Business Case
Life Extension of Legacy Telecommunications Data Comms

ERGON. ENERGY NETWORK

Executive Summary

The purpose of this document is to provide justification to extend the life of ageing substation and protection telecommunications infrastructure, as well as to commence a staged transition to modern technology solutions. The delivery of this program commenced in 2014-15 and will continue through the 2020-25 period; hence it is included in the 2020-25 regulatory proposal.

The assets presented in this business case are an essential component of sending and receiving communications across the network. Time Division Multiplexing (TDM), a method of transmitting and receiving independent signals over a common path, is the legacy data communication system. The TDM assets need to be eventually phased out, as the existing TDM network is aged and key components of the system are no longer in production. Failure of these ageing assets can lead to the loss of integrity for substation protection and Supervisory Control and Data Acquisition (SCADA) devices.

A counterfactual, 'do nothing' option was considered but rejected. Leaving the ageing assets in service will increase the rate of failure observed in the TDM network, and as the assets are no longer in production TDM spares would eventually reduce to zero. The network would eventually be left without vital data communications systems. Another option to upgrade end terminal equipment to new packet-based technology was also considered but rejected, due to anticipated costs being an order of magnitude larger than other possible options. One network option was evaluated for this business case:

Option 1 – This option would extend the life of Ergon's existing TDM telecommunications network where possible, commence a staged transition to a modern packet-based Internet Protocol / Multiprotocol Label Switching (IP/MPLS) system and replace ageing and expiring software systems.

Ergon Energy 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 case safety and reliability are strong drivers, based on the need to provide adequate data communication systems for substation protection and SCADA devices.

To this end, Option 1 was selected as the preferred option, as it was identified as the most economically efficient investment to address the forthcoming obsolescence of legacy data communication assets in the Ergon Energy network. The option has a Net Present Value (NPV) of -$4.8M. The upgrade and modernisation of these assets will enable the network to continue to operate as intended and maintain risks as low as reasonably practical.

The direct cost of the program for each submission made to the AER is summarised in the table below. Note that all figures are expressed in 2018/19 dollars and apply only to costs incurred within the 2020-25 regulatory period for the preferred option.

Regulatory Proposal	Draft Determination Allowance	Revised Regulatory Proposal
$5.2M	N/A	$5.2M

Contents

1. Introduction

The assets presented in this business case are an essential component of sending and receiving communications across the network. Time Division Multiplexing (TDM) has been the traditional data communication method, which is a method of transmitting and receiving independent signals over a common path. These assets need to be phased out eventually as the existing TDM network is aged and key components of the system are no longer in production. Failure of these ageing assets can lead to the loss of integrity of substation protection and Supervisory Control and Data Acquisition (SCADA) devices.

1.1 Purpose of document

This document recommends the optimal capital investment necessary for extension of the life of Ergon Energy's existing TDM telecoms. network or replacement of these assets where life extension is not possible or where suitable to generate spares for the remaining parts of the TDM network.

This is a preliminary business case document and has been developed for the purposes of seeking funding for the required investment in coordination with the Ergon Energy Revised Regulatory Proposal to the Australian Energy Regulator AER for the 2020-25 regulatory control period. Prior to investment, further detail will be assessed in accordance with the established Energy Queensland investment governance processes. The costs presented are in $2018/19 direct dollars.

Supporting information is contained in the Asset Management Plan (AMP) – Telecommunications and the Intelligent Grid Technology Plan.

1.2 Scope of document

This document will outline the rationale, benefits, and drivers for asset replacement and refurbishment, as well as present the recommended options as identified in the options analysis. These options, their associated risk assessments, delivery timeframes and project costs will be outlined and compared to provide a recommendation for the option that minimises risk and optimises cost efficiency.

1.3 Identified Need

Ergon Energy 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 case safety and reliability are strong drivers, based on the need to provide adequate data communication systems for substation protection and SCADA devices.

Prior to the introduction of the packet-based IP/MPLS (Internet Protocol/Multiprotocol Label Switching), TDM based technologies were the primary components of communication networks. These technologies were the mainstay of EQL's operational telecommunications network from the 1980s through to the 2000s. These networks are still the primary mechanism to carry a number of different substation-based service types, including business-critical protection communication services.

Most suppliers of these asset types have stopped the sale of these asset classes. Several assets have been identified as reaching the end of their useful life and are becoming at risk of failure. As the availability of replacement assets and systems is diminishing, a planned migration to MPLS networks

is required to allow an eventual withdrawal from legacy TDM based assets. This business case will extend the life of the legacy TDM network by “mining” selected asset spares to maximise the utilisation of every component while also readying the componentry for eventual upgrade. This proposal aligns with the CAPEX objectives and criteria from the National Electricity Rules as detailed in Appendix C.

1.4 Energy Queensland Strategic Alignment

Table 1 details how Life Extension of Legacy Data Communications contributes to Energy Queensland (EQL) corporate and asset management objectives.

Table 1: Asset Function and Strategic Alignment

Objectives	Relationship of Initiative to Objectives
Ensure network safety for staff contractors and the community	This initiative ensures the continued provision of communication services at substation field sites, necessary to reduce risk to staff, contractors and the community, in allowing for effective management of operations and to notify all of hazards or dangers.
Meet customer and stakeholder expectations	Customers benefit as the initiative contributes to ensuring that outage durations and severity are not impacted or worsened by ensuring SCADA and protection services maintain current performance levels.
Manage risk, performance standards and asset investments to deliver balanced commercial outcomes	This initiative allows for replacement of assets prior to their failure and so asset use can be maximised, contributing to risk management, maintenance of performance standards and balanced commercial outcomes.
Develop Asset Management capability & align practices to the global standard (ISO55000)	This initiative is consistent with ISO55000 objectives and drives asset management capability by promoting a continuous improvement environment as outlined in AMP – Telecommunications.
Modernise the network and facilitate access to innovative energy technologies	This initiative allows for modernisation of the network by ‘mining’ TDM equipment that is no longer provided by vendors to extend its useful life and readying the network for the replacement of units and migration of services.

1.5 Applicable service levels

Telecommunications Equipment will continue to be managed, consistent with corporate asset management policy, to achieve all legislated obligations and any specifically defined corporate key performance indicators, along with supporting all associated key result areas as reported in the Statement of Corporate Intent (SCI).

Safety risks associated with this asset class will be eliminated so far as is reasonably practicable (SFAIRP), and if not able to be eliminated, mitigated SFAIRP. All other risks associated with this asset class will comply with good asset management standards with risks reduced where possible.

All inspection and maintenance activities will be performed consistent with manufacturers’ advice, good engineering operating practice, and historical performance with the intent to achieve longest practical asset service life.

Assets may be operated longer than their nominal expected lifespans where suitable, consistent with legislative, reliability and risk-based constraints. Conversely, problematic assets such as those which

unusually high maintenance requirements or with significant associated risks will be considered for early retirement.

Assets of this class typically become obsolete before end of life. Once the asset type is obsolete, assets will be managed, replaced, and reallocated as appropriate to achieve appropriate risk management and optimum asset class longevity and performance.

1.6 Compliance obligations

Table 2 shows the relevant compliance obligations for this proposal.

Table 2: Compliance obligations related to this proposal

Legislation, Regulation, Code or Licence Condition	Obligations	Relevance to this investment
QLD Electrical Safety Act 2002 **QLD Electrical Safety Regulation 2013**	We have a duty of care, ensuring so far as is reasonably practicable, the health and safety of our staff and other parties as follows: • Pursuant to the Electrical Safety Act 2002, as a person in control of a business or undertaking (PCBU), EQL has an obligation to ensure that its works are electrically safe and are operated in a way that is electrically safe.[1] This duty also extends to ensuring the electrical safety of all persons and property likely to be affected by the electrical work.[2]	This proposal helps maintain compliance and electrical safety through ensuring equipment is operating within suitable specifications to prevent a drifting of settings that would encroach into other telecommunication frequency bands.
Distribution Authority for Ergon Energy or Energex issued under section 195 of *Electricity Act 1994* (Queensland)	Under its Distribution Authority: • The distribution entity must plan and develop its supply network in accordance with good electricity industry practice, having regard to the value that end users of electricity place on the quality and reliability of electricity services. • The distribution entity will ensure, to the extent reasonably practicable, that it achieves its safety net targets as specified. • The distribution entity must use all reasonable endeavours to ensure that it does not exceed in a financial year the Minimum Service Standards (MSS)	This proposal works to ensure appropriate protection systems are operating in their intended manner and that communication services are available to contribute to reducing frequency and duration of contingency events.
National Electricity Rules (NER), Chapter 5	Schedule S5.1 of the National Electricity Rules, Chapter 5 provides a range of obligations on Network Services Providers relating to Network Performance Requirements. These include: • Section S5.1.9 Protection systems and fault clearance times • Section S5.1a.8 Fault Clearance Times • Section S5.1.2 Credible Contingency Events	This proposal reduces the likelihood of in-service failure of communications assets, thereby reducing the risk that protection systems will be unavailable.

[1] Section 29, *Electrical Safety Act 2002*
[2] Section 30 *Electrical Safety Act 2002*

1.7 Limitation of existing assets

Prior to the introduction of the packet-based IP/MPLS, in Energy Queensland networks, TDM based technologies were the primary components of communication networks. These networks are still the primary mechanism to carry a number of different substation-based service types, including business-critical protection communication services. Two main types of TDM assets are currently utilised across EQL networks:

- **Higher-order TDM assets:** These assets have the capacity to carry multiple services each of which has a bandwidth equal or greater than 2MB. There are 905 assets in this class installed across 185 sites throughout Queensland
- **Lower-order TDM assets:** These assets carry small bandwidth services equal or less than 2MB in size. There are estimated to be in excess of 1000 assets in this class installed across over 200 sites throughout Queensland.

The current solution to provide Teleprotection services is depicted in Figure 1.

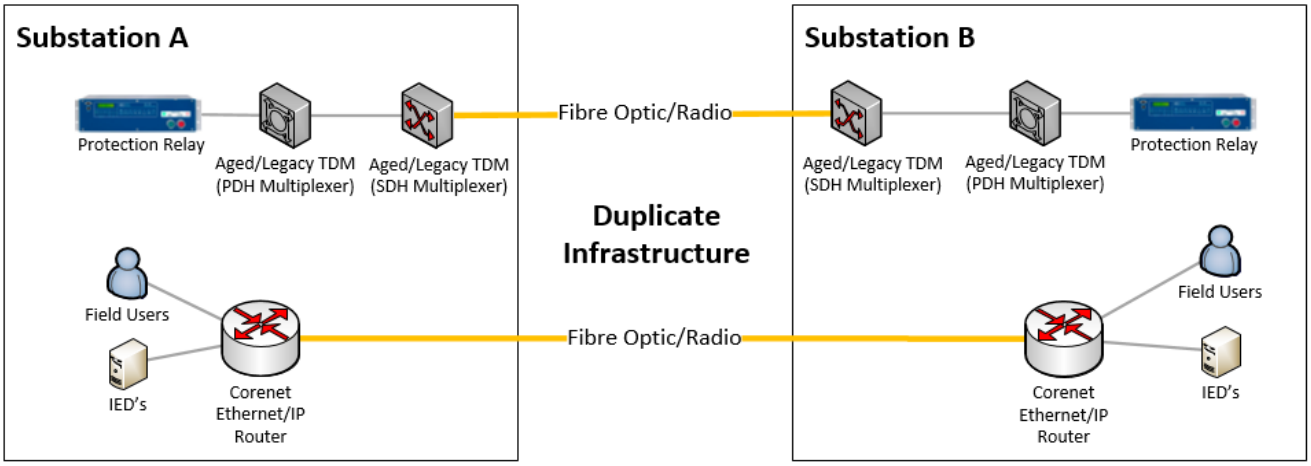

Figure 1: Current Teleprotection Service Architecture

This architecture has a number of shortcomings:

- It utilises the TDM technology which is becoming obsolete with most vendors no longer supplying the equipment and most vendor support arrangements for this equipment expiring towards the end of this AER period;
- Deficiencies for current operational TDM platforms have been identified which exposes Ergon to a large amount of risk should assets fail. Failure of these assets requires migration of services to the CoreNet network; however, this is typically not practical in a failed in-service scenario due to complex topologies that require significant planning and design that can take weeks/months to develop. To reduce costs associated with this technology migration and to minimise the impact of incidents, a more proactive approach is required;
- Duplicated communications infrastructure results in higher costs for greenfield/brownfield deployments. Legacy TDM assets are installed alongside modern CoreNet assets which often results in wasting fibre optic cores to provide communications to small capacity services.

2. Counterfactual Analysis

2.1 Purpose of asset

Future Teleprotection Architecture

The long-term future architecture and strategy to provide Teleprotection services using common CoreNet infrastructure is depicted in Figure 2.

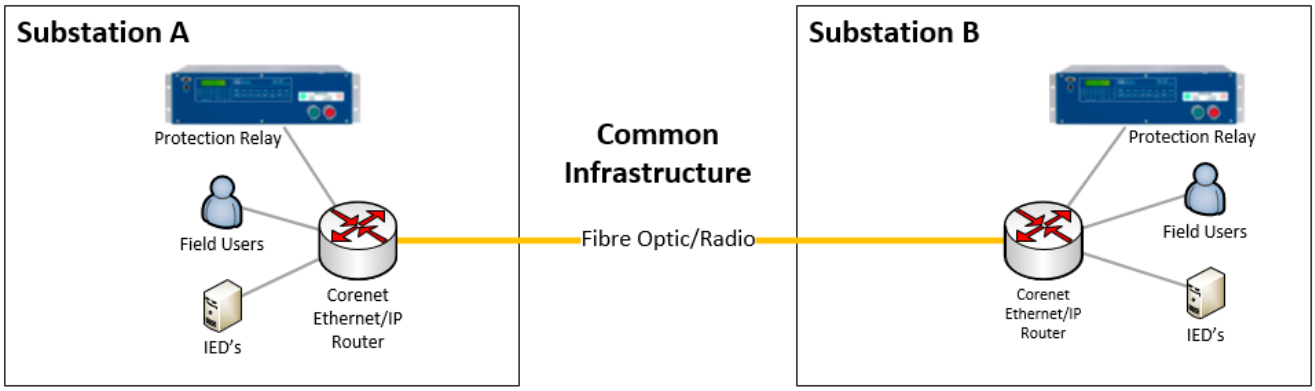

Figure 2: Future Teleprotection Service Architecture

Delivering services over the newer CoreNet infrastructure provides substantial benefits:

- Ability to share common CoreNet infrastructure thereby reducing asset duplication and wasting limited fibre/radio capacity for small capacity services;
- Reduced telecommunications costs for greenfield and brownfield deployments (including new major customer connections) by not having to acquire legacy TDM infrastructure;
- Ability to provide a higher level of resiliency by leveraging the diverse network paths within CoreNet to reduce points of failure;
- Significantly higher visibility into service and asset health;
- Simplifies the architecture of the network which allows Ergon to increase and manage capacity on core backbone links much more efficiently; and
- Enables the network to be augmented easier to deliver operational services in shorter timeframes.

This program is in alignment with Ergon's TDM Service Transition strategy roadmap.

2.2 Business-as-usual service costs

The counterfactual in this case is assumed to be running existing assets to failure and not replacing assets proactively. The business as usual (BAU) service costs for this approach are the maintenance costs associated with ongoing operations. In addition to these costs, significant emergency response and replacement costs would be incurred for the counterfactual BAU case in the event that failures occur, and full component replacement is required. These have not been explicitly costed in this case due to the safety, reliability and compliance risks associated with asset failures.

2.3 Key assumptions

The counterfactual in this case is assumed to be running existing assets to failure and not replacing assets proactively. The business needs to maintain/exceed the current level of reliability for critical

telecommunications services such as teleprotection, SCADA, metering and voice. As TDM assets age they are likely to fail more frequently in future.

2.4 Risk assessment

Table 3 outlines the risk assessment for the Ergon Energy network under the counterfactual scenario. Further Details of the risk ratings and descriptions can be found in Energy Queensland's Network Risk Framework.

Table 3: Risk Assessment

Risk Scenario	Risk Type	Consequence (C)	Likelihood (L)	Risk Score	Risk Year
SCADA – Failure of linear media connection results in loss of visibility of SCADA derived data which leads to a reduced capacity and an **inability to remotely control ≥2 bulk supply substations supply area**.	Business	*4* *(Inability to remotely control ≥2 bulk supply substations supply area)*	*3* *(Unlikely to occur)*	***12*** ***(Moderate risk)***	2019
Protection – Failure to duplicate communication paths for protection services results in a breach of National Electricity Rules and an **improvement notice issued by the regulator**.	Legislated	*4* *(Energex/ Ergon identified issue requiring regulator to be notified. Improvement notice issued)*	*3* *(Unlikely to occur)*	***12*** ***(Moderate risk)***	2019
Protection – A **single fatality** occurs when an unstable or failed communications path results in delayed relay operation and the fault is unable to be cleared within specified timeframes.	Safety	*5* *(Single fatality/ incurable fatal illness)*	*3* *(Unlikely)*	***15*** ***(Moderate risk)***	2019
Field Voice - Inability to communicate with field crews via substation phones, fax and radios fitted in vehicles (e.g. P25 and legacy VHF (Very High Frequency) network). Control Centre unable to transmit switching sheets via fax leading to **significant impact on any restoration or planned works equating to >$100,000**.	Business	*2* *(Significant impact on any restoration or planned works equating to >$100,000)*	*4* *(Likely to occur)*	***8*** ***(Low risk)***	2019

2.5 Retirement or de-rating decision

Ergon Energy's strategy is to cease further unnecessary investment in legacy-based communications equipment (which has limited asset life and vendor support) and eventually utilise newer packet-based solutions to deliver services on the common Corenet network where cost effective.

In the interim, extension and upgrade of assets through spares mining, service migration to IP hosted technology and software upgrades will upgrade the system so it is not reliant on ageing and unavailable technology. This investment in more modern communication technologies allows the

system to maintain resilience, improve effectiveness and efficiency, and reduce the time needed for return to service following asset failure as well as reducing the risk of that failure.

3. Options Analysis

3.1 Options considered but rejected

The following options were considered but rejected in this analysis.

Do Nothing

The 'Do Nothing' option would result in assets failing as they reached their end of useful life. As these assets are being phased out and will no longer be available from suppliers in the future, this would result in failure of telecommunication services. More specifically, TDM asset spares would reduce to zero. With ageing TDM assets there is an increased risk of asset failure and loss of critical teleprotection/ SCADA services. Equipment failure will result in significant costs and longer restoration timeframes of services (outages could extend to weeks or months in duration).

This option would also continue with in-house development and expansion of the existing legacy software system. This software has reached its end of life and is no longer supported by the vendor. A highly tailored upgrade would be required in order to continue to use this system.

This approach presents both a higher risk of asset failure and higher costs in maintaining the system. For these reasons this approach is not considered a feasible option.

Upgrade End Terminal Equipment to Newer Packet-Based Technology

This option is a newer method of telecommunication than the existing TDM technology, whereby small packets of information are collected and then sent down the wires regardless of capacity. It can sometimes result in overloads and delays with data transfers. This option would require an upgrade of end systems to the newer packet-based technology, however protection does not have a packet-based solution available (and there no plans in the current AER period), meaning this option is not a technical solution. The cost and asset life are significantly higher than the telecommunications equipment which also renders this option unviable. It is estimated that costs are in the order of $90M to upgrade all legacy SCADA, Protection and Voice services to native packet-based technology.

3.2 Identified options

3.2.1 Network options

The technology currently relied upon for telecommunications is being phased out of use by suppliers. In order to maintain required telecommunications services, the only viable option is to replace or upgrade the existing ageing technology and systems.

Option 1: Extension, service migration and software replacement

There are a number of components due for retirement in the Legacy Data Communications category. The action required for the continued service of telecommunications is dependent on the type of component. There are three main actions required:

- Extension of existing TDM asset classes. This includes ensuring strategic spares are in place and active monitoring of network faults continues,
- Migration of services from the current TDM to the IP/MPLS network, and
- Replacement of legacy Telco software.

3.2.2 Non-network options

No non-network options were identified at this stage of the process.

3.3 Economic analysis of identified options

3.3.1 Cost versus benefit assessment of each option

The Net Present Value (NPV) of each option has been determined by considering costs and benefits over the program lifetime from FY2020/21 to FY2024/25, using EQL's standard NPV analysis tool. The cashflows are discounted at the Regulated Real Pre-Tax Weighted Average Cost of Capital (WACC) rate of 2.62%.

Capital Costs:

Capital costs (CAPEX) associated have been defined as the labour, material, and equipment costs required to replace and upgrade services and assets at each site. These are summarised in Table 4.

Table 4: Program Funding Summary – expressed in $`000 18/19 direct dollars.

Cost Category	2018/19	2019/20	2020/21	2021/22	2022/23	2023/24	2024/25	Total
Labour	$378	$675	$689	$430	$171	$204	$89	$2,636
Material	$158	$1,111	$705	$367	$200	$237	$104	$2,882
Equipment	$1	$5	$10					$16
Other	$48	$19						$67
Total Annual Cost	**$585**	**$1,810**	**$1,404**	**$797**	**$371**	**$441**	**$193**	**$5,601**

Results

The Net Present Value (NPV) has been determined by discounting costs over the program lifetime using the EQL standard NPV analysis tool. **The estimated NPV of the recommended option is -$4.815 million.**

3.4 Scenario Analysis

3.4.2 Sensitivities

This program does not have viable alternatives. The key sensitivity in this case is the time at which failures occur – premature failures might drive higher reactive costs, rather than the planned approach as proposed.

3.4.3 Value of regret analysis

The proposal includes the progressive migration of critical services to the newer MPLS network while mining spares to extend the life of existing assets. This enables various development options to be considered in the future. These options also address the key regret, which in this case is a major failure of protection signalling that could result in significant safety risks to the community and major plant damage. The option proposed manages this key regret through proactive replacement of the assets and provision of spares for the remaining aged equipment.

3.5 Qualitative comparison of identified options

3.5.1 Advantages and disadvantages of each option

Table 5 below details the advantages and disadvantages of each option considered.

Table 5: Assessment of options

Options	Advantages	Disadvantages
Option 1: Extension, service migration and software replacement	• Lowest cost option over time. • Ensures minimal outage to critical services during failed in service events. • Reduces risks associated with failed in-service events and having no spares available, resulting in prolonged outages to services. • Sites identified where TDM assets are being recovered have little or no services and can be completed at low cost. • In-line with Energex's established similar solution – can leverage from their test results, learnings, configurations etc. • Avoids duplicating telecommunications infrastructure to support legacy TDM services. • Avoids future further investments in legacy telecommunications infrastructure. • Simplified network architecture, allowing easier augmentation. • Higher visibility of asset and service health by integration into IBM Tivoli monitoring systems. • Proactive monitoring of assets and services by Ergon's CNOC by leveraging existing service by management processes.	• If asset failure increases over time and further asset recovery is required, then assets become harder to recover and the cost of asset recovery will substantially increase. At this crossover point, it would be recommended to utilise the newer CoreNet pack solution to address this. • Higher CAPEX upfront cost than 'Do Nothing' option.

Options	Advantages	Disadvantages
"Do Nothing" Option	• Defer capital expenditure	• Higher risk for long telecommunications outages on critical services such as protection, SCADA, Metering and Voice. • Higher costs for greenfield/ brownfield deployments by having to duplicate legacy infrastructure alongside modern infrastructure. • Higher costs for Failed in Service events due to the significant design and planning work required as opposed to a systematic approach. • Continued higher resource requirements to maintain legacy TDM services as they have limited remote monitoring capabilities (to determine asset and service health when compared with modern CoreNet infrastructure).

3.5.2 Alignment with network development plan

The preferred option aligns with the Asset Management Objectives in the Distribution Annual Planning Report. In particular it manages risks, performance standards and asset investment to deliver balanced commercial outcomes while modernising the network to facilitate access to innovative technologies.

3.5.3 Alignment with future technology strategy

This program of work supports Energy Queensland's transition to a modern communications network, addressing the obsolescence and risks associated with legacy data technology in a manner which balances risk and cost. This is in alignment with the Future Grid Roadmap and Intelligent Grid Technology Plan, which promote the use of modern technology in maintaining affordability of the distribution network while also maintaining safety, security and reliability of the energy system, and supporting optimal customer outcomes and value across short, medium and long-term horizons.

Additionally, customers have indicated they want prudent investments in technology to modernise the network, to enable them to interact with the network, manage their electricity costs and take advantage of new products and technology developments. A modern communication network is a critical part of the intelligent grid of the future that will enable this for customers.

3.5.4 Risk Assessment Following Implementation of Proposed Option

Table 6: Risk assessment showing risks mitigated following Implementation

Risk Scenario	Risk Type	Consequence (C)	Likelihood (L)	Risk Score	Risk Year
SCADA – Failure of linear media connection results in loss of visibility of SCADA derived data which leads to a **reduced capacity to remotely control half of the Energex / Ergon network**.	Business	*(Current)* *4* (Mitigated) 4 (Inability to remotely control >= 2 bulk supply substations supply area)	*3* 1 (Almost no likelihood to occur)	***12*** **4** **(Very low risk)**	2019
Protection – Failure to duplicate communication paths for protection services results in a breach of National Electricity Rules and an **improvement notice issued by the regulator**.	Legislated	*(Current)* *4* (Mitigated) 4 (Energex/ Ergon identified issue requiring regulator to be notified. Improvement notice issued)	*3* 1 (Almost no likelihood to occur)	***12*** **4** **(Very low risk)**	2019
Protection – A **single fatality** occurs when an unstable or failed communications path results in delayed relay operation and the fault is unable to be cleared within specified timeframes.	Safety	*(Current)* *5* (Mitigated) 5 (Single fatality/ incurable fatal illness)	*3* 1 (Almost no likelihood to occur)	***15*** **5** **(Very low risk)**	2019
Field Voice - Inability to communicate with field crews via substation phones, fax and radios fitted in vehicles (e.g. P25 and legacy VHF network). Control Centre unable to transmit switching sheets via fax leading to **Significant impact on any restoration or planned works equating to >$100,000**.	Business	*(Current)* *2* (Mitigated) 2 (Significant impact on any restoration or planned works equating to >$100,000)	*4* 1 (Almost no likelihood to occur)	***8*** **2** **(Very low risk)**	2019

Potential risks to this program include:

- There is a risk that the CoreNet solution does not result as a viable alternative to legacy TDM based communications. The risk is considered extremely small given Energex have already conducted successful field trials.
- Business approval to securing additional Telco IP resources – resources are required to complete specialised work requiring TDM, IP and network architecture knowledge and skills.
- Securing consistent Ergon internal resources from Customer Service (Comms Design/Field Comms).
- Time impacts to meet changes in requirements of the Telecommunications standards as a result of approved merger activities.

- Delay in receiving equipment procurement orders may impact the schedule. Allowance for extended delivery will be factored into the schedule.
- The cost of any procured material & software may increase above assumed exchange rate fluctuations.

4. Recommendation

4.1 Preferred option

It is recommended that asset extension, service migration and replacement of software is completed, as outlined in Option 1.

Note: This approval request is in accordance with EQL's Governance and Delegations Policy (P013).

The total TDM replacement strategy cost is $5,601,823. This cost is $18/19 direct dollars.

All projects presented for approval are in alignment with:

- **EQL Strategy Alignment:** EQL's proposed Telco strategy covering the TDM asset class
- **EQL Projects Alignment:** Projects are consistent across EQL
- **Budget Requirements:** The TDM projects listed in Appendix B will be funded from the REPEX capital Program of Work. These projects are a part of the approved EQL North/South/South East regions 2018/19 Statement of Corporate Intent (SCI) and Corporate Plan (CP)
- **EQL Network Risk**

Following approval of the TDM strategy and this business case, it is recommended that the General Manager of Intelligent Grid Solutions will approve the progress of the projects through to completion.

Note:

- Telco specialised IP resources are fully constrained. Implementation of this program will require the engagement of a fully funded CAPEX IP approved panel resource for the duration of these projects.
- Project WR930035 has preliminary funding (Gate 2) approval. This project was originally a stand-alone project, however, in line with current business guidelines it has been included within a program comprising other similar Telco aged replacement projects. This arrangement provides clearer visibility of the Telco aged active equipment program. Due to ongoing resourcing issues over the last two years within the Telco group, Project 1 WR930035 has only been worked on intermittently as resources have been allocated to higher priority projects. As a result, the full funding (Gate 3) and subsequent milestones have not been met. Direct costs (actuals and forecast costs) at June 2018 are $99K, $6K lower than the project's approved preliminary funding (Gate 2).

4.2 Scope of preferred option

The recommended program implements a strategy for a balanced approach to legacy technology aged removal while improving the path for efficient migration to packet switched solutions. The major components of this program are:

- A low cost solution to extend the useful life of the TDM network by replenishing spares through asset mining,
- Development of a solution to carry teleprotection services over a packet-based MPLS/IP network rather than changing terminal equipment to native packet-based hardware. Migration of existing teleprotection communication links from TDM equipment to the MPLS/IP equipment so that it can be decommissioned and used as spares to keep the remaining TDM network operating, and
- Replacement of an unsupported service management system with a more resource efficient and effective software system.

Appendix A. References

Note: Documents which were included in Energy Queensland's original regulatory submission to the AER in January 2019 have their submission reference number shown in square brackets, e.g. Energy Queensland, *Corporate Strategy [1.001], (31 January 2019).*

Energy Queensland, *Asset Management Overview, Risk and Optimisation Strategy [7.025]*, (31 January 2019).

Energy Queensland, *Asset Management Plan, Telecommunications [7.043]*, (31 January 2019).

Energy Queensland, *Corporate Strategy [1.001],* (31 January 2019).

Energy Queensland, *Future Grid Roadmap [7.054],* (31 January 2019).

Energy Queensland, *Intelligent Grid Technology Plan [7.056],* (31 January 2019).

Energy Queensland, *Network Risk Framework*, (October 2018).

Ergon Energy, *Distribution Annual Planning Report (2018-19 to 2022-23) [7.049]*, (21 December 2018).

Appendix B. Acronyms and Abbreviations

The following abbreviations and acronyms appear in this business case.

Abbreviation or acronym	Definition
$, nominal	These are nominal dollars of the day
$real2019-20	These are dollar terms as at 30 June 2020
2020-25 regulatory control period	The regulatory control period commencing 1 July 2020 and ending 30 Jun 2025
AEMC	Australian Energy Market Commission
AEMO	Australian Energy Market Operator
AER	Australian Energy Regulator
ALARP	As Low as Reasonably Practical
Augex	Augmentation capital expenditure
BAU	Business as Usual
CAPEX	Capital expenditure
CP	Corporate Plan
Current regulatory control period or current period	Regulatory control period 1 July 2015 to 30 June 2020
IP	Internet Protocol
kV	kilovolt
kW	Kilowatt
kWh	kilowatt hour
KRA	Key Result Areas
MPLS	Multiprotocol Label Switching
MSS	Minimum Service Standard
NEL	National Electricity Law
NEM	National Electricity Market
NEO	National Electricity Objective
NER	National Electricity Rules (or Rules)
Next regulatory control period or forecast period	The regulatory control period commencing 1 July 2020 and ending 30 Jun 2025
NNA	Non-network alternatives
NPV	Net Present Value
OPEX	Operating and Maintenance Expenditure
PCBU	Person in Control of a Business or Undertaking
PDH	Plesiochronous Digital Hierarchy
POE	Probability of exceedance

Abbreviation or acronym	Definition
Previous regulatory control period or previous period	Regulatory control period 1 July 2010 to 30 June 2015
Repex	Replacement capital expenditure
RIN	Regulatory Information Notice
RTS	Return to Service
SAIDI	System Average Interruption Duration Index
SAIFI	System Average Interruption Frequency Index
SAMP	Strategic Asset Management Plan
SCADA	Supervisory Control and Data Acquisition
SCI	Statement of Corporate Intent
SFAIRP	So Far as Is Reasonably Practicable
TDM	Time Division Multiplexing
VHF	Very High Frequency
WACC	Weighted average cost of capital

Appendix C. Alignment with the National Electricity Rules (NER)

The table below details the alignment of this proposal with the NER capital expenditure requirements as set out in Clause 6.5.7 of the NER.

Table 7: Alignment with NER

Capital Expenditure Requirements	Rationale
6.5.7 (a) (2) The forecast capital expenditure is required in order to **comply with all applicable regulatory obligations or requirements** associated with the provision of standard control services	Our alignment to regulatory obligations or requirements is demonstrated in this proposal, whereby CAPEX is required in order to maintain compliance and electrical safety through alignment with the QLD Electrical Safety Act 2002 and the QLD Electrical Safety Regulation 2006.
6.5.7 (a) (4) The forecast capital expenditure is required in order to maintain the **safety of the distribution system** through the supply of standard control services.	This proposal has employed a standard risk analysis to highlight the safety risks that exist for staff, contractors and the community. That risk analysis has identified safety concerns that require capital expenditure to be addressed and mitigated.
6.5.7 (c) (1) (i) The forecast capital expenditure reasonably reflects the **efficient costs** of achieving the capital expenditure objectives	The Unit Cost Methodology and Estimation Approach sets out how the estimation system is used to develop project and program estimates based on specific material, labour and contract resources required to deliver a scope of work. The consistent use of the estimation system is essential in producing an efficient CAPEX forecast by enabling: • Option analysis to determine preferred solutions to network constraints • Strategic forecasting of material, labour and contract resources to ensure deliverability • Effective management of project costs throughout the program and project lifecycle, and • Effective performance monitoring to ensure the program of work is being delivered effectively. 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 forecast capital expenditure reasonably reflects a realistic expectation of the demand forecast and cost inputs required to achieve the capital expenditure objective	The prudency of this proposal is demonstrated through the options analysis conducted and the quantification of risk and benefits of each option. 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).

Appendix D. Mapping of Asset Management Objectives to Corporate Plan

This proposal has been developed in accordance with our Strategic Asset Management Plan. Our Strategic Asset Management Plan (SAMP) sets out how we apply the principles of Asset Management stated in our Asset Management Policy to achieve our Strategic Objectives.

Table 1: "Asset Function and Strategic Alignment" in Section 1.4 details how this proposal contributes to the Asset Management Objectives.

The Table below provides the linkage of the Asset Management Objectives to the Strategic Objectives as set out in our Corporate Plan (Supporting document 1.001 to our Regulatory Proposal as submitted in January 2019).

Table 8: Alignment of Corporate and Asset Management objectives

Asset Management Objectives	Mapping to Corporate Plan Strategic Objectives
Ensure network safety for staff contractors and the community	**EFFICIENCY** ***Operate safely as an efficient and effective organisation*** Continue to build a strong safety culture across the business and empower and develop our people while delivering safe, reliable and efficient operations.
Meet customer and stakeholder expectations	**COMMUNITY AND CUSTOMERS** ***Be Community and customer focused*** Maintain and deepen our communities' trust by delivering on our promises, keeping the lights on and delivering an exceptional customer experience every time
Manage risk, performance standards and asset investments to deliver balanced commercial outcomes	**GROWTH** ***Strengthen and grow from our core*** Leverage our portfolio business, strive for continuous improvement and work together to shape energy use and improve the utilisation of our assets.
Develop Asset Management capability & align practices to the global standard (ISO55000)	**EFFICIENCY** ***Operate safely as an efficient and effective organisation*** Continue to build a strong safety culture across the business and empower and develop our people while delivering safe, reliable and efficient operations.
Modernise the network and facilitate access to innovative energy technologies	**INNOVATION** ***Create value through innovation*** Be bold and creative, willing to try new ways of working and deliver new energy services that fulfil the unique needs of our communities and customers.

Appendix E. Risk Tolerability Table

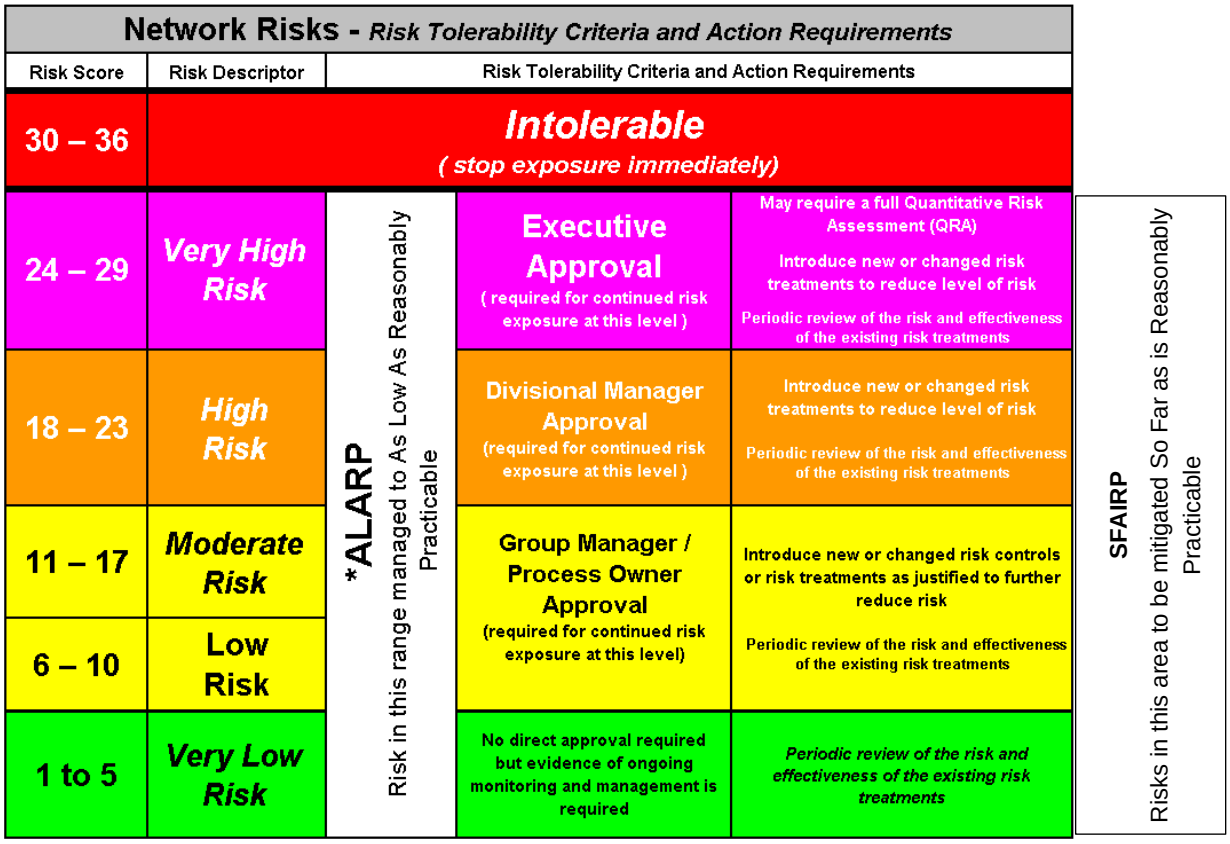

Figure 3: A Risk Tolerability Scale for evaluating Semi-Quantitative risk score

Appendix F. Reconciliation Table

Reconciliation Table Conversion from $18/19 to $2020	
Business Case Value	
(M$18/19)	$5.20
Business Case Value	
(M$2020)	$5.40

Appendix G. Additional information

This business case relates to work required across seven projects. The funding and expected completion of works is as follows:

Table 9: Direct estimated costs per project, expressed in $'000 18/19 direct dollars

WR 1159395	Last Century Data Comms	Completion target date	2018/19	2019/20	2020/21	2021/22	2022/23	2023/24	2024/25	Total
930035	Telco, TDM Aged Replace Parcel 1	31/3/20	$300	$106	$0	$0	$0	$0	$0	$406
1159396	Telco, TDM Aged Replace Parcel 2 CH2	28/2/23	$0	$79	$447	$431	$0	$0	$0	$957
1161221	Telco, TDM Aged Circuit Emulation CH3	30/12/21	$187	$1,055	$284	$7	$0	$0	$0	$1,533
1169765	Telco, TDM Lower Class Eq Replacement CH4	31/3/22	$27	$240	$673	$154	$0	$0	$0	$1,094
1267845	Telco, TDM Aged Service Management Replacement CH5	31/1/21	$71	$330	$0	$0	$0	$0	$0	$401
1343643	Telco, TDM Aged Replace 2015-2020 CH6	30/6/23	$0	$0	$0	$205	$371	$0	$0	$576
1381384	Telco, TDM Aged Replace 2020-2025 CH7	30/6/25	$0	$0	$0	$0	$0	$441	$193	$634
	Telco Strategy L2 Parent – WR``59395		$585	$1,810	$1,404	$797	$371	$441	$193	$5,601