performance objectives, including customer expectations.

Given the residual unresolved issues, it is not recommended to pursue this option.

4. Option Evaluation

4.1 Economic evaluation

In line with the objective of the National Electricity Rules, JEN's augmentation investment decisions aim to maximise the present value of the net economic benefit to all those who produce, consume and transport electricity in the National Electricity Market.

To assess benefits against this objective, JEN has undertaken a probabilistic cost-benefit assessment of replacement options that considers the likelihood and severity of critical network outages. The methodology assesses the expected impact of asset failures and subsequent network outages on supply and combines this with the value that customers place on reliability (VCR) and compares the result with the costs required to reduce the likelihood and/or impact of supply outages. The benefits considered in this economic analysis relate to mitigating the increasing risk of failure of remote controllable devices on the network. This includes the safety risks associated with Option 1 (do nothing) as described in section 3.3.1. The following table summarises the economic analysis undertaken.

Table 4-1: Economic Analysis Results Summary, $2024

($M)	Option 1	Option 2	Option 3
Total Expected costs	0	9.3	11.1
Total Expected market benefits	0	18.9	11.8
Net market benefits	0	11.4	3.7
Option ranking	3	1	2

4.1.1 Disposals

An assessment had been made on the equipment to be replaced as part of this project. The equipment has no written-down value due to its age and design life.

5. Recommendation

This business case proposes a total capital investment as outlined in Table 1–2.

It is recommended that Option 2 be adopted with upgrades completed as a stand-alone project to the Operational Technology Communications Network in the nominated areas. All equipment installed will be utilising modern equivalents, installed to current standards and philosophies.

This option maximises the net present value to JEN customers' and addresses all identified risk and issues, therefore mitigating negative impacts on safety, reliability and security of customer supply.

The project is proposed to commence in 2026 with completion in 2031.

6. Exclusions

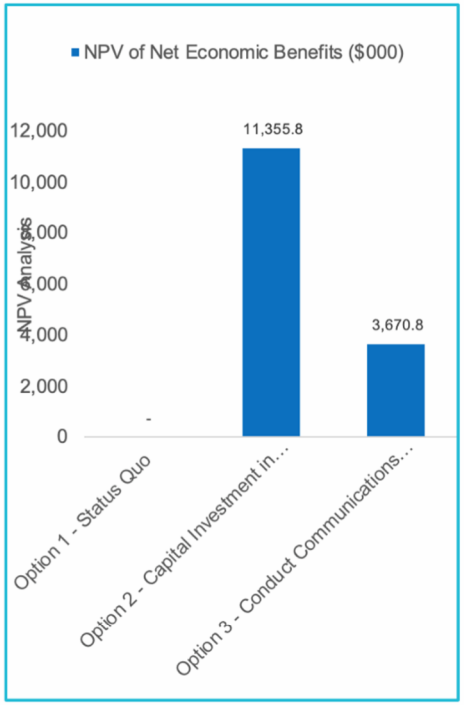
There are no exclusions within this business case.

Appendix A
Financial Evaluation Spreadsheets

Jemena
bringing energy to life

A1. Financial Evaluation Spreadsheets

Overview of Options Analysis			
Options	**Option 1 - Status Quo**	**Option 2 - Capital Investment in strengthing communication network - Critical Sites Pro Active approach.**	**Option 3 - Conduct Communications infrastructure upgrades for the high priority areas on a project basis; re-active approach**
Recommended Option		✓	
NPV of Net Economic Benefits ($000)	-	**11,355.8**	**3,670.8**
NPV of Total Economic Benefits ($000)	-	18,922.4	11,807.4
Avoided cost at asset failure	-	*51.4*	*13.0*
Improved energy reliability	-	*18,871.0*	*11,794.4*
Reduced energy losses	-	-	-
Other Economic Benefits	-	-	-
NPV of Incremental Total Costs ($000)	-	7,566.6	8,136.6
Total Incremental Net Capex	-	*7,566.6*	*8,136.6*
Total Incremental Opex - One-off	-	-	-
Total Incremental Opex - Ongoing	-	-	-
Sensitivity on Economic Benefit NPV ($000)			
Economic Benefits turn out to be 10% lower	-	9,463.5	2,490.1



Appendix B
Network Risk Assessment Summary

Jemena
bringing energy to life

B1. Network Risk Assessment Summary

Risk Register	**Operational Technology - Communications Network Upgrade**																												
Participants:	**Matthew Ch'ng, David Bonavia, Jon Bernardo**																									**Workshop Date:**	**7/02/2024**		
S/No	**Business Unit**	**Business Objective Category**	**Risk type**	**Risk Title**	**Risk Description**	**Root Causes Category**	**Root Causes - Description (Contributing Factors)**	**Risk Consequence Category**	**Risk Consequence - Description**	**Risk Owner**	**Untreated Consequence**	**Untreated Likelihood**	**Untreated Risk Rating**	**Current Controls**	**Control Owner**	**On-going Assessment Required?**	**Adequacy of Controls**	**Current Consequence**	**Current Likelihood**	**Current Risk Rating**	**Risk Treatment Option**	**Action Plan Name**	**Action Plan Description**	**Action Owner**	**Due Date**	**Status**	**Target Consequence**	**Target Likelihood**	**Target Risk Rating**
1	Jemena Networks - Electricity	Growth	**O-Asset & Security**	The infrastructure, capacity, reliability, and expandability of the existing communications network **is at risk of not meeting the current and future demand.**	- Communication Network can not support new and existing network devices installation - Reliabilty impact on JEN - Failure of The Fault Location, Isolation and Service Restoration (FLISR) - Mal-operation of REFCL protected networks	Technology - New, Amended, Adopted Technology	- Unprecedented increase in the number and rate of deployment of remote controllable pole top field devices (to enable new technologies such as FLISR and REFCL) without supporting operational technology communications network upgrades and expansion. - new approach to have all devices remote controllable where ever possible. - technology limitations (architecture and reach)	Operational	- Loss of communication between switches and SCADA i.e. dropouts, missing data packets - Failure of the Fault Location, Isolation and Service Restoration (FLISR) - Mal-operation of REFCL technology - Damage to business reputation - Extended customer supply outages	Michael Ciaverella	Serious	Almost Certain	High	Reducing network traffic by implementing schemes that do not require high volume of data	David Bonavia	Yes	Poor	Serious	Almost Certain	High	Pursue	Upgrade of the communications network infrastructure and the expansion of its capacity to address the short-to-medium-term demands effectively	Study the proposal of immediate (<6 months), short term (6-12 months), and medium term (12-24 months) requirements for improving the capacity and reliability of the communications network	Jignasa Sharma/Bradley Williamson	31/12/26	**Not Started**	Serious	Rare	Low
														JEN PR 0029 JEN Communications Design & Installation Standard	David Bonavia	Yes	Adequate					Technical risk assessment of likelihood of failure of communication network supporting FLISR and other projects	Jignasa Sharma/Bradley Williamson	31/12/26	**Not Started**			
														Managing current network capacity limitation by using field resources (manual switching and contro)	Lindsay Cross	Yes	Poor					Prepare detail scope of work, option analysis and other PMM related formalities	Jignasa Sharma/Gabril	30/06/27	**On Track**			
																						Finalise business case and obtain approvals for the succesful roll out	Jon Bernardo	30/06/26	**On Track**			
																						Conduct Delivery risk assessment	Ben Nelson	31/08/27	**Not Started**			