Grid Comms Reliability Core MPLS and Fibre AUGEX Ergon Energy

Justification Statement

18/ 10/ 2024

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

Title	Grid Comms Reliability Core MPLS and Fibre
DNSP	Ergon Energy
Expenditure category	☐ Replacement ☒ Augmentation ☐ Connections ☐ Non-network
Identified need *(select all applicable)*	☐ Legislation ☒ Regulatory compliance ☒ Reliability ☐ CECV ☒ Safety ☐ Environment ☐ Financial ☒ Other This program shall provide reliability improvements to Core network transmission components, specifically leveraging extension of the MLPS diversity capability, reduction of reliance on legacy TDM technology and diverse paths from new 3rd party carrier extensions.
Expenditure	(see table below)
Benefits	Compliance with the NER S5.1.2.1(d), Avoids Reliability issues associated with failing network links and non-redundant links causing outages and loss of N-1 security while issues are being resolved.

Year	2025-26	2026-27	2027-28	2028-29	2029-30	2025-30
$m, direct 2022-23	$0.325M	$0.325M	$0.325M	$0.325M	$0.325M	$1.623M

2 PURPOSE AND SCOPE

This document recommends the optimal capital investment necessary to provide suitable network upgrades to the Core of the Ergon Energy network to enable the increased reliability in Core network transmission.

This business case document has been developed for the purposes of seeking funding for the required investment in coordination with the Ergon Energy 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 ($1.623M) are in (2022/23) direct dollars.

3 BACKGROUND

3.1 Asset Population / Site Summary / Capability

Ergon Energy's Telecommunications Network Assets enable 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.

These network assets largely operate at the Data Link, Network and Transport Open System Interconnection (OSI) layers and comprise of Internet Protocol (IP) network routers and switches, microwave radio links, Time Division Multiplexing (TDM) equipment (made up of Synchronous Digital Hierarchy [SDH] and Plesiochronus Digital Hierarchy [PDH], Cellular Modems, Operational Support Systems (OSS), and Mobile P25 Digital Radio and Fixed IP Telephony systems.

There is an ongoing need for assessment and evaluation of current and future needs of the telecommunication network to meet the growth of the network reliability, capacity and coverage requirements.

The communications network asset types are separated into three levels of importance as categorised below based on the criticality to the business should they fail:

- *High* – Multiple services on Critical or Core infrastructure. These assets typically provide carriage for very large volumes of telecommunications services. Examples include assets that form part of the network core that should it fail will cause significant widespread business disruption or loss of control or functional capability of business systems.
- Medium – Multiple services on a Core or Distribution network device that should it fail will cause moderate regionalised business disruption.
- Minor – Typically only single service on an Access or Edge network device that should it fail will have minor low level localised business impacts affecting a single site or service.

This specific program will target reliability improvements of Core network communications transmission components at a *High* level of importance (Multiple services on Critical or Core infrastructure), specifically leveraging extension of the Multiprotocol Label Switching (MPLS) diversity capability, including alternate backhaul for portions of the Core network in "spur" arrangements with multiple core sites with single paths and leveraging diverse paths from new 3rd party carrier extensions.

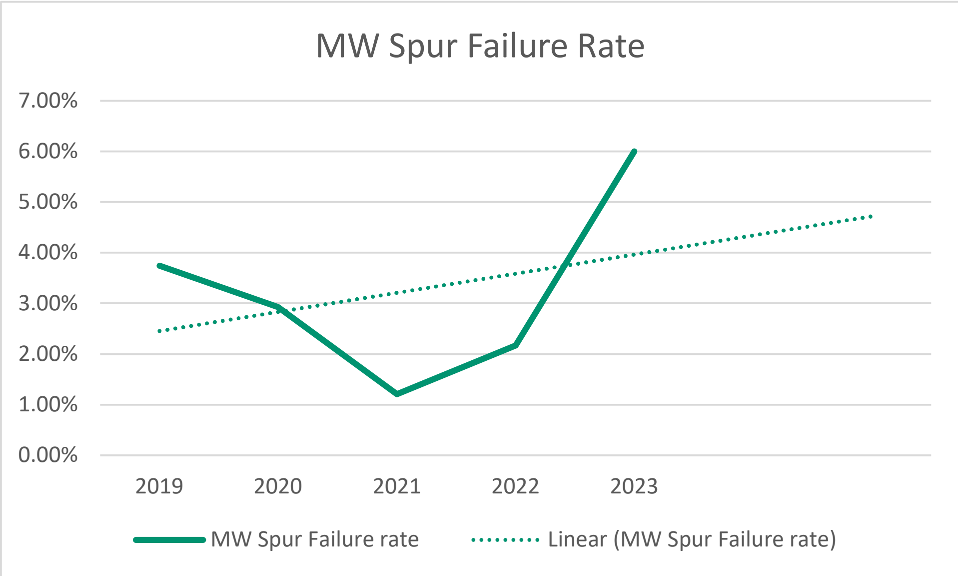
The program aligns with the EQL strategic plan and underpins the "Powering Tomorrow" initiative by enabling a more reliable smart grid network to support operational excellence and improve customer experience.

3.2 Asset Failure Rates / Cost

This program is targeting reliability issues in relation to core components in the network with no current alternate/redundant paths for underlying protection, SCADA, OT and Corporate data services.

Spur Microwave Links

Below is an indication of failure on “Spur” microwave links which are susceptible to a number of failure events including server weather events (cyclones etc) and equipment failures, with an average service restoration time 1.6 days per event.



Spur Microwave Failure Rate

Example Microwave Spur Outage - Maurice Hill to Westwood Range

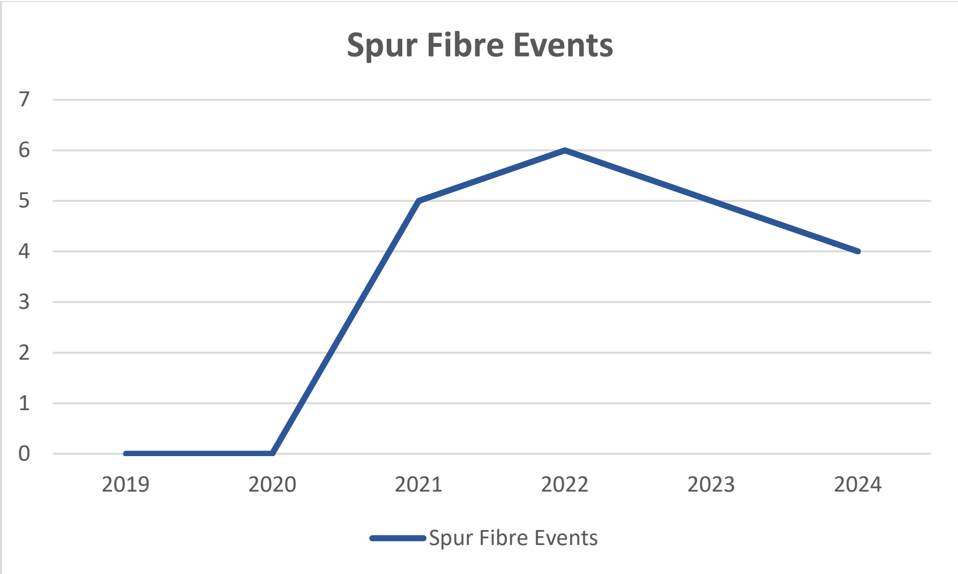
The spur microwave link Maurice Hill to Westwood range link experienced significant outages & poor performance for an extended duration over the period October 2022 to September 2023. Whilst the service was returned to normal operation in September 2023, this risk of future failure has not been mitigated.

This single microwave spur link impacted the below services during this period:

- Duplicate 132kV protection scheme
- 2 substation SCADA services (~10MW Load)
- 2 x P25 Voice repeater sites
- 1 depot (approximately 10 staff) and associated OT & Corporate services.

Spur Fibre Links

Below is an indication of failure on “Spur” fibre links which are susceptible to a number of failure events including impacted assets, server weather events (cyclones etc) and equipment failures, with an average service restoration time of 3.8 days.



Spur Fibre Outage Events

Example Fibre Spur Outage – Yeppoon SS to Tanby SS

The spur fibre link was impacted in May 2024 with a fibre cable fault impacting all services for 2 days prior to rectification works being implemented. Temporary restoration works were able to be implemented for SCADA but not the protection service.

This single fibre spur failure impacted the below services during this period:

- Duplicate 66kV protection scheme
- 1 substation SCADA services (~3MW Load)

4 IDENTIFIED NEED

4.1 Summary

This program seeks to improve the reliability of the comms network by removing single points of failure. Removing these will improve the performance of the underlying comms services for protection, SCADA, Corporate Depot data, substation voice communications and a range of other services. Cost savings will be achieved in avoided lost productivity, loss of control of substations when SCADA links are down and reduction in risk associated with protection services not operating.

This specific program will target reliability improvements of certain Core network communications transmission components at a *High* level of importance (Multiple services on Critical or Core infrastructure). The proposed program will implement or leverage newly available alternate backhaul for portions of the Core network that is configured with multiple core sites in a “spur” and will provide infrastructure that will enable automatic rerouting of services utilising Multiprotocol Label Switching(MPLS) infrastructure.

These proposed improvements shall support maintaining staff and public safety, minimising damage to electrical assets during power system faults, efficient and safe field operations, minimising the impact of electrical network outages on customer supply, optimising electrical asset management of equipment and a host of other improvements by ensuring that communications services to substations, depots and control rooms continue to operate at suitable levels of performance.

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, 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 safety, reliability and program of work efficiencies are strong drivers, based on the continuing focus of reliability improvements on Core network infrastructure.

This program will include the following:

Deploy standard IP/MPLS nodes to improve reliability of microwave connected networks in ring topology;

- The Core network has been extending MPLS to the edge of the network which has enabled the ability to leverage the improved diversity with the reduction of Layer 2 spanning tree protocols (STP) for diversity and redundancy options.
- There are numerous microwave ring topology networks which current utilise STP for diversity switching, implementing MPLS to the edge of these network areas will provide a more robust and reliable diversity ring topology which shall improve reliability in these area of the network.

Implement diverse transmission paths via newly introduced 3rd party alternate transmission capacity, (eg. Powerlink, Queensland rail, NBN, Telstra etc);

- With the continued expansion of 3rd party carrier networks additional redundancy is able to be leveraged to enable improved capacity and reliability with minimal infrastructure increase from Ergon Energy. The carrier expansions provide the ability to provide logical ring topology for current spur routes in the network.

Implement diverse transmission path on multi-hop spur microwave links to improve reliability and availability;

- Microwave transmission forms a large portion of the network for Ergon Energy as it is a cost-effective means to provide capacity to our substations and depots across the state.
- Due to the geographical distance covered by Ergon Energy network this does mean that there are a number of spur microwave links which have been implemented with multiple hops and multiple depots and substations reliant on a single link attached to the main core of the network.
- Implementing a diverse connection at the extremities to these microwave spur via 3rd party carrier connections will provide a more reliable and resilient network for SCADA, OT, Voice and Corporate data services.
- Refer to Appendix 3 for examples.

Reliability Improvement Summary of Works

Description of Work	Site / Link Upgrades	Reliability Improvement Site Qty
Extend IP/MPLS network to microwave ring networks to improve reliability	10 Sites	18 Sites (North Queensland & Capricorn region)
Implement new transmission capacity from existing 3rd party carriers to provide alternate path for end of spur / single point of failure sites to improve reliability	7 sites	51 sites (Far North Queensland, North Queensland, MacKay, Capricorn, South West Queensland)

4.2 Options Considered

Ergon Energy has evaluated a number of options to determine the most suitable solution to for reliability improvements at the Edge of the network. These options are summarised in the table below with more details in the subsequent section.

Option	Proposed Transmission Services			Total Cost	OPEX /annum	NPV
	MPLS / PLQ / Other Backhaul	Satellite & Cellular	Total			
Option 1A (Original) – Multi Technology *Utilises all available standard technology solutions*	28	7	35	$1.82M	$40k	-$7.2k
Option 1B – Multi Technology reduced program (Preferred Option) *Utilises all available standard technology solutions, highest priority sites*	14	3	17	$1.623M	$32k	$70k
Option 1C – Multi Technology (Expanded scope) *Utilises a number of diverse fibre builds and alternate microwave builds.*	38	22	60	$9.9M	$399k	-$2.2M
Option 2 - Single Technology Solution	17		17	Not a feasible option		
Option 3 – Do Nothing			11	$2,8M		-$2.59M

Reactive works only @ failure rate of 11 sites per year						

4.2.1 Option 1A – Multi Technology (Original Option)

This option is to implement standard solutions for diverse backhaul for those spur links which have multiple sites / services which could be impacted by a single backhaul failure. Priorities will be allocated to potential risk of failure due to service criticality and transport medium. These solutions will be implemented with standard multi-technology approach to provide the most cost-effective solution for the applicable links.

4.2.2 Option 1B – Multi Technology Reduced Program (Preferred Option)

This option will implement the same strategy as Option 1 but the scope of sites selected will be reduced due to other recently developed standards (COTE WAN solution), product developments and planned 3rd party carrier backhaul migrations from TDM to WAN solutions which will have impact to the site selections from the original proposal.

The site priorities will target those links which have had previous known poor performance and or are in higher risk due to service impact's, an example would be links with protection services and multiple substation SCADA.

4.2.3 Option 1C – Multi Technology (Expanded scope) All Network Spur Links

Ergon Energy considered implementing a large scale solutions on all network section with reliability issues in the wider network. This program would cost $10M and was subsequently rejected.

4.2.4 Option 2 - Single Technology Solution

Ergon considered a single technology solution approach rather than the proposed multi technology solution to manage the reliability issues however this was not practical due to the variation of services being supported, eg. Protection can not be supported over a Cellular / satellite network. Alternatively if fibre was implemented it would be cost prohibitive at the majority of sites with microwave as this technology has been implemented due to cost.
Similarly requirements for duplicate and diverse communications paths would rule out a duplicate microwave link due to adverse weather impacts at common ends of microwave links.
Given the above technology review it was determined to be unsuitable for a reliability solution as it did not provide reliability improvements to all impacted services at the selected sites, partially those targeted as being non-compliant with NER requirements.

4.2.5 Option 3 – Counterfactual (Do nothing)

This program would be intended to be purely reactive with no mitigation of risk for failure of equipment and subsequent services due to single backhaul connection to the Ergon Energy network. This means that only restoration of services will be funded through operating costs, with no capital investment in minor or major upgrades of the network infrastructure.
The current failure rates of microwave equipment 3.2% & legacy SDH network components 4.1% are expected to increase over the next AER period as over 89% of this backhaul equipment is EoL & EoS.

These failure of spur components of the Core network make up approximately 35% of the network Core. With projected failures of 32 failures projected over 5 years from total core assets it would be expected 11 of these would be from the spur area's of the network. The restoration of these would be expected to cost at least 2.5 times to restore due to end of sale of asset.

Whilst the counterfactual option will cost nothing initially, the required effort and associated cost to restore impacted services in an outage due to limited diversity of backhaul via either SDH / microwave / 3rd party carriers without the ability to reroutes services will imposes significant impacts to the business operations in regards to:

- Customer impacts – extended outages for corporate OT, voice and data services potentially impacting deports and offices, which would equate into reduce efficiency of impacted depot / office staff.
- Loss of control of substations for extended period (duration of network repair likely 10 to 24 hours)
- Loss of protection scheme / schemes for extended periods (duration of network repair likely10 to 24 hours)
- Service restoration costs - additional costs associated with service restoration requiring significant redesign and construction due to unplanned requirement which impact the network architecture outside of standard implementations or require emergency implementation of alternate backhauls. Duration of repairs could be weeks.

4.3 Risks

Table below outlines the risk assessment for the counterfactual scenario with no proactive program in place to address reliability issues.

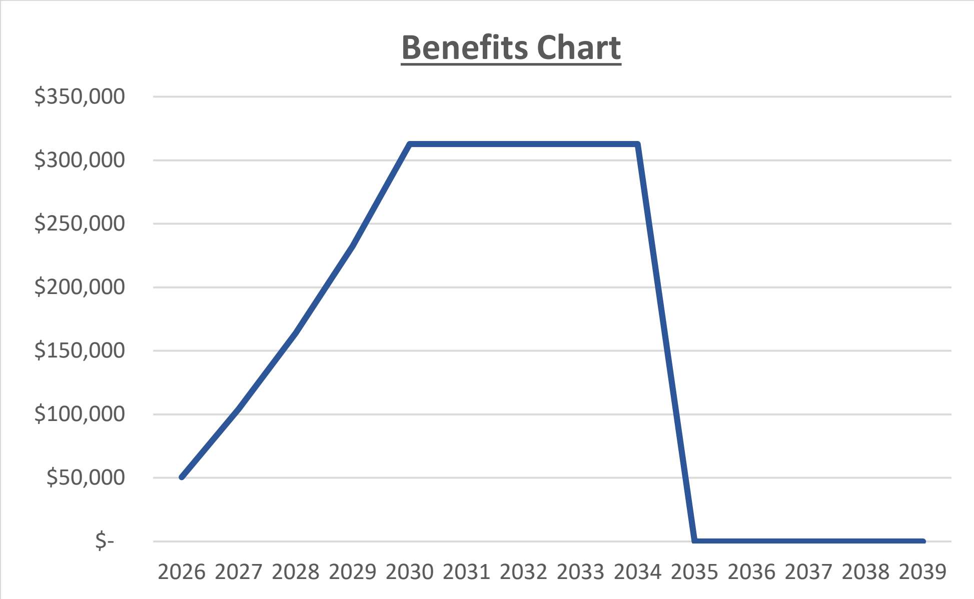
The risks addressed under this business case primarily address the reliability of Ergon Energy Core MPLS network and associated infrastructure. The following estimations/assumptions have been made regarding the risk below:

- There is a likelihood that on a yearly basis 5% of the at-risk assets will be impacted requiring an emergency response that will cost an additional 3 times effort to implement compared to implementing a planned proactive program due to the significant temporary works, repeated at multiple locations with associated cascaded works due to islanding of technology types and implemented in an unplanned manner.

Risk Scenario	Description of risk
No alternate backhaul available on SDH backhaul sites, fibre cable between site fails, all services extending out to islanded sites fail and cannot be returned to service till fibre cable repaired.	Emergency design and construction required to restore services with native IP/MPLS device and requires significant integration into remaining SDH network in an unplanned manner, with significant limitations. Potential to impact multiple substation controls / protection services during the outage period. There is a likelihood that on a yearly basis 5% of the at-risk assets will be impacted requiring an emergency response that will cost an additional 3 times effort to implement compared to implementing a planned

	proactive program due to the significant temporary works, repeated at multiple locations with associated cascaded works due to islanding of technology types and implemented in an unplanned manner.
Multi hop microwave link spur has a catastrophic failure of a structure impacting all down stream sites and services, no end of spur alternate route available	Emergency construction required to restore services. Extended outage for duration of works, significant delays in construct due to effort required and availability of materials and people resources. Potential to impact multiple substation controls / OT data / corporate IT services during the outage period.
Vehicle impact an electrical network pole during network outage. Protection and SCADA impacted by delays in restoration of network outage, resulting in a fatality or a serious injury.	A vehicle impacts a pole during network outage, with reduced network protection functions and no SCADA to substations due to isolated network, results in a fatality or a serios injury, Very low likelihood.
Outage on legacy spur network without MPLS diversity / backup impacts small regional depot	Small depot without diverse WAN unable to operate effectively impact staff, 10 staff for 8 hours with a 50% probability.
Outage on legacy spur network without MPLS diversity / backup impacts regional office	Regional office without diverse WAN unable to operate effectively impact staff, 30 staff for 8 hours with a 10% probability.
No alternate backhaul available on SDH backhaul sites, fibre cable between site fails, all services extending out to islanded sites fail and cannot be returned to service till fibre cable repaired. Extended outage, Power Network fault and delays restoration to customers.	Emergency design and construction required to restore services with native IP/MPLS device and requires significant integration into remaining SDH network in an unplanned manner, with significant limitations. Extended outage for duration of works, significant delays in design and construct due to effort required and availability of materials and people resources. Potential to impact multiple substation controls / protection services during the outage period. Delays in service restoration totalling 4 hours of an average 22kV feeder (2000kW) with an assumed VCR of $52 per kwh with a likelihood of 20% p.a.

The table below outlines the cost benefits which have only been modelled over the estimated asset life of 9 years of the equipment with the shortest asset life.



5 ECONOMIC ANALYSIS

5.1 Cost summary 2025-30

Table 1 Cost summary 2025-30

Options	2025-26	2026-27	2027-28	2028-29	2029-30	Total 2025-30
Option 1A	$528,903	$528,903	$528,903	$528,903	$528,903	$2,644,515
Option 1B	$324,600	$324,600	$324,600	$324,600	$324,600	$1,623,000
Option 1C	$1,997,400	$1,997,400	$1,997,400	$1,997,400	$1,997,400	$9,987,000
Option 2	Not a feasible option					
Option 3	$561,000	$561,000	$561,000	$561,000	$561,000	$2,805,000

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 $70,923.

Table 2 NPV analysis

	Discount rate		Benefits		
Options	**2.5%**	**4.5%**	**125%**	**75%**	**NPV**
Option 1A	$57,309	-$64,277	$737,379	-$651,768	-$7,819
Option 1B	$117,564	$30,213	$620,530	-$377,436	$70,923
Option 1C	-$2,154,318	-$2,276,555	-$485,562	-$3,861,331	-$2,224,071
Option 2	Not a feasible option				
Option 3	-$2,723,678	-$2,464,668	-$2,646,325	-$2,533,607	-$2,589,966

APPENDICES

Appendix 1: Alignment with the National Electricity Rules

Table 3 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 physical linear media assets. Without this program, these obligations would be at significant risk of being breached.
6.5.7 (a) (3) to the extent that there is no applicable regulatory obligation or requirement in relation to: (i) the quality, reliability or security of supply of standard control services; or (ii) the reliability or security of the distribution system through the supply of standard control services, to the relevant extent: (iii) maintain the quality, reliability and security of supply of standard control services; and (iv) maintain the reliability and security of the distribution system through the supply of standard control services	This program of work ensures the integrity of communications functions that support SCADA, protection, voice and data communications systems. They are critical in the provision of network reliability in support of MSS and safety net security and reliability targets.
6.5.7 (a) (4) maintain the safety of the distribution system through the supply of standard control services.	This program of work ensures the integrity of communications functions that support SCADA, protection, voice, and data communications systems. They are critical in ensuring safety through correct protection operation, and through the availability of voice and data communications.
NER capital expenditure criteria	**Rationale**
The AER must be satisfied that the forecast capital expenditure reflects each of the following:	
6.5.7 (c) (1) (i) the efficient costs of achieving the capital expenditure objectives	The options considered in this proposal take into account the need for efficiency in delivery. The preferred option has utilised a delivery approach that provides for bundling of work in terms of both timing and geography to enable a lower cost delivery compared to other options. It generally avoids emergency replacements that incur higher costs by enabling efficient use of labour resources in the delivery of the work programs. Specialised contractors are utilised as appropriate to ensure that costs are efficiently managed through market testing. Cost performance of the program will be monitored to ensure that cost efficiency is maintained.

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

[redacted]

[redacted]

[redacted]