Business Case
Operational Technology Environment

ERGON. ENERGY NETWORK

Executive Summary

The Ergon operational technology environment (OTE) provides a secure computing environment, architected to support real-time and high criticality computing solutions for the operation and control of the Ergon distribution network. As such these assets are central to ensuring the supply of energy to customers.

As assets reach the end of their supported life, not only are additional risks introduced due to the lack of support, but the risk of in-service failure increases to an unacceptable level. As such, measures are necessary to address the replacement of ageing assets in Ergon's OTE.

This document seeks to provide a high-level description and justification of an allocation of funds in the 2020-25 regulatory control period to replace these ageing assets in a program that balances risks and costs and should be considered in conjunction with broader strategic documents such as the Intelligent Grid Technology Plan.

Five options were considered but rejected in this business case; a counterfactual, 'do nothing' option, the use of cloud-based solutions instead of physical assets, server-based firewalls in place of physical firewall assets, rationalisation of OTE assets between Ergon Energy and Energex, and a fail-fix approach. These options were rejected due to concerns around suitability, cost and compatibility, as well as increased risk in the case of the counterfactual and the fail-fix approach. Two network options were evaluated in this business case:

Option 1 – Replacement based on age without considering asset condition

Option 2 – Replacement based on considering both age and condition

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 business case network security and safety are strong drivers, due to the need to replace OTE assets which are at increased risk of in-service failure and no longer supported by suppliers.

To this end, Option 2 is the preferred option as it addresses the need to manage the replacement of OTE assets with modern equivalents, while providing the least negative Net Present Value (NPV) result (-$ of the three network options considered

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
$2.1M	N/A	$2.9M

Contents

1. Introduction

Ergon Energy owns and operates an Operational Technology Environment (OTE) which is predominately situated at Ergon Energy operated data centres in Townsville and Rockhampton. This proposal concerns the OTE replacement program, which considers the need to address a range of ageing assets to maintain the performance of the OTE.

1.1 Purpose of document

This document recommends the optimal capital investment necessary for replacement of ageing OTE assets.

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. This document should be considered in conjunction with the Energy Queensland's Future Technology Roadmap and Intelligent Grid Technology Plan.

1.2 Scope of document

This document lays out the requirement for measures to address ageing of assets within the OTE. The OTE consists of communications switching equipment, firewalls, application managers and servers. The OTE is a separate network to the Corporate Information Technology (IT) network and implements strict controls around the interconnection points with the Corporate IT network.

The OTE Refurbishment program considers a range of ageing assets for the generation of this plan, including the following:

- IP (Internet Protocol) Switch
- IP Firewalls
- Appliance Manager
- Applications Server

This program does not consider equipment that has been deployed as part of the Ergon Energy Telecommunications Network, including but not limited to Corenet and Ubinet. All Ergon Energy Telecommunications Network equipment has been included in the Obsolete Telecommunications plan.

Any expansion in OTE functionality to support future infrastructure requirements is not included in this business case and is assumed to be included in other Intelligent Grid related business cases.

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 business case network security and safety are strong drivers, due to the need to replace OTE assets which are at increased risk of in-service failure and no longer supported by suppliers.

The assets addressed in this proposal are necessary to support the safe and efficient operation of the network. As assets reach the end of their supported life, not only are additional risks introduced

due to the lack of support, but the risk of in-service failure increases to an unacceptable level. As such, measures are necessary to address the replacement of ageing assets in Ergon's OTE. 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 OTE Refurbishment contributes to Energy Queensland's corporate and asset management objectives. The linkages between these Asset Management Objectives and EQL's Corporate Objectives are shown in Appendix D.

Table 1: Asset Function and Strategic Alignment

Objectives	Relationship of Initiative to Objectives
Ensure network safety for staff contractors and the community	The safety of staff and the community could be negatively impacted by risks associated with the ageing of these assets. By addressing these issues, these safety risks can be mitigated.
Meet customer and stakeholder expectations	This work ensures management of the power network via the Master station can be maintained at current performance levels, thus limiting negative impacts on customer outage durations.
Manage risk, performance standards and asset investments to deliver balanced commercial outcomes	Failure of this asset can result in increased public safety risk and disruption of the electricity network. The proposed work supports the provision of a cost-effective network for customers by managing cyber security risks associated with obsolescence and potential impacts from malicious cyber-attacks.
Develop Asset Management capability & align practices to the global standard (ISO55000)	This proposal is consistent with ISO55000 objectives and drives asset management capability by promoting a continuous improvement environment. The proposed approach is a trade-off between the risk of asset failures and costs of replacements. The program is systematic and based on information.
Modernise the network and facilitate access to innovative energy technologies	This proposal recommends the replacement of assets at end of economic life as necessary to suit modern standards and requirements.

1.5 Applicable service levels

Under the Distribution Authorities, Energy Queensland (EQL) is expected to operate with an 'economic' customer value-based approach to reliability, with "Safety Net measures" for extreme circumstances. Safety Net measures are intended to mitigate against the risk of low probability vs high consequence network outages. Safety Net targets are described in terms of the number of times a benchmark volume of energy is undelivered for more than a specific time period. EQL is expected to employ all reasonable measures to ensure it does not exceed minimum service standards (MSS) for reliability, assessed by feeder types as

- System Average Interruption Duration Index (SAIDI), and;
- System Average Interruption Frequency Index (SAIFI).

Both Safety Net and MSS performance information are publicly reported annually in the Distribution Annual Planning Reports (DAPR). MSS performance is monitored and reported within EQL daily.

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 would address risks posed to the public by a potential failure of these assets. In addition, it would help to mitigate the heightened cyber-attack risks that are a high risk with obsolete assets of this type.
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 contributes to minimising the outage durations experienced by customers. This is achieved by ensuring management of the power network via the master station continues to meet the required performance levels.

1.7 Limitation of existing assets

Technical obsolescence is a major driver for the replacement of OTE Equipment. As assets reach the end of their supported life, risks are introduced due to this lack of supplier support, and in particular growing cybersecurity threats. In an increasingly complex digital landscape where utilities face increased cyber risks, it is essential to ensure the lifecycle of assets is managed in such a way as to minimise these risks. Cyber-attacks not only risk potential business impacts for Energy Queensland, but also significant risk to the wider community Energy Queensland serves. Utilising the most up to date systems and software is a key method do address these cyber risks.

In addition, once the software, firmware or hardware of the equipment becomes obsolete, the continued operation of these assets presents an increased risk to Ergon due to the increased risk of an unrecoverable in-service failure. It is also important to consider that the rate of failure for this sort of equipment is not linear and tends to increase as it ages. The current population of assets considered in this proposal are detailed below in Table 3.

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

Table 3: Current population levels of OTE assets relevant to the scope of in this proposal

Asset Type	Population	Expected Lifespan (Years)	# of Units that Exceed Lifespan in 2020-2025 Period
Switch	7	7	7
Server / Appliance Manager	28	7	28
Router	-	7	-
Firewall	10	7	10
Carrier Gateway	-	7	-
VoIP Phone	-	7	-

In order to reduce the length of in-service failures, Ergon maintains spare equipment holdings for its OTE equipment. For equipment that no longer has an associated vendor supply contract – those that are obsolete or obsolescent – spares are typically sourced from units that have been proactively removed from service elsewhere in the network. This strategy has been adopted as it is rarely possible to perform like-for-like replacements using different equipment models or different vendors due to physical, functional or configuration differences. Without internal spares holdings, a lengthier replacement process would need to be completed, which would lead to an unacceptable return to service delays in emergencies or unplanned failure situations.

In-service failure can significantly impact Ergon until repairs are carried out, potentially resulting in the following:

- Loss of Master Station functions and associated systems - or the delivery of data to Master station for processing - resulting in the inability to remotely operate and manage the power networks, along with risks to planned and reactive works.
- Loss of TOTEM[3] and/or PQ Sapphire [4] and associated systems - or the delivery of data from TOTEM for processing - resulting in the inability to collect and view non-SCADA (Supervisory Control and Data Acquisition) power system data.
- Loss of cyber-security protections, exposing vulnerabilities in network security.

Table 4 describes issues Energy Queensland has previously experienced due to failures relating to these types of assets.

Table 4: Examples of previous negative impacts to Energy Queensland from failures of asset types addressed by this proposal

Issue	Impact
SCADA core switch failure	During Loss of Supply event for Mt Isa region, Loss of SCADA indication and control to majority of Ergon electricity network occurred for approx. 3hrs due to failed switch hardware and failed redundancy.
SCADA Firewall Failed in Operations Control Centre SCADA (OCCS) due to hardware fault.	Loss of redundancy to master in South region only.
Data Centre Core Router Interface Failure	76% packet loss across core link between Core routers affecting all data centre traffic.

[3] TOTEM historical non-SCADA network information analytics and data storage platform
[4] PQ Sapphire – Analytic package for power quality data provide from network devices

Issue	Impact
Virtual router in Data Centre impacted by serious security vulnerability.	Limited impacted to monitoring traffic only.
Failure of all Network time Protocol (NTP) Servers due to a single vendor and the inability to correctly deal with leap-seconds.	Due to all time servers failing, there were log-in failures for Net-Ops controllers. This led to loss of manual control of the power network.
Failure of the core firewall	This caused fail-over of all OTE infrastructure to a single data centre. Some infrastructure did not successfully fail-over, leading to multiple outages on different systems. Impacts included inability for additional users to log in to the distribution management system (DMS), and severe restrictions on the ability to the identify root-cause and affected system

2 Counterfactual Analysis

2.1 Purpose of asset

The Ergon OTE provides a secure computing environment, architected to support real-time and high criticality computing solutions for the operation and control of the Ergon distribution network. As such these assets are central to ensuring the supply of energy to customers. The counterfactual case would involve no replacement of any of the asset types considered in this proposal.

2.2 Business-as-usual service costs

The business as usual (BAU) service costs for these assets 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. These have not been explicitly costed in this case due to the significant safety, reliability and compliance risks associated with asset failures.

2.3 Key assumptions

The counterfactual case involves replacement of assets purely on a fail-fix basis. Whilst this may represent the 'cheapest' option in the short-term, it results in significant increases in risk associated with operating assets beyond their supported operational lifespan. It is anticipated that all equipment vendors will provide End-of-Life notices for equipment not currently End-of-Life before the end of the 2020-2025 period.

2.4 Risk assessment

Table 5 details Ergon's risk exposure at the start of the regulatory period if no action is taken. This risk assessment is in accordance with the EQL Network Risk Framework and the Risk Tolerability table from the framework is shown in Appendix E.

Table 5: Counterfactual risk assessment

Risk Scenario	Risk Type	Consequence (C)	Likelihood (L)	Risk Score	Risk Year
• OTE environment experiences an end of life equipment issue with no existing fix available & no manufacturer remediation. • OTE functions out of service during extreme weather. • A wires-down event occurs while the OTE is inoperable and controllers are unable to de-energise the line remotely resulting in **a single fatality**.	Safety	5 *(Single Fatality or Incurable Fatal illness)*	2 *(Very Unlikely)*	**10** ***(Low Risk)***	2020
• OTE environment fails due to end of life equipment issue with no existing fix available & no manufacturer remediation. • OTE functions out of service. • **15,000 customers experience service interruptions** due to the increased time to identify the cause of the fault and restore as OTE is unable to support.	Customer	4 *(15,000 customers, >1 day to restore, every day in 1 week)*	2 *(Very Unlikely)*	**8** ***(Low Risk)***	2020

Risk Scenario	Risk Type	Consequence (C)	Likelihood (L)	Risk Score	Risk Year
• OTE environment fails due to end of life equipment issue with no existing fix available & no manufacturer remediation. • OTE functions out of service. • **Inability to remotely control the majority of Ergon network** for the duration of the OTE outage.	Business	6 *(Most Severe)*	2 *(Very Unlikely)*	**12** ***(Moderate Risk)***	2020

Further Details of the risk ratings and descriptions can be found in Energy Queensland's Network Risk Framework.

This risk will continue to increase if not addressed. A consequence of continuing to operate obsolete and aged equipment is the reduced ability to carry out repairs in an efficient manner due to the inability to access vendor spares and technical support. Some equipment failures would result in an outage of services including remote network access and management for extended durations.

As more assets exceed their expected lifespan, the organisation will be unable to restore OTE functionality if large numbers of in-service failures occur. During severe weather events and power network outages, in-service failures of OTE equipment would expose work crews and the public to increased safety risks as restoration coordination becomes more difficult and the network requires manual switching.

Risk Justification Statement

With this level of safety, customer and business risk, the counterfactual is not an acceptable option based on the principles of ALARP.

Risk Assessment Outcome

The network (business) risk the organisation would be exposed to if the project was not undertaken is not deemed to be as low as reasonably practicable (ALARP). Addressing the risks as detailed below through implementation of the preferred option will reduce Energy Queensland's risk exposure to the levels indicated in Table 10.

2.5 Retirement decision

Retirement or de-rating of OTE assets is not considered a feasible option as these are critical assets required to maintain electricity supply. There is currently no real feasible method to predict "failure" of these types of assets, and much of the justification for the removal of obsolete OTE equipment from the network is not centred around "failure" in the traditional sense of the equipment stopping to work completely. In most cases once vendors no longer support equipment then no software updates are available which can mean if issues occur then no fix will be made available to resolve the issue, security problems discovered will not then have patches generated by the vendor, management software will no longer support changes to devices etc. This escalating risk drives replacement of the obsolete equipment before likely complete in-service failure would drive replacement.

3 Options Analysis

3.1 Options considered but rejected

Counterfactual

The counterfactual was considered but rejected on the basis of the unacceptable network security and safety risks it would introduce due to the the increased risk of in-service failure of OTE assets which are no longer supported by suppliers.

Cloud Solutions rather than physical assets

Energy Queensland has considered the potential of cloud-based solutions to reduce asset costs and improve agility where possible. As such, the potential for these solutions to be replaced with cloud-based solutions was investigated.

The servers currently residing within the Ergon Energy OTE are specifically located there due to the unsuitability of existing corporate and cloud infrastructure. Data stored on these servers is typically not appropriate for transmission beyond the OTE due to the security classification of the data. Many of these servers provide OTE support functions such as Domain Name System (DNS) and Active Directory, which cannot be moved outside the OTE without posing risks to the security of the OTE. As such, cloud-based solutions are not a suitable option in this case.

Firewalls

Consideration was given to the potential of server-based firewalls as opposed to firewall security appliances. Typically firewall security appliances are cheaper to purchase than separately purchasing server hardware and firewall application licenses. Firewall security appliances are also far cheaper to operate and maintain, with fewer support and maintenance agreements and significantly reduced configuration requirements. As such, alternative options around the replacement of firewalls were not suitable for this application.

OTE Rationalisation

Energy Queensland has Identified convergence of OTE between Energex and Ergon as a key focus. As such, options to rationalise any assets between the Energex and Ergon systems was considered. Currently the two OTE solutions host very different solutions with little overlap except for the distribution management system (DMS) solution.

Once a common OTE is established and agreement on single vendor solutions is obtained, with the geographical requirements, it was found that there would still be no resulting reduction in the underpinning hardware requirements. This is because the capacity, resilience, and security requirements would drive having hardware at each data centre. As such all assets addressed in this proposal were considered essential and rationalisation of assets was rejected as an option.

Replace only enough units to support fail-fix

This is a high-risk approach that continues to utilise assets outside of vendor supply & support contracts. This option prioritises replacements for strategic spares holdings in order to facilitate a fail/fix approach, accompanied with reduced system capabilities. This quantity of replacements would remove existing system redundancies to produce sufficient spares, introducing intolerable risks to the continued operation of Ergon's OTE under current network standards. However, given this option would result in all replacements occurring under emergency conditions, it is considered unviable

since this would by default be more expensive than the other proposed replacement options (see Section 3.2).

3.2 Identified options

In addition to considering the counterfactual, three different options were identified to address the replacement needs of OTE assets. These include replacing assets purely based on asset age, considering both age and condition, or replacing only to the extent required to support fail-fix. Table 6 below shows the recommended replacement quantities of each of the three proposed options for the 2020-2025 AER period.

Table 6: Quantities of Replacements in Proposed Options

Asset Type	Replacements Recommended	
	Option 1 (Replace on Age)	Option 2 (Replace on Age and Condition)
Switch	7	7
Server / Appliance Manager	28	28
Router	-	-
Firewall	10	6
Carrier Gateway	-	-
VoIP Phone	-	-

Option 1: Replace on age

Option 1 presents the least risk for the network, with assets replaced at the end of their expected lifespan regardless of condition. This eliminates any risk that arises through operating these assets past this point. These expected lifespans represent what is typical for the given asset as per Energy Queensland's Information and Communications Technology (ICT) Infrastructure Guidelines, and as such continued operation is done so with an increased risk of in-service failure. The quantities of replacements for the 2020-2025 period shown in Table 6 have been adjusted to consider existing projects that are underway and will be replacing assets before or during the current AER period.

Option 2: Replace on age and condition

This presents an optimised replacement scenario in which aged assets that are still in an acceptable condition and predicted to be suitable for continued operation throughout the 2020-2025 period are not considered for replacement. In this case condition is assessed based on hardware status and software support from the vendors. When assessing the condition of assets to determine whether assets are to be replaced replacement include considering the quantity of spares held by EQL, the availability of spares from vendor, the degree of difficulty required to replace a failed asset, and the Impacts of their failure (e.g. loss of redundancy vs loss of function).

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 costs of the counterfactual cannot be predicted due to limited methods for predicting the failure of these types of assets, so only the costs for Options 1 and 2 were compared. A summary of the annual costs for each option is given in Table 7 below.

Table 7: Cost Summary of Options in 2018-19 dollars

Option	Option 1: Replace on Age	Option 2: Replace on Age and Condition
Labour ($ p.a.)	$162,012	$146,484
Material / Equipment ($ p.a.)	$486,035	$439,453
Annual Total ($ p.a.)	$648,047	$585,937
Total Cost 2020/21 to 2024/25	**$3,240,236**	**$2,929,685**

Results

The NPV and Present Value (PV) of each option was calculated, using the Regulated Real Pre-Tax Weighted Average Cost of Capital (WACC) rate of 2.62% as the discount rate (as per EQL's Standard NPV Tool). The results are summarised below in Table 8.

Table 8: NPV of each option ($ 000s)

Option	PV of CAPEX	NPV
Option 1	-3,000	-3,000
Option 2	-2,713	-2,713

3.4 Scenario Analysis

3.4.1 Sensitivities

This proposal is a risk-based replacement approach but is sensitive to variations in costs or other parameters. The preferred option may change depending on these costs but at this time these are the best estimates available for the costs of this program.

3.4.2 Value of regret analysis

In terms of selecting a decision pathway of 'least regret', Option 2 presents an economically efficient and balanced approach to investment by which aged assets that are still in an acceptable condition and predicted to be suitable for continued operation throughout the 2020-2025 period are not considered for replacement. This ensures that risk is reduced to the greatest extent without bringing forward unnecessary expenditure as proposed in Option 1.

3.5 Qualitative comparison of identified options

3.5.1 Advantages and disadvantages of each option

Table 9 below details the advantages and disadvantages of each option considered.

Table 9: Assessment of options

Options	Advantages	Disadvantages
Option 1: Replace on Age	• **Risk:** Lowest risk of all options considered.	• **Cost:** Relatively high costs when compared with the other options.
Option 2: Replace on Condition	• **Risk:** Lowers risk of in-service failures significantly. • **Cost:** Represents reduced cost relative to the more conservative approach in option A	

3.5.2 Alignment with network development plan

Ergon's network development plan's OTE strategy identifies strengthening the resilience of its operational technology as a core goal, this is particularly important given the heightened complexity of the network in a climate of increased cyber and physical security threats. The works recommended by this proposal would form a part of the planned operational technology investments identified in the Distribution Annual Planning Report (DAPR), and the preferred option aligns with the Asset Management Objectives in the DAPR. This proposal 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

Energy Queensland's Future Grid Roadmap identifies three distinct platforms as necessary to enable transition to an intelligent grid, including Power, Technology, and Digital platforms. A key focus within the Intelligent Grid Technology Plan includes reducing the total cost of ownership (TCO) of the OTE. This is to be achieved through commoditisation of ICT infrastructure through strategies such as virtualisation, hyper-converged solutions, and cloud-based infrastructure. Nearly all existing arrangements are already hyper-converged or virtualised. As such, replacement of the associated hardware directly supports the ongoing control and performance of the grid in alignment with the Future Grid Roadmap. In future, Energy Queensland intends to continue to shift towards cloud-based solutions wherever possible, delivering further savings.

3.5.4 Risk Assessment Following Implementation of Proposed Option

Table 10 outlines the risk assessment for the Ergon Energy network following implementation of the proposed option.

Table 10: Risk assessment showing risks mitigated following Implementation

Risk Scenario	Risk Type	Consequence (C)	Likelihood (L)	Risk Score	Risk Year
Following a series of cascading events described in Table 5: • A wires-down event occurs while the OTE is inoperable and controllers are unable to de-energise the line remotely resulting in **a single fatality**.	Safety	*(Original)* *5* *(Single Fatality or Incurable Fatal illness)* (Mitigated) (As above)	*2* *(Very Unlikely)* 1 (Almost none)	***10*** ***(Low Risk)*** **5** **(Very low risk)**	2020
Following a series of cascading events described in Table 5: • **15,000 customers experience service interruptions** due to the increased time to identify the cause of the fault and restore as OTE is unable to support.	Customer	*(Original)* *4* *(15,000 customers, >1 day to restore, every day in 1 week)* (Mitigated) (As above)	*2* *(Very Unlikely)* 1 (Almost none)	***8*** ***(Low Risk)*** **4** **(Very low risk)**	2020
Following a series of cascading events described in Table 5: • **Inability to remotely control the majority of Ergon network** for the duration of the OTE outage.	Business	*(Original)* *6* *(Most severe)* (Mitigated) (As above)	*2* *(Unlikely)* 1 (Almost none)	***12*** *(Moderate Risk)* **6** **(Low risk)**	2020

With risk treatment as identified in Option 2, the likelihood reduces to *'almost no likelihood to occur' (L=1)* as the failure rate would be reduced and the manufacturer would be obliged to remediate if a failure occurred. This would have a treated risk score of low or very low for all categories of risks.

4 Recommendation

4.1 Preferred option

Option 2 is the preferred selection, as it presents the most balanced outcome for the network between residual risk and cost. Option 2 ensures that existing assets continue to be supported by the supplier and that spares are readily available for replacements.

4.2 Scope of preferred option

The volumes of each asset to be replaced under the preferred option are given in Table 11 below. Equipment replacements would be progressively rolled out over the AER 2020-2025 period.

Table 11: Quantities of Replacements in Preferred option

Asset Type	Replacements
Switch	7
Server / Appliance Manager	28
Firewall	6

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).*

Energex, *Distribution Annual Planning Report (2018-19 to 2022-23) [7.050]*, (21 December 2018).

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

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

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

Energy Queensland, *ICT Infrastructure Guidelines,* 2018

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).

Ergon Energy,

Appendix B. Acronyms and Abbreviations

The following abbreviations and acronyms appear in this business case.

Abbreviation or acronym	Definition
$M	Millions of dollars
$ nominal	These are nominal dollars of the day
$ real 2019-20	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 Practicable
AMP	Asset Management Plan
BAU	Business As Usual
CAPEX	Capital expenditure
Current regulatory control period or current period	Regulatory control period 1 July 2015 to 30 June 2020
DAPR	Distribution Annual Planning Report
DC	Direct Current
DMS	Distribution Management System
DNS	Domain Name System
EQL	Energy Queensland Ltd
IP	Internet Protocol
ICT	Information and Communications Technology
IT	Information Technology
KRA	Key Result Areas
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
NPV	Net Present Value
NTP	Network Time Protocol
OCCS	Operations Control Centre SCADA

Abbreviation or acronym	Definition
OTE	Operational Technology Environment
PCBU	Person in Control of a Business or Undertaking
Previous regulatory control period or previous period	Regulatory control period 1 July 2010 to 30 June 2015
PV	Present Value
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
TCO	Total Cost of Ownership
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 12: 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	In accordance with QLD Electrical Safety Act 2002 and QLD Electrical safety Regulation 2013, this expenditure will improve the safety of field workers and the public by enabling rapid control of assets in the event of an incident.
6.5.7 (a) (3) The forecast capital expenditure is required in order to: (iii) maintain the **quality, reliability and security of supply** of supply of standard control services (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 vital communications functions, which are critical in the provision of network reliability in support of MSS and safety net security and reliability targets.
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 program of work ensures the integrity of vital communications functions that support numerous systems. They are critical in ensuring safety, and the availability of communications during all routine and emergency events.
6.5.7 (c) (1) (i) The forecast capital expenditure reasonably reflects 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 a staging of work timing to enable a lower cost delivery compared to other options. It generally avoids emergency replacements that incur higher costs. 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. 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 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 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).
6.5.7 (c) (1) (iii) The forecast capital expenditure reasonably reflects a realistic expectation of the **demand forecast and cost inputs** required to achieve the capital expenditure objective	Our peak demand forecasting methodology employs a bottom-up approach reconciled to a top-down evaluation, to develop the ten-year zone substation peak demand forecasts. Our forecasts use validated historical peak demands and expected load growth based on demographic and appliance information in small area grids. Demand reductions, delivered via load control tariffs, are included in these forecasts. This provides us with accurate forecasts on which to plan.

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 13: 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

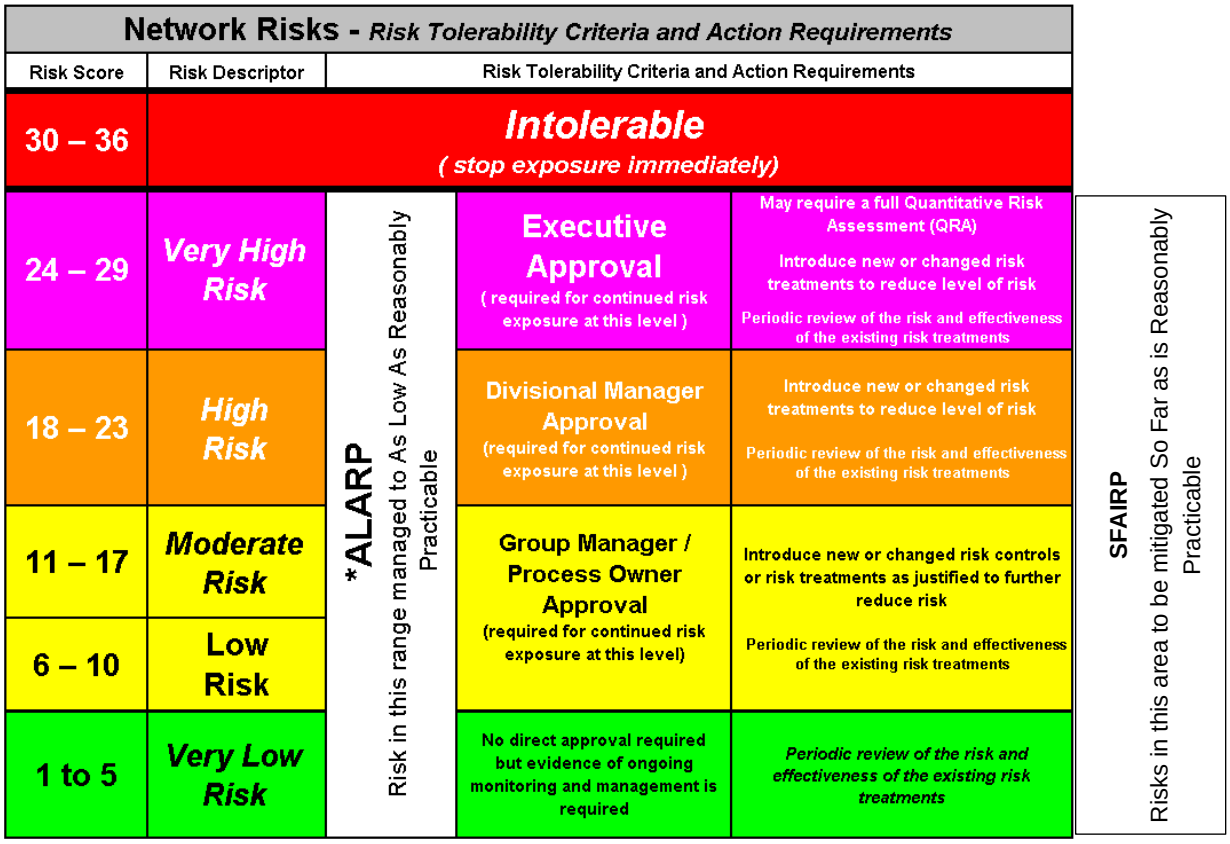

Figure 1: A Risk Tolerability Scale for evaluating Semi-Quantitative risk score

Appendix F. Reconciliation Table

Reconciliation Table Conversion from $18/19 to $2020	
Business Case Value	
(M$18/19)	$2.90
Business Case Value	
(M$2020)	$3.01