Grid Comms SDH Replacement Edge REPEX Ergon Energy

Justification Statement

07/ 10/ 2024

ERGON ENERGY NETWORK
Part of Energy Queensland

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DOCUMENT VERSION

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

1 SUMMARY

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<tr><td>Expenditure category</td><td>☒ Replacement ☐ Augmentation ☐ Connections ☐ Non-network</td></tr>
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☒ Reliability ☐ CECV ☒ Safety ☐ Environment ☒ Financial
☐ Other
An ongoing program to proactively replace aged and unsupported SDH assets prior to in-service failure. For the majority of the SDH network, Ergon is reliant on sufficient spares to maintain reliable operation while migrating services to IP/MPLS as a long-term strategy. Responding to faults to SDH infrastructure without a like-for-like spare results in extended outages of critical services, additional costs and wider-spread network impact as reconfiguration and additional replacement is required.</td></tr>
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<tr><td>$m, direct 2022-23</td><td>$6.5M</td><td>$0.68M</td><td>$0.68M</td><td>$0.68M</td><td>$0.68M</td><td>$0.68M</td><td>$3.41M</td></tr>
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<tr><td>Benefits</td><td>This proactive program will reduce costs associated with moving to a reactive program, will reduce risks associated with increased outages of in service equipment and has a range of other advantages compared to the a fail fix asset strategy</td></tr>
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2 PURPOSE AND SCOPE

This document recommends the optimal capital investment necessary for replacement of obsolete Synchronous Digital Hierarchy (SDH) telecommunications network assets. This is a preliminary business case document has been developed for the purposes of seeking funding for the required investment in coordination with the Ergon Regulatory Proposal to the Australian Energy Regulator (AER) for the 2025-30 regulatory control period. Prior to investment, further detail will be assessed in accordance with the established Energy Queensland investment governance processes. The costs presented ($3,411,488) are in (2022/23) direct dollars.

3 BACKGROUND

3.1 Asset Population / Site Summary / Capability

Ergon Energy is currently operating a large SDH network that is still the primary mechanism underpinning both the Plesiochronus Digital Hierarchy (PDH) and IP/MPLS (Multi Protocol Label Switching) network assets that enables mission critical real-time voice and data communications to allow automation, remote monitoring and control of the power network, enable ability to co-ordinate safe and efficient work activities as well as extend the reach of corporate information systems across a common infrastructure.

Most suppliers of these asset types have stopped sale of these asset classes and a planned technology migration to Ethernet/IP/MPLS networks is required to allow a withdrawal from these legacy based assets.

Table 1 Asset Class and Base

Asset Class / Technology Type	Total Edge Quantity	2025-30 End of Life Quantity	Asset Criticality	Replacement Strategy
EDGE				
[redacted]	47	47	High Component failure leads to extended large, regionalised outages.	Proactive replace critical sites strategically – to use as spares for remaining fleet.
[redacted]	47	47		
[redacted]	60	60		

3.2 Asset Management Overview

Outlined in the graph below is the age distribution for SDH Edge based equipment. Ergon Energy currently has 154 Edge SDH multiplexers in-service with the vast majority installed between 2007 and 2014. Since 2016 there has been no further deployment of this technology in favour of native IP/MPLS (Multiple Protocol Label Switching) technology.

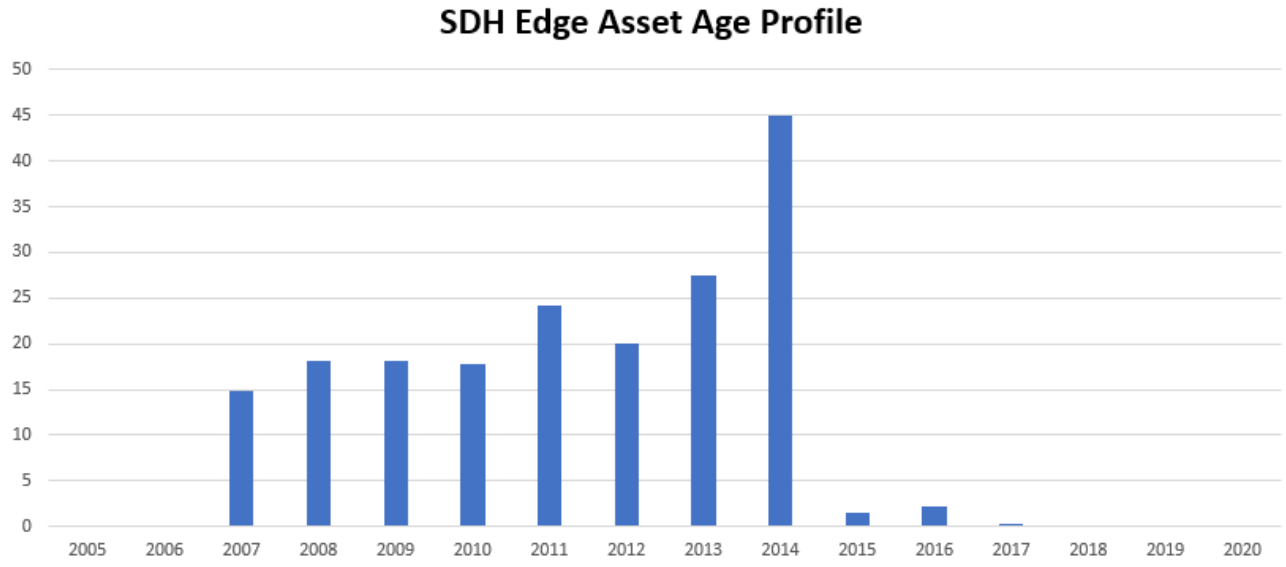


Figure 1: SDH Edge Asset Age Profile

3.3 Asset Failure Rates

Asset performance considerations for the SDH fleet is as follows:

- All existing SDH components have gone End of Life, manufacturers have ceased support and very limited options exist for equipment repairs and refurbishment.
- All existing SDH components do not have like-for-like replacements; it is required to conduct a technology migration to IP/MPLS which introduces a range of complexities.
- Vendor supplied SDH Network Management Systems; craft terminals have all gone end of life, along with the supporting software components such as Windows / Linux operating systems these systems depend on.
- Combined average failure rate during the 5 year period between 2019 and 2023 has been ~4.10% and is anticipated to increase as the electronic components age.

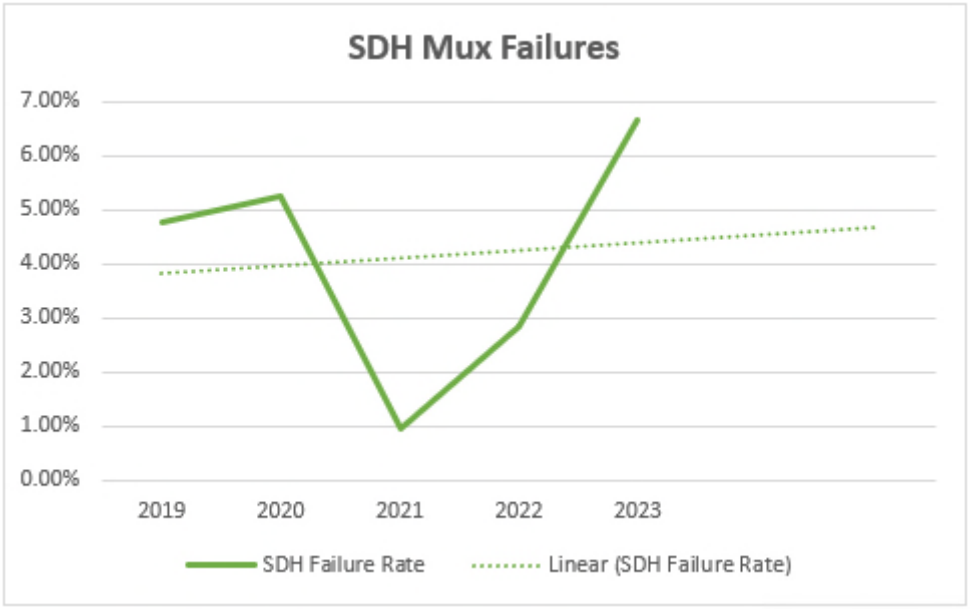


Figure 2: SDH Asset Failures

4 IDENTIFIED NEED

4.1 Summary

This program seeks to manage costs associated with provision of comms equipment by ensuring spare equipment is available ahead of in-service failure. By replacing selected components of end of supply equipment to generate spares we can extend the life of the remaining fleet significantly and deferring replacement costs. Not proceeding with the program will require expensive reactive replacement when units fail in-service and no spares are available and when services are switched off as part of vendor service close down.

All existing deployed SDH platforms have gone End of Sale with most having already exceeded End of Life/Support dates with the final asset class now EoL from 2026. EQL has limited spares of this equipment and it's expected these spares will be fully depleted in the coming period.

A technology transition strategy to address this need has been well established over the past 10 years and involves the following:

- **Reduce SDH network expansion:** Continue a focus on limiting the deployment of new SDH technology. This involves ensuring all telecommunications services are deployed as native IP/MPLS.
- **Extending the life of the SDH network**: Continue a focus on asset life-cycle management of the existing SDH asset classes. Ensuring strategic spares are in-place and active monitoring of network faults will continue to be the primary methods to ensure the SDH network maintains the reliable carriage of services. This represents the most cost-effective solution and will be in place until the planned progressive exit from SDH technologies is completed (> 2035).

- **Teleprotection solution over IP/MPLS network:** The migration of services from SDH technologies to the IP/MPLS network will continue to occur where feasible and prudent to support reliability and capacity drivers. Use this capability to further mine spares from the network to support the existing fleet.

4.2 Options Analysis

Ergon Energy evaluated multiple options as follows to determine the most prudent asset management approach for the SDH based assets. These options are summarised in the table below and detailed further in each subsequent section.

Option	Qty Proactive	Total Proactive Cost	Qty Reactive	Total Reactive Cost	Total Cost	NPV
Option 1A - Spares mine 4% *Assumes failure rate remains the same as previous period*	30	$3.41M	0	$0	$3.41M	$0.08M*
Option 1B - Spares mine 5% *Assumes failure rate will rise but less than the trend suggests.*	38	$4.37M	0	$0	$4.37M	$0.06M*
Option 1C - Spares mine 6.5% *Assumes failure rate will rise inline with observed trend.*	50	$5.75M	0	$0	$5.75M	$0.08M*
Option 1D - Spares mine 3% *Accept AER proposed 37% reduction. Resulting in 24 x proactive and ~8 x reactive replacements.*	24	$2.71M	8	$2.30M	$5.06M	-$1.90M
Option 2 - Wholesale replace *Replacement of all obsolete assets*	154	$14.18M	0	$0	$14.18M	-$7.02M
Option 3 – Counterfactual *No proactive replacement in place*	0	$0	32	$9.08M	$9.08M	-$7.59M

**Note NPV for spares mining options that stay ahead of assumed failure rates all return marginally positive NPV based on increased expenditure in alignment with estimated failure rates.*

4.2.1 Option 1A (Proposed) – Strategic spares mining assuming failure rate remains the same (4% per annum) as previous period

This proposed option is based on allowing for a failure rate of equipment to not increase from the current observed 4%. This option will allow the existing SDH fleet to continue to remain in service without significant change to ultimately extend the life of the existing SDH infrastructure.

To achieve this Ergon intends to continue the existing practice of strategic spares mining which involves proactive replacement and recovery of operational SDH assets for the likely amount required to support failure in service.

The approach to prioritise assets for recovery has strong focus on alleviating deliverability issues through targeted selection of assets that are simple to recover have reduced complexity based on where it is located and services it provides. The key methodology is as follows:

- Assets where design and construction can be aligned with other planned works, such as those assets interfacing to SDH based Microwave radios.
- Sites that have existing modern IP/MPLS based assets and the SDH nodes are not providing Protection based services are generally the simplest to recover.

This program is to perform targeted replacement of the most critical SDH assets in the Edge network. Out of the 154 total SDH Edge assets, 4% will be targeted yearly for a total of 30 assets for the 5 years. The most critical assets will be targeted for replacement with IP/MPLS technology under this project with the recovered units to be utilised as spares for the existing fleet.

Total cost of this program $3,411,488.

4.2.2 Option 1B (Previously submitted) – Strategic spares mining assuming failure rate will rise but at less than trend line suggests

This option was the original proposal which was based on allowing for a failure rate of equipment to increase from the current observed 4% to an average of 5% for the coming period.

As with the proposed option this allows the existing SDH fleet to continue to remain in service without significant change to ultimately extend the life of the existing SDH infrastructure, via the use of strategic spares mining.

This program is to perform targeted replacement of the most critical SDH assets in the Edge network. Out of the 154 total SDH Edge assets, 38 of the most critical assets will be targeted over the 5 year term for replacement with IP/MPLS technology under this project with the recovered units to be utilised as spares for the existing fleet.

Total cost of this program $4,374,895.

4.2.3 Option 1C – Strategic spares mining assuming failure rate will rise in line with observed trend

This option is based on allowing for a failure rate of equipment to increase from the current observed 4% p.a. to an average of 6.5% p.a. for the coming period.

As with the proposed option this allows the existing SDH fleet to continue to remain in service without significant change to ultimately extend the life of the existing SDH infrastructure, via the use of strategic spares mining.

This program is to perform targeted replacement of the most critical SDH assets in the Edge network. Out of the 154 total SDH Edge assets, 50 of the most critical assets will be targeted over the 5 year term for replacement with IP/MPLS technology under this project with the recovered units to be utilised as spares for the existing fleet.

Total cost of this program $5,756,440.

4.2.4 Option 1D – Accept the AER proposed 37% reduction for the proactive replacement program and Spare Mine and Reactive works.

This option is accepting the AERs 37% reduction in the program ($2.7M) and only replacing 24 assets. For this option we would be likely performing reactive replacements of between 6 and 14

units. The total cost of the program will be the sum of the proactive program and the reactive program to cover the fail-fix where spares would not be available.

$2.71M (proactive component) + $2.30M (reactive component) = $5.06M (total).

4.2.5 Option 2 - Wholesale replacement

Ergon considered performing an accelerated program with minimal risk which involves wholesale proactive replacement of all 154 x obsolete SDH Edge assets based on age, condition and vendor support removal as an alternate to the proposed multi-faceted approach that replaces a smaller subset however the program was grossly ($14.18M) more expensive than the proposed program and was rejected.
In addition to being extremely cost prohibitive, there was concerns in the deliverability due to the technology migration to IP/MPLS being labour intensive.

4.2.6 Option 3 – Counterfactual (Reactive replacement only).

This program is intended to be purely proactive in nature. The counterfactual considers the continued use of the current infrastructure platform beyond its useful asset life. This means that only remedial/restoration of services will be funded through operating costs, with no capital investment in minor and major upgrade and/or replacement of the infrastructure.

Should failure rates continue at 4.1% total of 32 failures would be expected over the 5 year period requiring reactive return to service action which is estimated to cost at least 2.5 times to restore services due to assets having gone end of sale, remaining spares eventually becoming depleted and no like for like replacements are available. There are several factors that can lead to these significantly higher costs:

- The absence of proactive capital investment in the 2025-30 regulatory period would mean that over time the current infrastructure would no longer be fit-for-purpose and may become incompatible with new and emerging systems and technologies used by Ergon and third parties.

- Replacing SDH equipment requires migrating to newer IP/MPLS technology which when done in a reactive method can be extremely inefficient due to complexities such as the following:
    - Requires planning, re-engineering, and replacement of hardware at multiple sites, leading to unexpected expenses beyond the immediate failure.
    - Re-design the remaining operational SDH equipment to ensure network services, clocking/synchronisation and remote management can be maintained to required service levels.
    - Re-design the IP/MPLS network to ensure the IP based services are integrated.
    - Where the failed SDH asset interconnects to either 3rd Party SDH services it is required to engage the 3rd party to design and deliver replacement IP based service.
    - Where the failed SDH asset interconnects to SDH Microwave radio it is required to additionally replace the associated microwave radio equipment at each endpoint.
- Reactively replacing SDH can result in longer network downtime, which adds indirect costs due to service outages, business impacts and the urgency of securing specialised resources to implement the migration.

The total estimated cost of the counterfactual case over the period is $9,086,000.

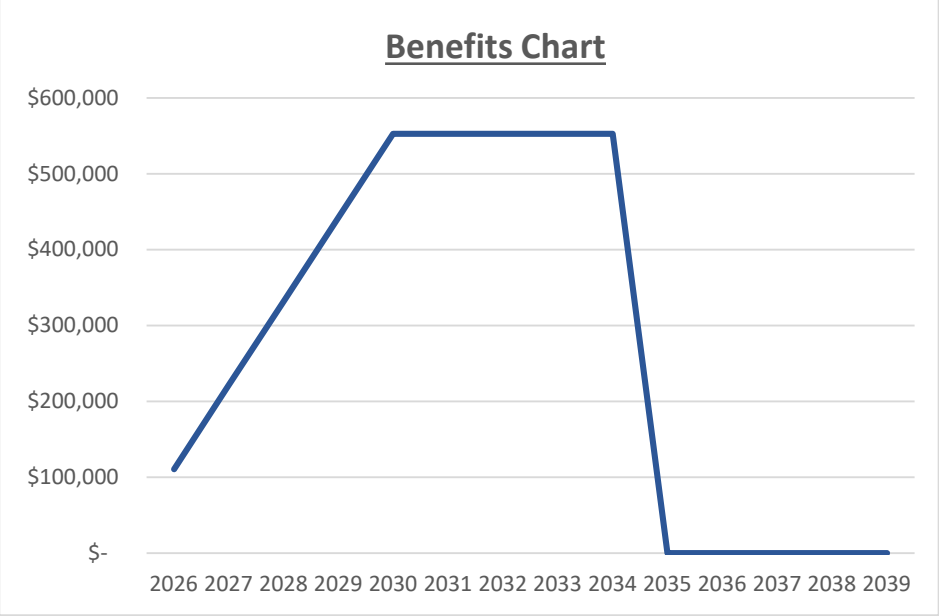
4.3 Risks

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

Table 2 Risks Associated with the counterfactual

Risk Scenarios	Description of Risk
SDH hardware or software failure occurs on aged unsupported equipment resulting in significant extra reactive works increasing costs.	With the continued use of unsupported SDH equipment with an observed susceptance to failure due to age, condition and vendor obsolescence will result in extended outages to business-critical services such as Teleprotection, SCADA, Remote Engineering, Corporate, telephony and site security for an extended period. Reactively replacing SDH equipment under a failure event is very difficult to achieve due to the inefficiencies of asset removal in a discontiguous manner, results in cascading flow on effects to dependant PDH, MW Radio, Ethernet assets and a high volume of temporary/repeated work to maintain network synchronisation and remote management that results in significant increase in time/costs. There is an estimated likelihood that on a yearly basis 6.5% of the at-risk assets will experience either hardware or software defects that will result in extended network outages that require an emergency response costing 2.5 times as much to fix compared to resolving as part of planned proactive work.

The table below outlines the cost benefits for the preferred option which has only been modelled over the estimated asset life of ~12 years.



5 ECONOMIC ANALYSIS

5.1 Cost summary 2025-30

Table 3 Cost summary 2025-30

Option	2025-26	2026-27	2027-28	2028-29	2029-30	Total 2025-30
Option 1A – Spares mine 4%	$682,298	$682,298	$682,298	$682,298	$682,298	$3,411,488
Option 1B – Spares mine 5%	$874,979	$874,979	$874,979	$874,979	$874,979	$4,374,894
Option 1C – Spares mine 6.5%	$1,151,288	$1,151,288	$1,151,288	$1,151,288	$1,151,288	$5,756,440
Option 1D – Spares mine 3%	$1,013,133	$1,013,133	$1,013,133	$1,013,133	$1,013,133	$5,065,667
Option 2 – Wholesale Replace	$2,836,774	$2,836,774	$2,836,774	$2,836,774	$2,836,774	$14,183,868
Option 3 – Counterfactual	$1,801,600	$1,801,600	$1,801,600	$1,801,600	$1,801,600	$9,008,000

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

5.2 NPV analysis

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

The resulting NPV value calculated for the proposed program was $85,118.

The NPV difference between options 1A, 1B and 1C are not significant as we have assumed that the failure rate will be 4% and removing enough or more equipment than what is necessary to keep up the necessary spares, and thus would not have any reactive program.

Should the failure rate accelerate during the coming period EQL will need to perform more replacements than the selected option allows for and assign funding from other less critical programs.

Table 4 NPV analysis

Option	NPV	Discount rate		Benefits	
		2.5%	4.5%	125%	75%
Option 1A – Spares mine 4%	$85,118	$173,905	$7,807	$825,343	-$655,107
Option 1B – Spares mine 5%	$62,568	$172,809	-$33,267	$1,000,187	-$875,050
Option 1C – Spares mine 6.5%	$82,327	$227,380	-$43,773	$1,316,035	-$1,151,381
Option 1D – Spares mine 3%	-$1,901,485	-$1,927,240	-$1,872,297	-$1,309,305	-$2,493,665

Option	NPV	Discount rate		Benefits	
		2.5%	4.5%	125%	75%
Option 2 – Wholesale Replace	-$7,021,742	-$7,225,781	-$6,819,481	-$5,788,033	-$8,255,450
Option 3 – Counterfactual	-$7,593,473	-$7,966,615	-$7,242,492	-$7,593,473	-$7,593,473

APPENDICES

Appendix 1: Alignment with the National Electricity Rules

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

NER capital expenditure objectives	Rationale
A building block proposal must include the total forecast capital expenditure which the DNSP considers is required in order to achieve each of the following (the capital expenditure objectives):	
6.5.7 (a) (1) meet or manage the expected demand for standard control services over that period	
6.5.7 (a) (2) comply with all applicable regulatory obligations or requirements associated with the provision of standard control services;	As indicated in section 4, this proposal ensures that safety obligations, reliability obligations and protection requirements are met by providing an appropriate, economically efficient program of works to prevent in-service failure of SDH infrastructure. Without this program, these obligations would be at significant risk of being breached.
6.5.7 (a) (3) to the extent that there is no applicable regulatory obligation or requirement in relation to: (i) the quality, reliability or security of supply of standard control services; or (ii) the reliability or security of the distribution system through the supply of standard control services, to the relevant extent: (iii) maintain the quality, reliability and security of supply of standard control services; and (iv) maintain the reliability and security of the distribution system through the supply of standard control services	This program of work ensures the integrity of communications functions that support SCADA, protection, voice and data communications systems. They are critical in the provision of network reliability in support of MSS and safety net security and reliability targets.
6.5.7 (a) (4) maintain the safety of the distribution system through the supply of standard control services.	This program of work ensures the integrity of communications functions that support SCADA, protection, voice, and data communications systems. They are critical in ensuring safety through correct protection operation, and through the availability of voice and data communications.
NER capital expenditure criteria	**Rationale**
The AER must be satisfied that the forecast capital expenditure reflects each of the following:	

NER capital expenditure objectives	Rationale
6.5.7 (c) (1) (i) the efficient costs of achieving the capital expenditure objectives	The options considered in this proposal take into account the need for efficiency in delivery. The preferred option has utilised a delivery approach that provides for bundling of work in terms of both timing and geography to enable a lower cost delivery compared to other options. It generally avoids emergency replacements that incur higher costs by enabling efficient use of labour resources in the delivery of the work programs. Specialised contractors are utilised as appropriate to ensure that costs are efficiently managed through market testing. Cost performance of the program will be monitored to ensure that cost efficiency is maintained. The unit costs that underpin our forecast have also been independently reviewed to ensure that they are efficient (Attachments 7.004 and 7.005 of our initial Regulatory Proposal).
6.5.7 (c) (1) (ii) the costs that a prudent operator would require to achieve the capital expenditure objectives	The prudency of this proposal is demonstrated through the options analysis conducted. The prudency of our CAPEX forecast is demonstrated through the application of our common frameworks put in place to effectively manage investment, risk, optimisation and governance of the Network Program of Work. An overview of these frameworks is set out in our Asset Management Overview, Risk and Optimisation Strategy (Attachment 7.026 of our initial Regulatory Proposal).
6.5.7 (c) (1) (iii) a realistic expectation of the demand forecast and cost inputs required to achieve the capital expenditure objectives	NA

Appendix 2: Reconciliation Table

Table 6 Reconciliation

Expenditure	DNSP	2025-26	2026-27	2027-28	2028-29	2029-30	2025-30
GRID COMMS SDH Replacement Edge REPEX ($ Direct)	Ergon	$0.68M	$0.68M	$0.68M	$0.68M	$0.68M	**$3.41M**