January 2026

Powerlink 2027-32 Revenue Proposal

Project Pack

CP.02841 Garbutt Secondary Systems Replacement

Project Status: Unapproved

Network Requirement

Garbutt Substation was originally established in the late 1950's in conjunction with the Kareeya hydro power station as a 132/66kV bulk supply point to the distribution network in the Townsville area. It was expanded in the early 1960's to take additional 132kV supply from the new Collinsville power station. In 2004 the substation was rebuilt in a transformer ended configuration with the switching function transferred to the newly established Alan Sheriff Substation nearby. Currently, the 132kV incoming feeders have only a single protection system (X protection) from the Garbutt Substation end.

A condition assessment indicates that most secondary systems devices are reaching the end of their technical asset life, recommending replacement by 2025. It further notes that while the field cables are suitable for a further 15 to 20 years of service and that the secondary systems panels are in good condition and may be retained, the secondary systems are housed in the original three story brick control building which contains asbestos [1], [3]. The driver for replacing secondary systems is the obsolescence and end of manufacturer support for the existing relays. Ageing secondary systems, which are no longer supported by the manufacturer are increasingly at risk of failing to comply with Schedule 5.1.9(c) of the National Electricity Rules, AEMO's Power System Security Guidelines and the reliability standard included in Powerlink's Transmission Authority.

Powerlink's 2025 Central scenario forecast confirms there is an enduring need to maintain electricity supply in the Townsville area. The removal or reconfiguration of the Garbutt 132/66kV Substation due to secondary system failure/obsolescence would violate Powerlink's N-1-50MW/600MWh Transmission Authority reliability standard and significantly impact electricity supply within the Townsville area [2].

Recommended Option

As this project is currently 'Unapproved', project need and options will be subjected to the public RIT-T consultation process to identify the preferred option closer to the time of investment.

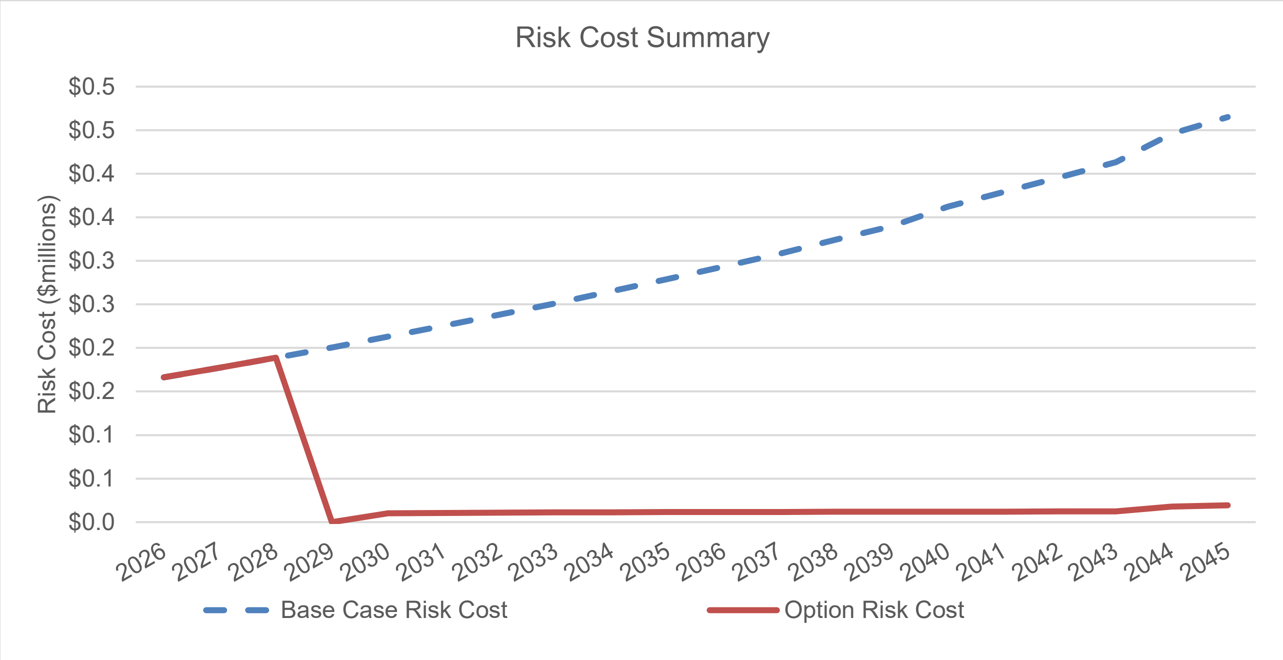
The current recommended option is for in-panel replacement of all secondary systems in the existing control building by 2028 [3].

Options considered but not proposed include:

- Replacement of all secondary systems in a new demountable building expected to be greater overall cost.

Figure 1 shows the current recommended option reduces the forecast risk monetisation profile of the Garbutt Substation secondary systems from around $0.19 million per annum in 2028 to less than $0.01 million from 2029 [5].

Figure 1 Annual Risk Monetisation Profile ($ Real, 2025/26)



Cost and Timing

The estimated cost to replace secondary systems at Garbutt substation is $10.7m ($2025/26) [4].

Target Commissioning Date: October 2028.

Document in CP.02841 Project Pack

Public Documents

1. T046 Garbutt Secondary Systems Condition Assessment Report
2. CP.02841 Garbutt Secondary Systems Replacement – Planning Statement
3. CP.02841 Garbutt Secondary Systems Replacement – Project Scope Report
4. CP.02841 Garbutt Secondary Systems Replacement – Concept Estimate
5. CP.02841 Garbutt Secondary Systems Replacement – Risk Cost Summary Report

T046 Garbutt 132kV Substation

Secondary Systems Condition Assessment Report

Document Details			
Version Number	1.0	**Principal Author**	[redacted]
Objective ID	A4447718	**Authorised by**	[redacted]ett
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Date	Version	Nature of Change	Author	Authorisation
12/11/2020	1.0	Final	[redacted]	[redacted]
14/03/2025	2.0	building related update	[redacted]	[redacted]er

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1. Introduction

T046 Garbutt Substation was built in the late 1950s as a 132/66kV bulk supply and transformation point to the distribution network. It is located at the corner Dalrymple Rd and Woolcock St, Townsville. In the early 1960s three bays were added to the substation, and in 1978 two power transformers replaced the previous units. In 2004, the substation was rebuilt in a transformer ended configuration, with the switching function established at Alan Sherriff.

The original, 132/66kV 71MVA (ONAF), transformers 1 and 2 at Garbutt substation were recently replaced by two 100/66/11kV 60/80/100 MVA Wilson transformers in 2018.

The existing secondary systems were replaced during the substation rebuild in 2004. Currently, feeders 7239 and 7240 only have a single protection system, i.e. X protection, from Garbutt substation end. A recent condition assessment in 2020 indicates that the condition driven risks associated with existing secondary systems equipment are expected to be replaced by 2025.

Garbutt's substation primary bays and network elements are listed in Table 1:

Table 1 – Garbutt Substation Network Elements					
Local Substation (T046 Garbutt)					**Remote Substation**
	Voltage (kV)	**Quantity**	**Bay Designation**	**Operational Element**	
Feeders	132	2	=D02	7239	T150 – Alan Sherriff
			=D05	7240	T150 – Alan Sherriff
Transformers	132/66/11	2	=D02	T1 TFMR	Ergon 66kV
			=D05	T2 TFMR	Ergon 66kV

The main purpose of this report is to assess the condition of secondary systems assets associated with the primary plants, as shown in Table 1, and to recommend the optimal reinvestment timing for these assets. Recommendations in this report have been formulated based on asset conditions only, excluding considerations for network reconfigurations, network-enduring needs, economic options, engineering solutions and delivery methodologies.

Garbutt substation operational line diagram and pictorial aerial view are shown in Figure 1 and Figure 2 respectively.

[redacted]

Figure 1 – 132kV Garbutt Substation Electrical Single Line Diagram

Figure 2 – 132 kV / 132kV Garbutt Substation Aerial View

Note: This photo still shows two old transformers that have been removed and replaced with new transformers.

2. Inclusions and Exclusions

2.1 Inclusions

Secondary systems and associated equipment that provide monitoring, supervision, control and protection functions to Powerlink's substations and Queensland transmission system. The condition assessment of the following systems and equipment will be covered in this report.

- Secondary system cables – All cables that are associated with secondary systems and equipment, including:
  - Cables between control and protection panels and termination racks,
  - Cables between termination racks and yard marshalling kiosks, AC and DC kiosks.
- OpsWAN panels, system and equipment,
- Secondary system AC and DC supply – Low voltage (LV) AC marshalling cubicle heaters and lights, DC batteries and chargers,
- Secondary system panels and associated ancillary parts, including links, terminals, input / output modules, signal converters, transducers and power supplies.
- Indoor and outdoor secondary systems marshalling kiosks, AC and DC kiosks, termination racks, including internal links, terminals, MCBs and fuses,
- Indoor and outdoor control cables to outdoor secondary systems kiosks or cables from indoor secondary systems panels directly connected to primary equipment control kiosks.
- Secondary system equipment and systems, including protection relays, HMI computers, RTUs, data acquisition units, Programmable Logic Controllers (PLCs), Intelligent Electronic Devices (IED),
- Available space in existing control buildings to accommodate new secondary system panels.

2.2 Exclusions

The condition assessment of the following assets are not in scope of this report:

- Condition of control buildings and associated light and power circuits
- Civil structures, cable trenches and foundations,
- AC auxiliary supply systems (> 230VAC), including transformers, diesel generators and building power and light circuits,
- Substation flood lights,
- Primary equipment and associated components e.g. transformer and circuit breaker control cubicles,

- Primary equipment kiosks and associated components, e.g. Power transformer, circuit breaker control kiosks.
- Cables from secondary systems outdoor kiosks (e.g. bay marshalling kiosks) to primary plant control kiosks,
- Cables from primary plant control kiosks to primary plant equipment,
- Telecommunication assets, including 50VDC batteries and chargers.

3. Condition Assessment Principles and Methodology

Principles of secondary systems condition assessment were based on Powerlink' s Secondary Systems Asset Risk Model developed in [1], and "Powerlink – Asset Risk Management – Framework" in [2]. The methodology consists of two main parts – Desktop assessment based on [1, 2] and site visual inspection.

The desktop assessment is limited only to assets recorded in SAP asset database, e.g. protection relays, RTUs and IEDs. It is important to note that a significant number of secondary systems equipment, including cables, kiosks, terminals, links, panels, termination racks, auxiliary equipment and some IEDs are not recorded in SAP. The condition assessment of these depends solely on the site visual inspection. Site visual inspection also provides moderation and manual update of desktop assessments to reflect the actual condition of operational equipment at site.

The desktop assessment models the equipment health indices based on the optimisation of risk, cost and performance of Powerlink's secondary assets since 1999. The health index is the key condition measurement for each equipment in service. The model takes into account equipment failure rates calculated based on operational data, environmental conditions where the equipment is installed and the mean physical ages of a group of equipment at bay and system (fleet) levels.

Health indices are modelled in the range from zero (0) to ten (10), where zero represents newly installed equipment and ten indicates equipment that have reached the end of their technical service life. Equipment with a health index close to ten represents only a moderate increased risk of functional failures, but significantly longer outage duration and higher risk of impacting system's availability and reliability.

The key outcome of this report is the recommended replacement timing for secondary systems assets and equipment detailed in the Appendix section based on their health indices and condition assessment data. It also takes account of the criticality of equipment that are (or are not) directly associated with the performance of secondary systems. For example, OpsWAN equipment with health indices are close to ten, but may not need to be replaced urgently because their functions are considered to be non-critical to the secondary systems performance. In this case, they should only be opportunistically replaced as part of the secondary system replacement project to optimise cost.

4. Buildings

4.1 Substation Secondary Systems Buildings

Garbutt 132kV secondary systems are currently housed in the top floor of the existing three storey brick building +1. Details of the existing 132kV building +1 are summarised in Table 2.

Table 2 – Garbutt Substation Building

Building Description	Designation	Functional Use	Spare Sec Sys Panel Spaces
132kV secondary systems demountable building +1	+1	Bay =D02 (Feeder 7239) Bay =D05 (Feeder 7240) T1 Transformer T2 Transformer Revenue Meters, Mux Communications Substation Master OpsWAN, Common RTU and SCADA 125V X&Y Batteries and Chargers	To confirm, as it appears there are some decommissioned panels, yet to be removed

Figure 3 – T046 - 132kV Existing Control Building +1

5. Condition Assessment

5.1 Secondary System Outdoor Marshalling Kiosks

Garbutt 132kV substation consists of two transformer ended feeder bays, i.e. =D02 and =D05, without local 132kV circuit breakers. Outdoor marshalling kiosks at Garbutt substation are for interface points between transformer T1 and T2 control panels and existing secondary systems. Based on existing condition, these kiosks can be kept in service until 2044; internal links and terminals may be replaced to meet Powerlink's current standard if deemed necessary. Door seals appear to be made from low quality / unsuitable materials. Some door seals have degraded / disintegrated and should be replaced as part of routine maintenance.

Health Indices for secondary system outdoor marshalling kiosks with recommended replacement timeframes have been detailed in **Appendix A**. Physical appearance of typical outdoor marshalling cubicles are shown below.

Figure 4 –132kV Outdoor Marshalling Cubicle Bay +D01-A10 (top) and +D03-A10 (bottom),

5.2 Outdoor Secondary System Cables

Control and protection cables were terminated directly between secondary systems indoor panels in the existing control building and outdoor marshalling cubicles – with no existing building termination racks. Visual inspection of these cables indicated they are still in good condition, as shown in Figure 5.

Figure 5 – Physical Appearance of Typical Outdoor Secondary System Cables

5.3 Indoor Termination Racks / Yard Interface Cubicle

There are no termination racks at Garbutt substation. Secondary system cables were installed directly between the indoor panels and outdoor primary plant control cubicles.

5.4 Indoor Secondary System Cables

Powerlink secondary systems cables inside the existing control buildings are still good condition.

5.5 Control and Protection Systems

Condition assessment of Garbutt Substation control and protection systems, including cubicles, equipment, internal components such as links, terminals, wirings, MCBs, fuses, cables is summarised in **Appendix A**.

5.5.1 Secondary Systems Panels

Existing secondary systems panels, including auxiliary parts e.g. links, terminals and internal wiring, were installed around 2004. Secondary systems panels, internal wiring, links and terminals have been kept in clean and air-conditioned environment and can be kept in service until 2044.


Transformer T1


Transformer T2


Feeders 7239 & 7240

Figure 6 – 132kV Indoor Secondary Systems Cubicles

5.5.2 Control, Protection, Auxiliary, Ancillary, Metering and OpsWAN Equipment

5.5.2.1. Control, Protection, Auxiliary, Ancillary Equipment

Garbutt substation 132kV secondary system comprises mostly microprocessor based control and protection equipment. Health indices and recommended replacement timeframe for the 132kV secondary system equipment and associated ancillary equipment are tabled in Appendix A.

Figure 7 – Garbutt Substation Typical Indoor 132kV Secondary System Equipment

5.5.2.2. Revenue Metering Panels

Garbutt substation revenue-metering panel, including auxiliary parts e.g. links, terminals and internal wiring will be decommissioned and replaced by a new metering panel, preferably to be installed at Alan Sherriff substation, subject to suitable metering CTs and VTs at Alan Sherriff substation and Powerlink's metering specialist's decision.

Figure 8 – Garbutt substation revenue metering panel

5.5.2.3. Revenue Metering Equipment

Garbutt substation revenue metering equipment need to be replaced by new meters at either Garbutt or Alan Sherriff substation, subject to suitable metering CTs and VTs at Alan Sherriff substation and Powerlink's metering specialist's decision. Health indices and recommended replacement timeframe for the 132kV secondary system revenue metering equipment and associated ancillary equipment are tabled in Appendix A.

Figure 9 – Garbutt substation typical revenue meters

5.5.2.4. OpsWAN Systems and Equipment

OpsWAN systems and equipment in the existing control building +1 were installed in 2004. OpsWAN systems are still functioning and have an important role in operation and maintenance efficiencies. They are considered as auxiliary components of the power system. Their condition and performance generally do not have material impact on the performance, reliability and availability of secondary systems and the power system.

Indoor OpsWAN systems and equipment should only be replaced opportunistically as part of the secondary systems replacement project. OpsWAN cameras should only be replaced under corrective maintenance when they fail and shall be excluded from secondary system refurbishment projects.

Figure 10 – 132kV Building OpsWAN and SCADA equipment

Figure 11 – Garbutt Substation Typical OpsWAN Equipment

5.5.3 Auxiliary Supply

5.5.3.1. AC Auxiliary Supply

AC auxiliary supplies, including station transformers and backup diesel generator/s are not in scope of this report. AC heaters and lights servicing secondary system panels should only be replaced as part of secondary systems panels.

5.5.3.2. DC Batteries and Chargers

Garbutt substation 125VDC X and Y batteries and associated chargers were installed in 2019. Batteries, chargers and DC monitoring systems for the 132kV secondary systems should be replaced as per recommendations in Appendix A.

Existing battery banks and associated chargers can be transferred to Ergon or retrieved as spares.

Figure 12 - 132kV Building +P – Chargers, Monitors, DC Distribution 2009, Batteries 2019

6. Secondary Systems Asset Strategies Recommendations

Recommendations below have been strategically optimised based on the replacement timing (condition based timing) of individual equipment Health Indices (HIs) in Appendix A. It is important that the responsible project team considers these recommendations in light of Powerlink delivery solutions, staging, resources and network outages to achieve safe and sustainable project delivery cost.

<table>
<tr><th colspan="11">Table 3 – Recommended Asset Replacement Timing and Options – Building +1</th></tr>
<tr><th colspan="6">Indoor Sec Sys Panels</th><th>Possible Options</th><th colspan="4">Outdoor Kiosks (Excl. Primary plant)</th></tr>
<tr><th>ID</th><th colspan="2">Functions</th><th>Panel</th><th>Equipment</th><th>Cables</th><th></th><th>ID</th><th>Functions</th><th>Panel</th><th>Cables</th></tr>
<tr><td>+2A1</td><td colspan="2">132kV Feeder 7239 (=D02) & Feeder 7240 (=D05) Protection</td><td>2025 (*)</td><td>2025</td><td>2025 (*)</td><td>C</td><td></td><td></td><td></td><td></td></tr>
<tr><td>+2A2</td><td colspan="2">Transformer 1 - 132 kV Bay =D02 Control and Protection</td><td>2025 (*)</td><td>2025</td><td>2025 (*)</td><td>C</td><td>+D01-A10</td><td>T1 Tfmr</td><td>2044</td><td>2025 (*)</td></tr>
<tr><td>+2A3</td><td colspan="2">Transformer 2 - 132 kV Bay =D05 Control and Protection</td><td>2025 (*)</td><td>2025</td><td>2025 (*)</td><td>C</td><td>+D03-A10</td><td>T2 Tfmr</td><td>2044</td><td>2025 (*)</td></tr>
<tr><td></td><td colspan="2">Transformer T1 & T2 Revenue Meters</td><td>2025 (*)</td><td>2025</td><td>2025 (*)</td><td>C</td><td></td><td></td><td></td><td></td></tr>
<tr><td>+2A4</td><td colspan="2">Substation Master OpsWAN, Common RTU and SCADA</td><td>2025 (*)</td><td>2025</td><td>2025 (*)</td><td>C</td><td></td><td></td><td></td><td></td></tr>
<tr><td rowspan="5">+8B2</td><td rowspan="5">Building +1 - 125VDC (X & Y) Batteries, Monitors and Chargers</td><td>X Battery</td><td colspan="3">2031</td><td>C</td><td colspan="4" rowspan="5"></td></tr>
<tr><td>Y Battery</td><td colspan="3">2031</td><td>C</td></tr>
<tr><td>X DC Monitor & Charger</td><td colspan="3" rowspan="3">2040</td><td rowspan="3">C</td></tr>
<tr><td>Y DC Monitor & Charger</td></tr>
<tr><td>DC Distribution board</td></tr>
</table>

Notes:

(i). *Option A: In-Situ (Equipment) Replacement - Replace equipment in existing panel.*

(ii). *Option B: Install new panels / Systems in existing building.*

(iii). *Option C: Install new panels in new building. Existing Panels can be decommissioned or recovered for operational emergency spares*

(iv). *Unless specified, e.g. Transformer PLCs and some SICUs, all electronic equipment installed inside primary plant control cubicles (e.g. SICU, PASS M0 OLMs) are considered as integral parts of primary plant assets and are not in scope of this report.*

(v). *Innovative replacement solutions should be considered to maximise the use of available spaces in existing building to save cost.*

(vi). *Replacement timing for PASS M0 switchgear and its control cubicles depends on primary plant strategy.*

(vii). *Panel includes chassis, links, terminals and internal wirings.*

(viii). *Powerlink's asset lifespan for batteries is around 12 years, chargers and monitors is around 20 years.*

(ix). *(*) - Panels / Cables can be kept in service until 2044. However the existing control building is deemed to be unsafe, therefore they are recommended to be decommissioned and replaced by new cables and panels to suit the new control building.*

7. Conclusion

This report details the conditions of Garbutt substation 132kV secondary systems and equipment. The primary objective of the optimal replacement timeframe is to maintain the current network reliability and availability and to minimise operational and compliance risks associated with secondary systems assets. 132kV secondary systems are recommended to be replaced by the end of calendar year 2025, as per secondary systems asset strategies recommendations.

8. Attachments

- **<u>Appendix A</u>** – T046 132kV Garbutt Substation Secondary Systems Equipment Health Indices and Recommended Asset Placement Replacement Timeframe.

  T046 Sec Sys - Appendix A.pdf

- CIGRE 2018 - B3 - 205 - Modelling Substation control and Protection Asset Condition for Optimal reinvestment Decision Based on Risk, Cost and Performance.

  B3 - 205 - Modelling Substation control an

- Powerlink – Asset Risk Management – Framework, ASM-I&P-FRA-A2417558, Powerlink Queensland, 2019.

  Powerlink Asset F

9. References

[1] "Modelling Substation control and Protection Asset Condition for Optimal reinvestment Decision Based on Risk, Cost and Performance", CIGRE PARIS 26-31 August 2018, T Vu, M. Pelevin, D. Gibbs, J.Horan, C. Zhang.

[2] "Powerlink – Asset Risk Management – Framework", ASM-I&P-FRA-A2417558, Powerlink Queensland, 2019.

10. Appendix A

APPENDIX A - T046 GARBUTT 132KV SUBSTATION SECONDARY SYSTEMS - EQUIPMENT HEALTH INDICES AND RECOMMENDED REPLACEMENT TIMEFRAME

Notes:
(a): Subject to Powerlink's O&M Safety Requirements, Current Standard Solutions and Implementation Methodologies, it may be more beneficial to align with the recommended replacement timeframe of sedondary systems equipment
(b): Recommended Timeframe is based on majority of Equipment Health Indices
(c): Based on Visual Inspection and Subject to the decision of the Control Building and Secondary Systems Panels. A number of New Cables may be requried if location of control building or secondary systems panels is changed.
(d): As a minimum requirement, Rubber Seals, Air filter and Terminals and Links are required to be repalced by the recommended timeframe. New Marshalling Kiosks should be considered if Exsiting Cables are to be reaplaced.

RECOMMENDED REPLACEMENT TIMMING (Based on Trigger Conditions only, Exclude considerations for Solutions, implementation methodologies)

BAY	C&P PANEL				SECONDARY SYSTEMS EQUIPMENT							X-PROT		Y-PROT		AUX & CTRL		REVENUE METERING		OPSWAN		CABLES (HI)	YARD MARSHALLING KIOSKS (HI)	C&P PANELS (Chassis)	Sec Sys Eqiupment	CABLES	YARD MARSHALLING KIOSKS
Function	Panel Descripion	Panel No.	Year	HI	Functional Loc.	Description	Manufacturer	Model number	Obsolescence (Yes / No)	Spare Qty	Material	Eff. Age	HI	Eff. Age	HI	Eff. Age	HI	Eff. Age	HI	Eff. Age	HI	C&P Panels to HV Yard Marshalling Kiosks (CB, MK, CT, VT, AC, DC, COOLING)	Yard Marshalling Kiosks (CB, MK, CT, VT, AC, DC, COOLING)	C&P Panels	Sec Sys Equipment & Auxiliary Components	C&P Panels to HV Yard Marshalling Kiosks (CB, MK, CT, VT, AC, DC, COOLING)	Yard Marshalling Kiosks (CB, MK, CT, VT, AC, DC, COOLING)
TRANSFORMER T1 - 132 kV BAY =D02 CONTROL AND PROTECTION	TRANSFORMER 1 - 132 kV BAY =D02 CONTROL AND PROTECTION	+2A2	2004	4.57	T046-SSS-441--BAYCONT	REMOTE TERMINAL UNIT FOXBORO C50	FOXBORO	[redacted]	Yes	0	26047					16.65	8.32					4.57	4.57	2044	2024/25 (b)	2044	2044
					T046-SSS-441--XPROT	RELAY TRANSF DIFF GE T60	GE	[redacted]	Yes	6	25384	15.13	7.57														
					T046-SSS-441--XPROT	RELAY DIFF 25-325V 1POLE AREVA MFAC14	AREVA	[redacted]	No	4	12241	0.46	0.23														
					T046-SSS-7239-PSDITA	DEWAR DM1200 PROT SIG DIG 90-320V SUPPLY	DEWAR	[redacted]	Yes	5	17308	15.13	7.57														
					T046-SSS-7239-PSDITB	DEWAR DM1200 PROT SIG DIG 90-320V SUPPLY	DEWAR	[redacted]	Yes	5	17308			15.13	7.57												
					T046-SSS-441--YPROT	RELAY BIASED DIFF SEL-387-5 (1A) (3U)	SCHWEITZER	[redacted]	Yes	6	25465			15.13	7.57												
TRANSFORMER T2 - 132 kV BAY =D05 CONTROL AND PROTECTION	TRANSFORMER 2 - 132 kV BAY =D05 CONTROL AND PROTECTION	+2A3	2004	4.57	T046-SSS-442--BAYCONT	REMOTE TERMINAL UNIT FOXBORO C50	FOXBORO	[redacted]	Yes	0	17276					16.67	8.33					4.57	4.57	2044	2024/25 (b)	2044	2044
					T046-SSS-442--XPROT	RELAY DIFF 25-325V 1POLE GEC MFAC14	GEC	[redacted]	No	4	12241	17.40	8.70														
					T046-SSS-442--XPROT	RELAY TRANSF DIFF GE T60	GE	[redacted]	Yes	6	25384	15.13	7.57														
					T046-SSS-7240-PSDITA	DEWAR DM1200 PROT SIG DIG 90-320V SUPPLY	DEWAR	[redacted]	Yes	5	17308	15.13	7.57														
					T046-SSS-7240-PSDITB	DEWAR DM1200 PROT SIG DIG 90-320V SUPPLY	DEWAR	[redacted]	Yes	5	17308			15.13	7.57												
					T046-SSS-442--YPROT	RELAY BIASED DIFF SEL-387-5 (1A) (3U)	SCHWEITZER	[redacted]	Yes	6	25465			15.13	7.57												
132kV FEEDER 7239 (=D02) & FEEDER 7240 (=D05) PROTECTION	132kV FEEDER 7239 (=D02) & FEEDER 7240 (=D05) PROTECTION	+2A1	2003	4.86	T046-SSS-7239-XPROT	RELAY CURRENT DIFF GE L90 (2 TERM)	GE	[redacted]	Yes	9	25209	16.93	8.465									4.86	4.86	2044	2024/25 (b)	2044	2044
					T046-SSS-7240-XPROT	RELAY CURRENT DIFF GE L90 (2 TERM)	GE	[redacted]	Yes	9	25209	15.13	7.565														
TRANSFORMER T1 & T2 REVENUE METERS	TRANSFORMER T1 & T2 REVENUE METERS		1993	7.71	T046-SSS-METR-REVMET1	CAP BANKS WH/VARH METER	EDMI	[redacted]	Yes	45	15879							19.61	9.81			7.71	7.71	2025	2024/25	2025	2025
					T046-SSS-METR-REVMET2	TRANSF 1 WH/VARH METER (REVENUE)	EDMI	[redacted]	Yes	45	15879							20.00	10.00								
					T046-SSS-METR-REVMET2	METER KWH/KVARH 1A 110V 3PH CL.5/1S (CH)	EDMI	[redacted]	Yes	45	15879							9.95	4.97								
					T046-SSS-METR-REVMET3	WH/VARH METER (REVENUE)	EDMI	[redacted]	Yes	45	15879							8.46	4.23								
					T046-SSS-METR-REVMET3	WH/VARH METER (REVENUE)	EDMI	[redacted]	Yes	45	15879							8.46	4.23								
					T046-SSS-NBAY-INTSWIT	SUB INTERROGATION SWITCH - T046	COMMUNITRON	[redacted]	Yes	9	12158							15.21	7.60								
SUBSTATION MASTER OPSWAN, COMMON RTU AND SCADA	SUBSTATION MASTER OPSWAN, COMMON RTU AND SCADA	+A24	2004	4.57	T046-SSS-NBAY-LCF	MONITOR	SUN	[redacted]	Yes	0						15.12	7.56					4.57	4.57	2044	2024/25 (b)	2044	2044
					T046-SSS-NBAY-LCF	LOCAL CONTROL FACILITY PC X TERMINAL	WYSE	[redacted]	Yes	2	35961					4.14	3.45										
					T046-SSS-NBAY-LCFINT	REMOTE TERMINAL UNIT FOXBORO C50	FOXBORO	[redacted]	Yes	0	26044					15.98	7.99										
					T046-SSS-NBAY-NSCLNK1	REMOTE TERMINAL UNIT FOXBORO C50	FOXBORO	[redacted]	Yes	0	26044					15.98	7.99										
					T046-SSS-NBAY-NSCLNK2	REMOTE TERMINAL UNIT FOXBORO C50	FOXBORO	[redacted]	Yes	0	26044					15.98	7.99										
					T046-SSS-NBAY-RTU1	REMOTE TERMINAL UNIT - G1 ERGON RTU EQ	NORQEB	[redacted]	Yes	0						17.69	8.85										
					T046-SSS-NBAY-RTU2	REMOTE TERMINAL UNIT C50	FOXBORO	[redacted]	Yes	0						18.06	9.03										
					T046-SSS-NBAY-RTUCOM1	REMOTE TERMINAL UNIT FOXBORO C50	FOXBORO	[redacted]	Yes	0	17276					15.72	7.86										
					T046-SSS-NBAY-TIMING1	GPS CLOCK - TEKRON TCG01	TEKRON	[redacted]	Yes	0	25933					16.19	8.09										
					T046-SSS-NBAY-INVERT1	INVERTER	LATRONICS	[redacted]	No	0						17.82	8.91										
					T046-SSS-NBAY-OWCAM1	AXIS ETHERNET CAMERA ASSEMBLY	Take a Look	[redacted]	No	5	33869									7.13	5.94						
					T046-SSS-NBAY-OWNTWK1	SERVER PORT 48VDC PERLE 04030450 -OPSWAN	PERLE	[redacted]	No	2	27733									11.53	9.61						
					T046-SSS-NBAY-OWNTWK1	SWITCH E/NET 32PRT RUGGED RSG2300 OPSWAN	RUGGEDCOM	[redacted]	No	3	30818									5.22	4.35						
					T046-SSS-NBAY-OWNTWK1	SWITCH E/NET 18PT	RUGGEDCOM	[redacted]	Yes	10	33600									5.22	4.35						
					T046-SSS-NBAY-OWNTWK2	PERLE IOLAN DS1, ETHERNET 10/100, DB9M	PERLE	[redacted]	No	2	34320									2.38	1.98						
					T046-SSS-NBAY-OWPRINT	PRINTER	HEWLETT PACKARD	[redacted]	Yes	0	26840									11.53	9.61						
132kV BLDG +1 DC AUXILIARY SUPPLY	BUILDING +1 125V DC X BATTERY	+8B2	2019	0.83	T046-SIN-DCSU-125DCX	BUILDING +1 125V DC X BATTERY	CENTURY YUASA	[redacted]																	2031		
	BUILDING +1 125V DC X BATTERY MONITOR AND CHARGER	+8B2	2019	0.50		BUILDING +1 125V DC X BATTERY MONITOR AND CHARGER	ALPHA TECHNOLOGIES	[redacted]																	2040		
	BUILDING +1 125V DC Y BATTERY	+8B2	2019	0.83	T046-SIN-DCSU-125DCY	BUILDING +1 125V DC Y BATTERY	CENTURY YUASA	[redacted]																	2031		
	BUILDING +1 125V DC Y BATTERY MONITOR AND CHARGER	+8B2	2019	0.50		BUILDING +1 125V DC Y BATTERY MONITOR AND CHARGER	ALPHA TECHNOLOGIES	[redacted]																	2040		
	BUILDING +1 125V DC DISTRIBUTION BOARD	+8B2	2019	0.50		BUILDING +1 125V DC DISTRIBUTION BOARD		[redacted]																	2040		

Planning Statement	07/08/2025
Title	CP.02841 - T046 Garbutt Secondary Systems Replacement
Zone	Ross
Need Driver	Emerging compliance risks arising from condition and obsolescence of Molendinar's ageing secondary systems.
Network Limitation	Garbutt Substation is required to meet Powerlink Queensland's N-1-50MW/600MWh Transmission Authority reliability standard.
Pre-requisites	None

Executive Summary

Garbutt Substation is a bulk supply point for Ergon Energy load located in the northern suburbs of Townsville.

Ageing and obsolete secondary systems at Garbutt Substation are increasingly at risk of failing to comply with Schedule 5.1.9(c) of the National Electricity Rules and AEMO's Power System Security Guidelines[1].

Powerlink's 2025 Central scenario forecast confirms there is an enduring need to maintain electricity supply into the Garbutt Substation and broader Townsville network. The removal or reconfiguration of the Garbutt Substation due to secondary system failure/obsolesce would violate Powerlink's N-1-50MW/600MWh Transmission Authority reliability standard.

Therefore, there is an enduring need to maintain the current function and capacity of the Garbutt Substation by replacing the at-risk secondary systems.

[1] AEMO, Power System Operating Procedure SO_OP_3715, Power System Security Guidelines, V105, June 2024 (the Rules require AEMO to develop and publish Power System Operating Procedures pursuant to clause 4.10.1(b) of the Rules, which Powerlink must comply with per clause 4.10.2(b)).

Table of Contents

1. Introduction

T046 Garbutt Substation was built in the late 1950s as a 132/66kV bulk supply and transformation point to the Townsville distribution network. Over the years it was expanded and then in 2004 rebuilt in a transformer ended configuration, with the switching function established at Alan Sherriff. Currently, feeders 7239 and 7240 (from Alan Sherriff) only have a single protection system, i.e. X protection, from Garbutt Substation end.

Townsville is supplied by a 132kV transmission network to the south and west of the greater load area injecting into an interconnected 66kV distribution system owned and operated by Ergon Energy. Connection points are located at the Townsville South 132/66kV, Dan Gleeson 132/66kV, Garbutt 132/66kV, and Alan Sherriff 132/11kV Substations.

Figure 1 gives a geographic overview of the Townsville network, including Powerlink's 132kV network and the Ergon Energy's Queensland 66kV network.

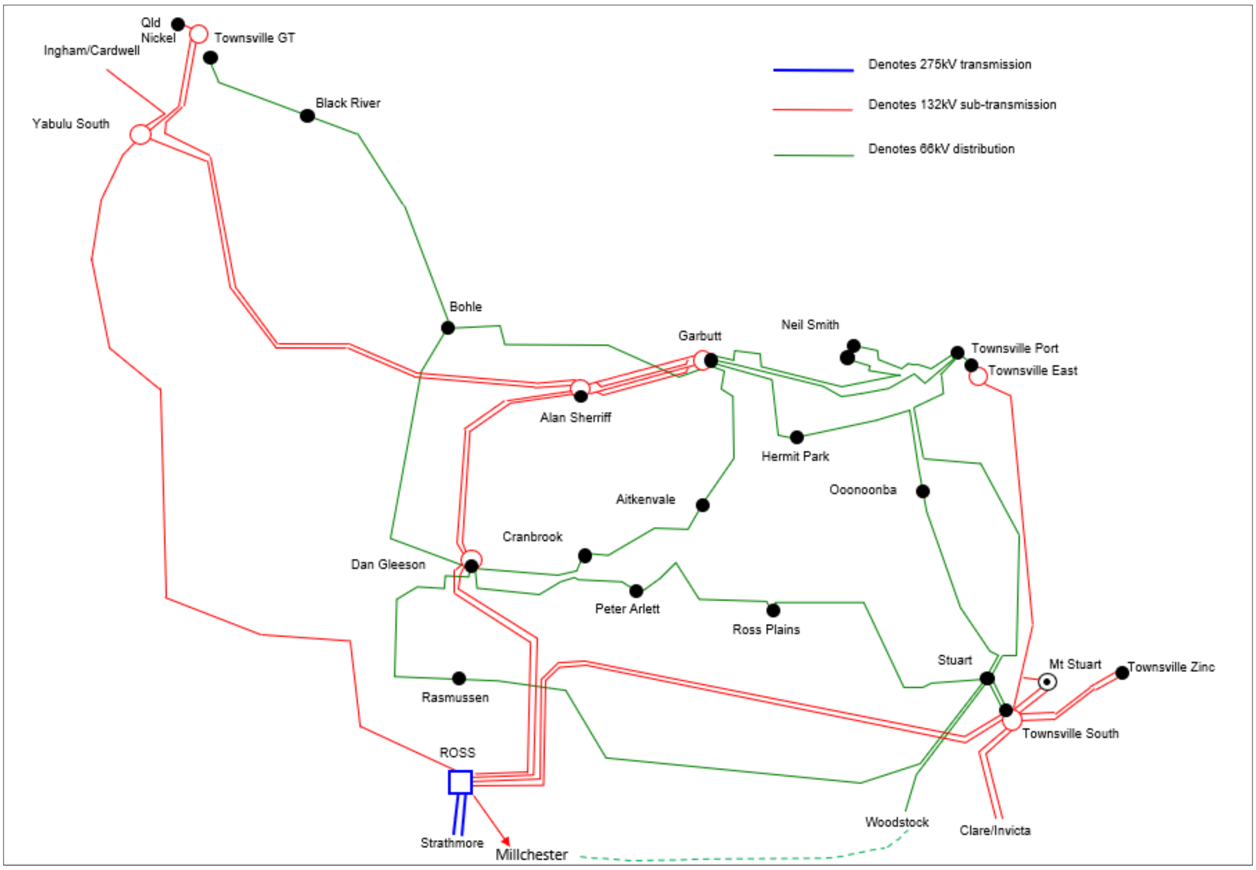

Figure 1. Townsville Distribution Network

The condition assessment [1] of the secondary system plant at Garbutt Substation has concluded many of the original assets are reaching the end of their operational life and recommends that action is taken to address the compliance risks arising from the condition and obsolescence of the at-risk plant.

In addition to the site-specific impacts of obsolescence at Garbutt Substation, it is also important to note the compounding impact of equipment obsolescence occurring across the fleet of secondary systems assets installed in the Powerlink network. Running multiple secondary systems to failure across the network increases the likelihood of concurrent systemic faults with significant implications on network reliability and safety.

This report assesses the impact that removal of the functionality enabled by the at-risk secondary systems would have on the performance of the network and Powerlink's statutory obligations. It also establishes the indicative requirements of any potential alternative solutions to the current services provided by Garbutt Substation.

2. T046 Garbutt Substation configuration

Figure 2 shows the operational diagram for the Garbutt Substation and the secondary systems in scope.

[redacted]

Figure 1. Line Diagram of Garbutt and Alan Sherriff substations

3. Garbutt Demand Forecast.

Figure 3 shows diagrammatically the interconnected 66kV network. Garbutt Substation is a key injection point to this 66kV network.

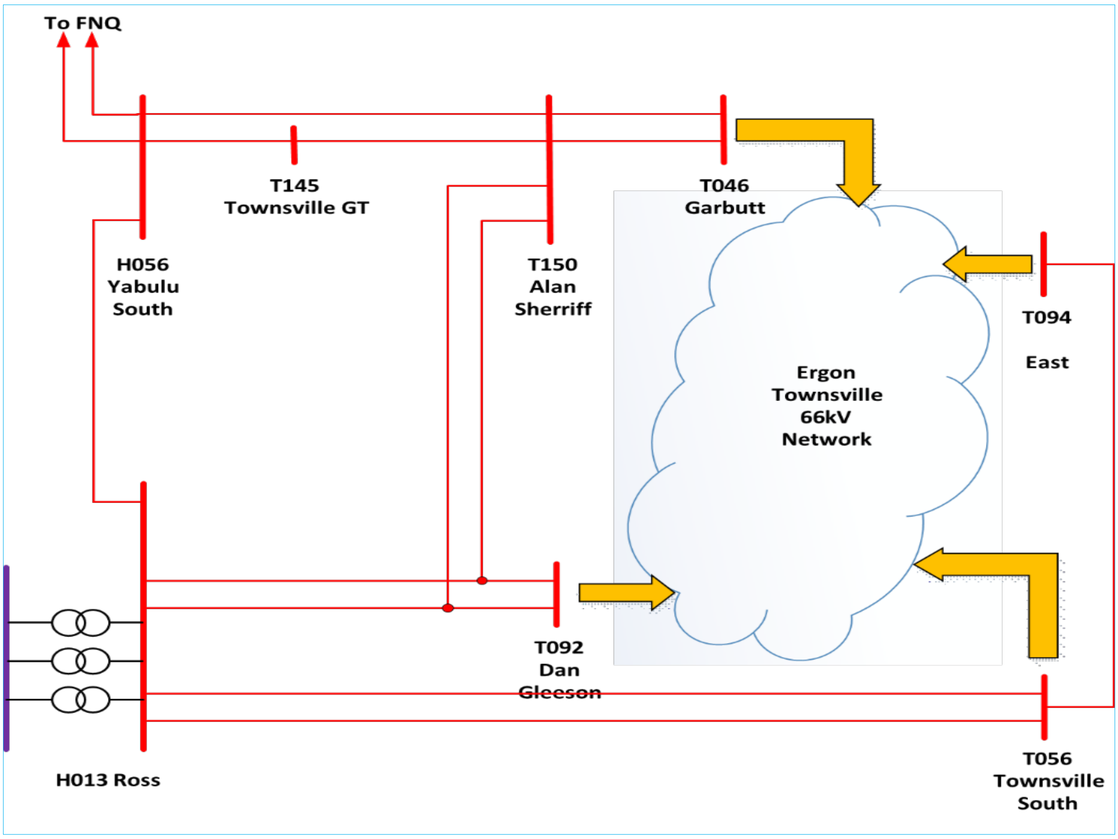

Figure 3. Townsville Distribution Network (Schematic Overview)

Historical and forecast maximum demand for the Garbutt load is shown in Figure 4. Over the planning period, the maximum demand is forecasted to steadily increase.

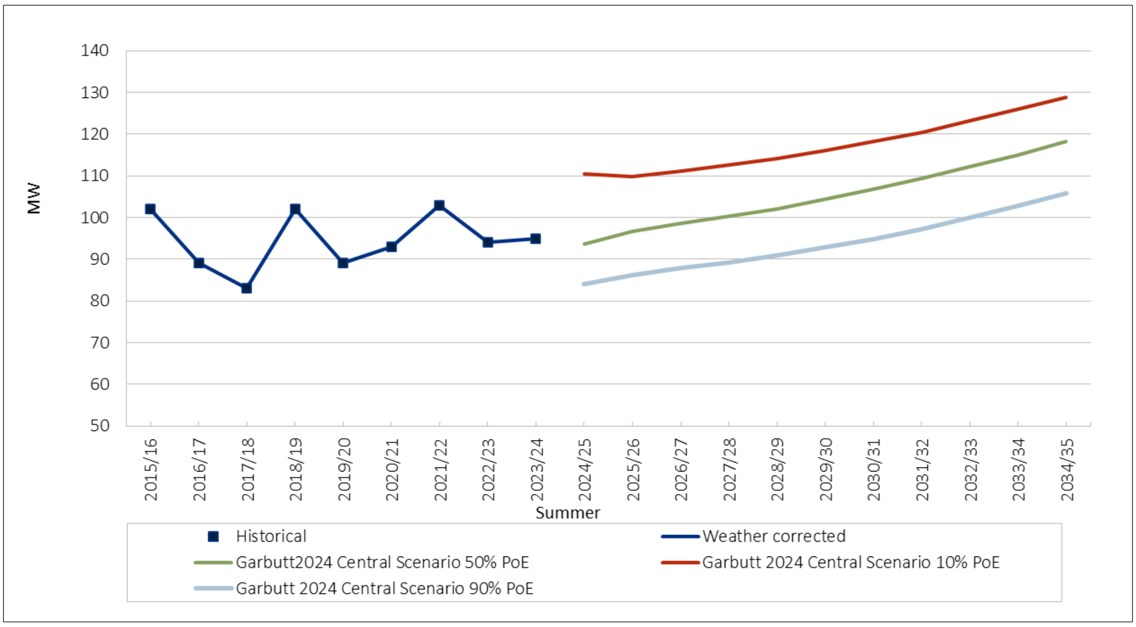

Figure 4. Garbutt 66kV Load History and Forecast

The annual load duration curves from 2020 are shown in Figure 5.

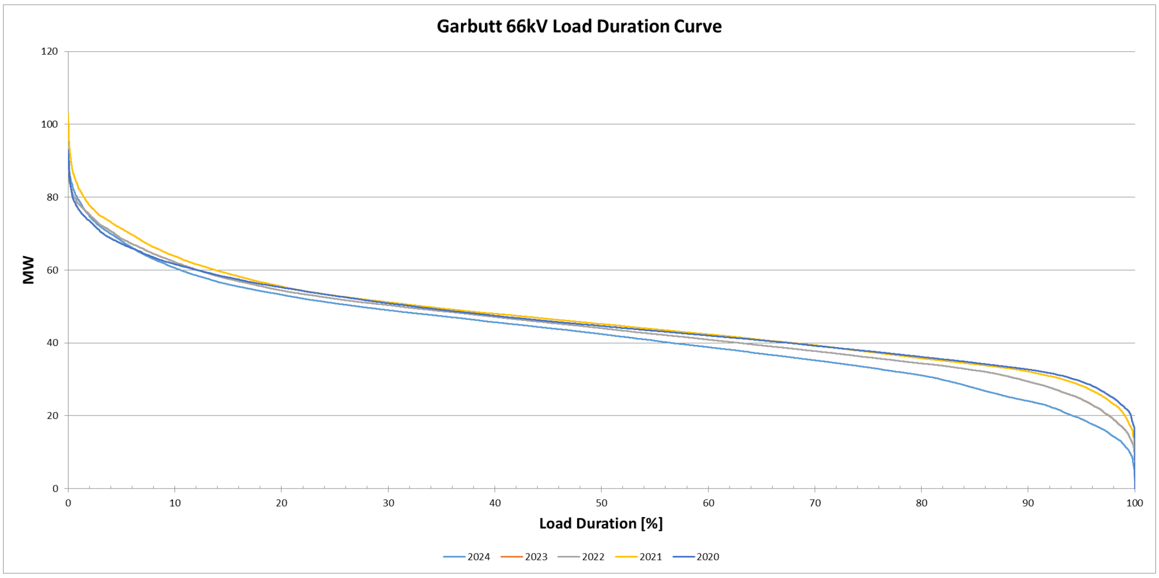

Figure 5. Garbutt 66kV Load Duration Curves

With consideration of rooftop PV within the Ergon Energy network supplied from Garbutt Substation the maximum customer load is significantly higher. Figure 6 shows that rooftop PV meets up to 60MW of underlying demand.

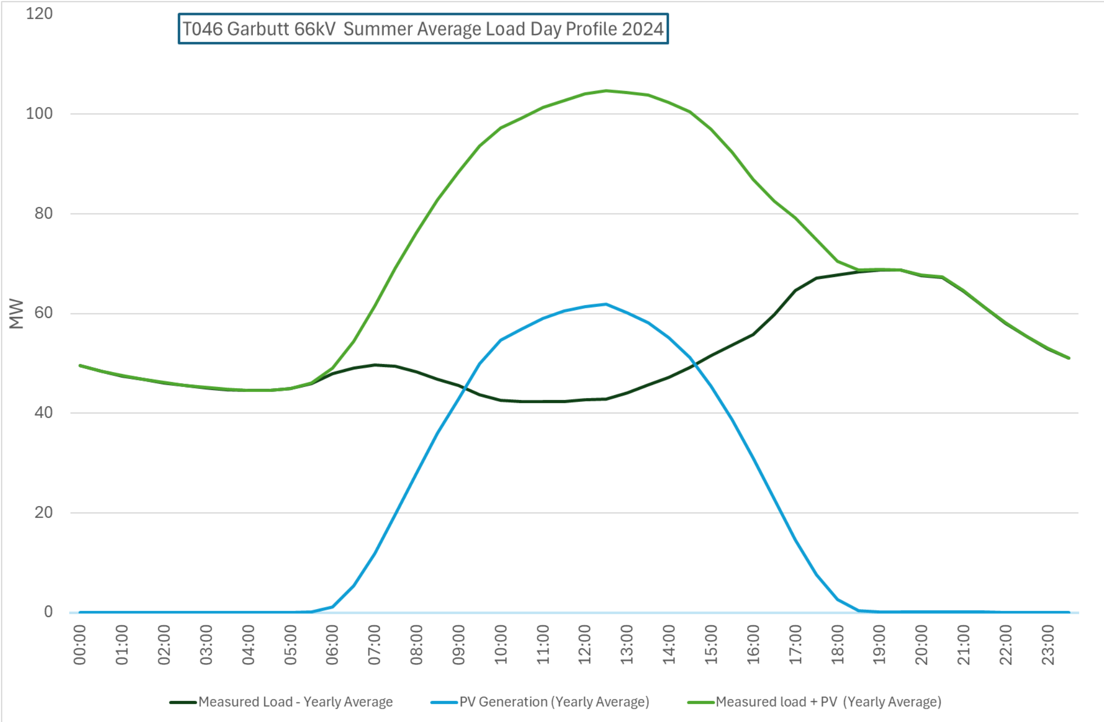

Figure 6. T046 Garbutt 66kV Summer Average Load Day profile 2023/24.

4. Statement of Investment Need

There is an enduring need for all network elements connected to T056 Garbutt.

The Garbutt 66kV load is supplied from Alan Sherriff via feeders 7239 & 7240.

Removing the functionality of this substation due to secondary system aging would result in the loss of support to the Townsville network from Garbutt resulting in overloading alternate 66kV feeders.

Considering the 2024 peak load, a loss of supply to Garbutt Substation would transfer approximately 97 MW of load to various feeders within Ergon Energy's 66 kV network. This would result in increased power flows across the 66 kV lines connecting to T092 Dan Gleeson as well as higher flows from Townsville Port towards Dan Gleeson. In this scenario under system normal conditions, the Energy Queensland 66 kV network would be overloaded.

Additionally, during N-1 contingency scenarios, the Powerlink transformers supporting the EQL network would be overloaded.

This would eliminate operational windows for planned maintenance activities.

Therefore, addressing the risks associated with the deteriorating condition of the secondary systems by decommissioning Garbutt Substation is not a viable option, as it serves as a critical supply point to the area.

A failure to maintain supply due to secondary system issues would overload Energy Queensland network under System normal conditions, which can lead to breach of 600MWh limit and violation of N-1 reliability standard and eliminate opportunities for planned maintenance.

4. Network Risk

Table 1 summarises the maximum load (MW) and energy (MWh) at risk for the 66kV loads assuming that a network element is removed from service due to a failure of Garbutt Substation secondary system element.

The Garbutt Substation is the supply point for Ergon loads in the northern Townsville area. The substation load is supplied from two132/66kV transformers at Garbutt Substation via feeders 7239 and 7240 from Alan Sherriff. Removing Garbutt Substation would cause overloads under peak conditions on the supporting 66 kV network. The "load at risk" refers to the portion of peak demand that can't be accommodated by the network due to limitations of alternate feeders.

Table 1. Load and energy at risk

At Risk	Contingency	Metric	2024 (Delivered)
66kV Ergon Load	Outage of feeder 7329 AND 7240	Max (MW)	97
		Average (MW)	38
		24h Energy Unserved Max (MWh)	1639
		24h Energy Unserved Average (MWh)	916
66kV Ergon Load	Outage of feeder 7329 OR 7240	Max (MW)	61
		Average (MW)	0.13
		24h Energy Unserved Max (MWh)	245.5
		24h Energy Unserved Average (MWh)	3.3

5. Non-Network Options

Potential non-network solutions would need to provide supply to the 66kV network at Garbutt as per Table 1. That is, up to 97 MW and 1640 MWh per day for 66kV network in 2023/24 excluding PV load.

These figures are expected to increase over time in line with projected load growth in 2034. The non-network solution would be required on a continuous basis and be able to meet reliability criteria under contingencies, i.e. N-1-50MW/600MWh.

Powerlink is not aware of any non-network solutions, including demand side management solutions, in the area. However, Powerlink will consider any proposed solution that can contribute significantly to the requirements of ensuring that Powerlink continues to meet its required reliability of supply obligations as part of the formal RIT-T consultation process prior to project approval.

6. Network Options

6.1 Proposed Option to address the identified need

To address network transfer capability due to failure of secondary system at Garbutt it is recommended that the secondary system reaching end of life to be replaced at an appropriate time as recommended by asset strategies ensuring reliability, availability and minimal operational and compliance risks associated with secondary systems assets.

This option ensures that ongoing reliability of supply and asset condition criteria for the load at Garbutt are met.

6.2 Option Considered but Not Proposed

This section discusses alternative options that Powerlink has investigated but does not consider technically and/or economically feasible to address the above identified issues and thus are not considered credible options.

6.2.1 Do Nothing

"Do Nothing" would not be an acceptable option as the primary drivers (primary system condition) and associated safety, reliability and compliance risks would not be resolved. Furthermore, the "Do Nothing" option would not be consistent with good industry practice and would result in Powerlink breaching their obligations with the requirements of the Technical Rules and its Transmission Authority.

7. Recommendations

Powerlink has reviewed the condition of the secondary systems at Garbutt Substation and anticipates they will reach end of technical service.

It is recommended the secondary system be replaced to ensure Powerlink's ongoing compliance with the Electrical Safety Act 2002, Electrical Safety Regulation 2013 and to meet its required reliability obligations (N-1-50MW/600MWh).

Powerlink is currently unaware of any feasible alternative options to minimise or eliminate the load at risk at Garbutt but will, as part of the formal RIT-T consultation process, seek non-network solutions that can contribute to reduced overall investment needs whilst ensuring Powerlink continues to meet its reliability of supply obligations

8. References

1. T046 Garbutt Secondary Systems Condition Assessment Report - 14 Mar 2025.
2. 2025 Transmission Annual Planning Report (A6049612)
3. Asset Planning Criteria - Framework (ASM-FRA-A2352970)
4. Powerlink Queensland's Transmission Authority T01/98

9. Appendix A – Network Risk methodology

EQL Bulk Supply Points: Outage of feeder 7329 and/or 7240

Garbutt is one of the four connection point to support Townsville region EQL 66kV network Without 132/66kV Garbutt transformer, EQL and potentially PLQ network will experience voltage and thermal issues for the next credible contingency. This requires EQL network to manage load for a single contingency or run split for double circuit contingency to in order to maintain network security. During summer, the split may require load management pre-contingency for network security. The split also means significant portion of EQL load is "at risk", as reflected in Table 1 with "single and "two" elements out of service.

Project Scope Report

CP.02841

T046 Garbutt Secondary Systems Replacement

Concept – Version 5

Document Control

Change Record

Issue Date	Revision	Prepared by	Reviewed by	Approved by	Background
1/12/20 – 12/5/21	1-3	[redacted]	[redacted]	[redacted]	
19/3/25	4	[redacted]	[redacted]	[redacted]	
4/6/25	5	[redacted]			Added telecommunications replacement/consolidation of SDH/PDH and OpsWAN (works previously scoped under CP.02811 & CP.02513)

Related Documents

Issue Date	Responsible Person	Objective Document Name
14/03/2025	[redacted]	T046 - Garbutt Secondary Systems Condition Assessment Report – 14 Mar 2025 (A5792196)
18/03/2025	[redacted]	CP XXXXX - Garbutt Secondary Systems Replacement (T046) - Project Initiation Form – 18 Mar 2025 (A5796155)

Document Purpose

The purpose of this Project Scope Report is to define the business (functional) requirements that the project is intended to deliver. These functional requirements are subject to Powerlink's design and construction standards and prevailing asset strategies, which will be detailed in documentation produced during the detailed scoping and estimating undertaken by DTS (or OSD), i.e. it is not intended for this document to provide a detailed scope of works that is directly suitable for estimating.

Project Contacts

Project Sponsor	[redacted]
Connections Manager (Ergon)	[redacted]
Strategist – HV Asset Strategies	[redacted]
Planner - Main/Regional Grid	[redacted]
Manager Projects	[redacted]
Project Manager	TBA
Design Manager	TBA

Project Details

1. Project Need & Objective

T046 Garbutt Substation is located in Townsville and was built in the late 1950s as a 132/66kV bulk supply and transformation point to the distribution network. In 2004, the substation was rebuilt in a transformer ended configuration, with the switching function established at Alan Sherriff. The existing secondary systems were replaced during the substation rebuild in 2004. Currently, feeders 7239 and 7240 only have a single protection system from Garbutt substation end.

The condition assessment, undertaken in 2020, indicated that the majority of secondary systems devices were reaching the end of their technical asset life. It further noted that the field cables are suitable for a further 20 to 25 years of service and that the secondary systems panels are in good condition and may be retained. The driver for the secondary systems replacement is the obsolescence and end of manufacturer support for the existing relays.

The objective of this project is to undertake replacement of secondary systems equipment at Garbutt substation by October 2028.

This project will follow the two (2) stage approval process, however, is expected to be exempt from RIT-T subject to confirmation of the estimated capital cost.

2. Project Drawing

Figure 1 – Location of Garbutt Substation


Figure 2 – Aerial view of Garbutt Substation

3. Deliverables

The following deliverables are to be provided in response to this Project Scope Report. The requirement dates for these deliverables will be communicated separately.

This project will follow the two stage approval process. The following deliverables are to be provided for the purposes of options analysis as required under the RIT-T:

1. A report (e.g. Concept Estimate Report) detailing the works to be delivered, high level staging, resource requirements and availability, and outage requirements and constraints for each option;

2. A class 5 estimate (minimum) for each option;

3. A basis of estimate document and risk table, detailing the key estimating assumptions and delivery risks for each option;

4. Outline staging and outage plans for each option;

5. Provide high level schedule and funding requirements to meet proposed commissioning date. Any requirement for pre-approval funding should be clearly identified;

6. For Option 1, undertake a feasibility assessment to confirm suitability of the in-panel replacement methodology including confirmation of sufficient space in the existing building, usability of existing cables (including condition and rating confirmation) and panels and that asbestos risks are able to be appropriately managed. Provide recommendations, including any alternate options identified, with clear justification; and

7. A comparison of the two options, including outage durations, resource requirements (MSP, contractors etc), return to service times, risks and any other relevant considerations.

4. Project Scope

4.1. Original Scope

The following scope presents a functional overview of the desired outcomes of the project. The proposed solution presented in the estimate must be developed with reference to the remaining sections of this Project Scope Report, in particular *Section 7 Special Considerations*.

Briefly, the project consists of undertaking replacement of secondary systems equipment at Garbutt substation.

Powerlink has identified two credible options to address the identified need, as presented in Table 1 below. Concept estimates are required for each option to inform feasibility and cost assessments.

Table 1 - Options summary

Option	Works	Comm Date
Option 1	Single stage in-panel selective replacement of 132kV secondary systems in existing building	October 2028
Option 2	Single stage replacement of 132kV secondary systems into new demountable building	October 2028

The scope requirements for each of the options are described in the following sections.

4.1.1. Transmission Line Works

Not Applicable

4.1.2. T046 Garbutt Substation Works

4.1.2.1. Option 1 – In-Panel Replacement

Phase 1 (to be done as part of the Concept Estimate):

Undertake site assessment to confirm feasibility of utilising the in-panel replacement methodology currently being developed under CP.02929 Sumner Secondary Systems Replacement project.

Cabling from the primary plant to the protection and control panels is to be treated as asbestos containing material. Design to be done to minimise disturbance to this existing cabling. Asbestos risk is also to be assessed in relation to the AC distribution boards.

Note: The in-panel replacement methodology has not yet been proven under CP.02929. If the Garbutt site assessment determines the in-panel methodology is feasible and preferred, this is to be assumed for estimating purposes, however, the project will not be approved until this methodology is approved.

Phase 2 (to be done following project approval):

- Design, procure, construct and commission new secondary systems within the existing control building for the following plant:
  - Transformer 1 (D02)
  - Transformer 2 (D05)
  - Feeder 7239 (Alan Sherriff) (D02)
  - Feeder 7240 (Alan Sherriff) (D05)
  - Substation SCADA and OpsWAN

- Replace OpsWAN equipment and relocate devices (except the camera) from the OpsWAN camera housing at the top of the pole to the camera patch box at the base of the pole;

- Modify customer interface kiosks as required;

- Review the existing AC and DC supply arrangements, modify as required to accommodate new secondary systems;

- Replace screw type CT links as required where modifying existing CT secondary circuits;
- Modify and upgrade telecommunications equipment as required to support the new secondary systems; and
- Decommission and recover all redundant equipment, and update drawing records, SAP records, config files, etc. accordingly.

4.1.2.2. Option 2 – Full Replacement in a New Demountable Building

- Design, procure, construct and commission new secondary systems in a new control building for the following plant:
  - Transformer 1 (D02)
  - Transformer 2 (D05)
  - Feeder 7239 (Alan Sherriff) (D02)
  - Feeder 7240 (Alan Sherriff) (D05)
  - Substation SCADA and OpsWAN
- Replace OpsWAN equipment and relocate devices (except the camera) from the OpsWAN camera housing at the top of the pole to the camera patch box at the base of the pole;
- Modify customer interface kiosks as required;
- Undertake all civil works to facilitate installation of the new control building and secondary systems including foundations, structures, drainage, trenches, conduits, roads etc;
- Install new and modify existing cabling, kiosks and termination racks as required to facilitate installation of the new control building and secondary systems;
- Install new DC supplies for protection and telecommunications equipment;
- Modify and upgrade AC and DC distribution as required to facilitate replacement of secondary systems;
- Replace screw type CT links as required when modifying existing CT secondary circuits;
- Modify and upgrade telecommunications equipment as required to support the new secondary systems;
- Upgrade fire and security systems as required to incorporate the new control building; and
- Decommission and recover all redundant equipment, and update drawing records, SAP records, config files, etc. accordingly.

4.1.3. T150 Alan Sherriff Substation Works

Secondary systems at T150 Alan Sherriff Substation are to be upgraded under CP.02400 Alan Sherriff Secondary Systems Replacement in conjunction with this project.

4.1.4. Telecoms Works

As per sections 4.1.2 and 4.1.3, review and upgrade telecommunications equipment as required to support the new secondary systems at Garbutt.

This includes replacement of the PDH and SDH equipment with a single consolidated device in coordination with CP.02811 Telecommunication Network Consolidation RAN 2.

In addition to this, the new OpsWAN solution determined under CP.02512 OspWAN Replacement Stage 1 is to be implemented. This solution will replace the functionality currently provided by the IP/MPLS and OpsWAN routers and allow the migration of all services to IP (OpsWAN will become a service over the network rather than a network in its own right). This work is to be coordinated with CP.02513 OpsWAN Replacement Stage 2.

4.1.5. Easement/Land Acquisition & Permits Works

Not applicable

4.2. Key Scope Assumptions

The following assumptions should be included in the estimating of this scope:

- Asbestos sampling and testing will be carried out on all Powerlink panels before confirming the preferred option. For estimation purposes, it is to be assumed that there is no asbestos risk whilst working on Powerlink's panels;
- The Energy Queensland owned tunnel board panels will not be removed due to asbestos risk;
- DC supplies for both protection and telecommunications equipment were replaced in 2019 and therefore, do not require replacement under this project;
- This project will be executed in conjunction with CP.02400 Alan Sherriff Secondary Systems Replacement. All works at T150 Alan Sherriff Substation will be done under CP.02400; and
- In-panel replacement methodology will be successfully implemented under CP.02929 Sumner Secondary Systems Replacement prior to project approval.

4.3. Variations to Scope (post project approval)

Not applicable

5. Key Asset Risks

Asset risk management shall be in accordance with the Asset Risk Management Process Guideline (A4870713).

6. Project Timing

6.1. Stage 1 Approval Date

The anticipated date by which the project will be approved is November 2025.

6.2. Site Access Date

Site access is immediately available for Powerlink construction works to commence as the site is an existing Powerlink site.

6.3. Commissioning Date

The latest date for the commissioning of the new assets included in this scope and the decommissioning and removal of redundant assets, where applicable, is 31st October 2028.

7. Special Considerations

- The substation secondary systems are housed in the original three storey brick control building built in the 1950s. The building is owned by Powerlink and shared with Ergon Energy. Ergon Energy's 11kV primary equipment is housed in this building and has a remaining service life to 2040;
- Building rectification works are currently being done under CP.02954 Garbutt Building Life Extension to ensure the building remains fit for purpose for a further 30 years;
- Control and protection cables are terminated directly between secondary systems indoor panels in the existing control building and outdoor marshalling cubicles with no building termination racks. Visual inspection of these cables indicated they are still in good condition;
- All cables inside the control building associated with Powerlink's secondary systems assets are still in good condition;
- Cabling from the primary plant to the protection and control panels is to be treated as asbestos containing material when working in the cable room. Design to be done to minimise disturbance to existing cabling and minimise/eliminate new cabling from the primary plant to the secondary systems panels;
- The old AC distribution board in the existing building is expected to contain asbestos.

8. Asset Management Requirements

Equipment shall be in accordance with Powerlink equipment strategies.

Unless otherwise advised Sarah Gilmour will be the Project Sponsor for this project. The Project Sponsor must be included in any discussions with any other areas of Network and Business Development including Asset Strategies & Planning.

Jay Tencate will provide the primary customer interface with Energy Queensland. The Project Sponsor should be kept informed of any discussions with the customer.

9. Asset Ownership

The works detailed in this project will be Powerlink Queensland assets.

The asset boundary with Ergon is the LV terminals of the 132/66kV transformers.

10. System Operation Issues

Operational issues that should be considered as part of the scope and estimate include:

- interaction of project outage plan with other outage requirements;
- likely impact of project outages upon grid support arrangements; and
- likely impact of project outages upon the optical fibre network.

11. Options

Not applicable

12. Division of Responsibilities

A division of responsibilities document will be required to cover the changes to the interface boundaries with Ergon. The Project Manager will be required to draft the document and consult with the Project Sponsor who will arrange sign-off between Powerlink and the relevant customer.

13. Related Projects

Project No.	Project Description	Planned Comm Date	Comment
Pre-requisite Projects			
CP.02825	Configuration Change Request – T046 Garbutt	April 2025	In Execution
CP.02954	T046 Garbutt BLD-01 Life Extension	October 2025	In Execution
CP.02929	Sumner Secondary Systems Replacement	Sept 2026	Planned to be the first project to utilise the in-panel replacement methodology
Co-requisite Projects			
CP.02400	T150 Alan Sherriff Secondary Systems Replacement	October 2028	In Definition
CP.02811	Telecommunication Network Consolidation RAN 2	Dec 2027	Definition
CP.02513	CP.02513 OpsWAN and MPLS Replacement RAN 2	Aug 2027	Definition
Other Related Projects			

CP.02841 T046 Garbutt Secondary Systems Replacement

Concept Estimate

Table of Contents

1. Executive Summary

The purpose of this report is to provide a high-level options analysis for the replacement of the secondary systems equipment at T046 Garbutt Substation.

This concept report considers two options:

- **Option 1:** Single stage in-panel selective replacement of 132kV secondary systems in existing building. The proposed commissioning date is October 2028 as stated in the project scope report.

- **Option 2:** Single-stage replacement of 132kV secondary systems into a new demountable building. The proposed commissioning date is October 2028 as stated in the project scope report.

This project will follow the two (2) stage approval process and be subject to a RIT-T consultation process.

Figure 1: Location of Garbutt Substation

2. Project Information

2.1 Options Comparison Table

	Option 1	**Option 2**
Cost (total escalated incl risk)	$15,679,701	$22,459,852
Proposed Commissioning	October 2028	October 2028
Outages	Two separate outages required (8 weeks in total) Garbutt feeders (FDR7239 and FDR7240) are directly impacted. These feeders are linked to Alan Sherriff, which means any outage or change at Garbutt affects the broader network.	Two separate outages are required (8 weeks in total).
Signalling & SCADA	Requires workarounds, paths, and retrofitting.	Clean implementation with modern systems
Design considerations	Avoid work in the cable room and minimise new cabling, assuming no asbestos risk in Powerlink panels.	Requires new building construction, avoids all asbestos-related risks.
Health and Safety	Involves working in an existing building with known asbestos-containing materials. The existing asbestos management plan restricts cable penetrations and structural modifications, making option 1 more hazardous and logistically complex. MSP has deemed the existing building unsafe for work until further resolution, which could delay or jeopardise option 1.	Avoids asbestos-related risks entirely by constructing a new building
Long-term Feasibility and Safety	Requires confirmation of space and structural integrity	Considered safer from a health and safety standpoint and avoids the need to manage asbestos risks in future operations. The new building provides a clean slate for future upgrades and maintenance.
Future Flexibility	Limited	High

2.2 Dependencies & Interactions

This project is dependent on the completion delivery of the following projects:

Project No.	Project Description	Planned Commissioning Date	Comment
Dependencies			
CP.02929	Sumner Secondary Systems Replacement	November 2025	Related to Option 1 only. Planned to be the first project to utilise the in-panel replacement methodology.
CP.02825	Configuration Change Request – T046 GARBUTT	April 2026	Execution
CP.02954	T046 Garbutt BLD-01 Life Extension	October 2025	Execution
Interactions			
CP.02400	Alan Sherriff Secondary Systems Replacement T150	October 2028	Definition
OR.02429	Statewide Substation AC Switchboard	December 2025	Concept
Other Related Projects			
CP.02811	Telecommunication Network Consolidation RAN 2	December 2027	Definition
CP.02513	OpsWAN and MPLS Replacement RAN 2	August 2027	Definition

2.3 Site-Specific Issues

Figure 2: T046 Garbutt Substation

- T046 Garbutt Substation is located in Townsville and was built in the late 1950s as a 132/66kV bulk supply and transformation point to the distribution network. In 2004, the substation was rebuilt in a transformer ended configuration, with the switching function established at Alan Sherriff. The existing secondary systems were replaced during the substation rebuild in 2004. Currently, feeders 7239 and 7240 only have a single protection system from Garbutt substation end.

- The condition assessment, undertaken in 2020, indicated that the majority of secondary systems devices were reaching the end of their technical asset life. It further noted that the field cables are suitable for a further 20 to 25 years of service and that the secondary systems panels are in good condition and may be retained. The driver for the replacement of secondary systems is the obsolescence and end of manufacturer support for the existing relays.

- The asset boundary with Energy Queensland will be the LV terminals of the 132/66KV transformer at T046 Garbutt substation.

- Dalrymple Road is a major heavy vehicle transport corridor with a constant high traffic flow volume. Traffic control may be required for the safe access and egress from site new control rooms and equipment deliveries.

- The T046 Garbutt Substation and Control Building was established in 1957, housing both Powerlink assets and EQL 11kV assets. The building is a 3-storey construction with a steel hoist structure between the floors. If the hoist is not operational, alternative methods will need to be investigated to bring equipment between the floors.

- Asbestos-containing material was identified within the T046 Garbutt Control Building. For works in that area, the respective Asbestos Management Plan and Asbestos Register shall be reviewed, and appropriate actions taken.

- The existing 415V AC Change-Over Board (ACCO) is end of life, and asset integrity is in poor condition. Failure of the ACCO will result in a long duration repair or replacement time.

- Existing spacing on the second floor of the Control Building has been assessed as insufficient to bring new equipment into the second floor for the current delivery pathway. Alternative paths will need to be assessed.

- T046 Garbutt Substation is located within Townsville and is subject to a six-month “wet season”, November to April, with considerable variation from year to year. Below is rainfall data from the Bureau of Meteorology indicating Mean Number of Days of Rain (>=10 mm) for the Townsville area.

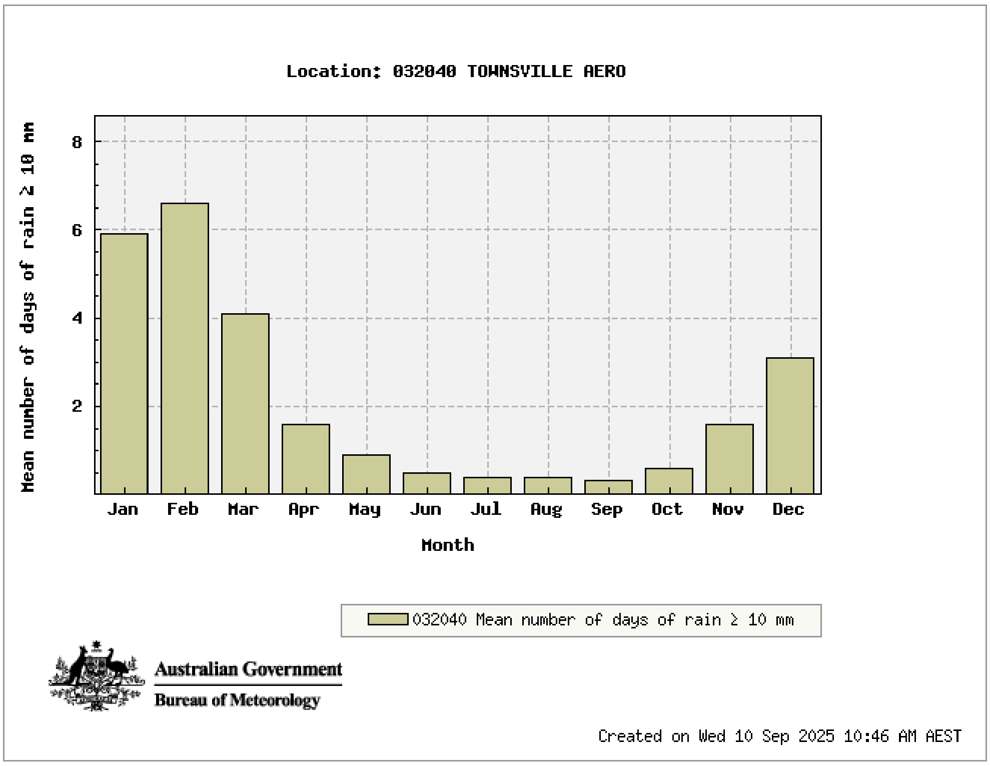

Figure 3 - Townsville Area Mean Number of Days of Rain >=10mm (Source: Bureau of Meteorology 10th of September 2025)

3. Option 1 – In-Panel Replacement

3.1 Option Definition

3.1.1 Option Scope

Design, procure, construct and commission the in-panel replacement of selected 132kV secondary systems at T046 Garbutt in the existing Powerlink building.

- Secondary Systems design based on SDM9.3.
- Replacement of the T046 Garbutt secondary systems and associated common control, protection and monitoring equipment in the existing Powerlink building. This includes:
  - 2 x New Feeder Panels
  - 2 x New combined SIP/Network Panels
  - Decommissioning of existing Transformer Feeder X Protection Cubicle (+2A1) and use as a cable termination panel for both the feeders. Also, convert the cubicle to use as a 125V DC Distribution board for the new panels.
  - In-situ replacement for the existing Transformer Panels +2A2 & +2A3.
  - Decommissioning of NSC/LCF Common RTA & OpsWAN Cubicle +2A4. Building and comms alarms shall be moved to station IED in new SIP panel. +2A4 shall be used as a termination point to extend the cables to the new station IED.
  - New Fibre cables between new SIP panels and the MPLS panels in the comms room.
  - Reuse existing CT/Trip/Control/Status cables between panels and switchyard.
- All Current Transformer (CT) link terminals associated with CT circuits are to be replaced with a new physical disconnect terminal, as per Standards Update, SU0049.
- Replacement of GPOs for Transformer 1 & 2 Bay Marshalling Kiosk, as per Standards Update, SU0129.
- Replace IONS (OpsWAN) equipment (except OpsWAN camera) and relocate all devices (except the camera) from the OpsWAN camera housing at the top of the pole to the camera patch box at the base of the pole. Refer to ASM-FRM-A4982111 and ETR 10434041.
- Panels, selective replacement of 132kV secondary systems in existing buildings, will be feasible with the assumption of no significant changes to the primary plant and Drawings.
- Sponsor has agreed per Project Scope to add telecommunication replacement/consolidation of SDH/PDH and OpsWAN (works previously scoped under CP.02811 & CP.02513.
- Install new fibre patch leads between the telecoms equipment in Room +4 and new Feeder panels in Room +2.
- Modify protection signalling paths for FDR7239 and update records.
- Modify protection signalling paths for FDR7240 and update records.
- Design o[redacted] MPLS/SIP network
- Deployment of Site Server with virtualised firewall
- Migration of SCADA circuits from SDH to MPLS/SIP
- Decommission and recover all redundant equipment.
- Update drawing records, SAP records, config files, etc., accordingly.

3.1.2 Scope Assumptions

The following key assumptions were made for the Project Estimate.

- All asbestos will be removed prior to Site Mobilisation.
- Internal design resources are available as required.
- No Restricted Access Zone will be deployed on this site during construction.
- Access to network and outage management resources are available.
- All existing equipment (including cables) is in good condition and working order.
- MSP will be available to complete the work.
- Interface between Energy Queensland and Powerlink.
- Energy Queensland construction resources will be available for remote end works when required.
- PLQ project and support resources are available to align with the project timing to support meeting the approved commissioning date
- Timely agreement of Division of Responsibility (DOR) between Energy Queensland and Powerlink for all the works involved.
- Structural review of the existing building before commencing works.
- All new telecoms equipment for these projects, CP.02811 and CP.02513, will be installed in Communications Room +4.
- Existing third-party equipment and services will not be moved.
- This project will be executed in conjunction with CP.02400 Alan Sherriff sec sys and all works at T150 Alan Sherriff will be done under CP.02400.
- Modifications/Installation of new marshalling kiosks/
- Civil works to facilitate the secondary replacement works.
- No changes to PLQ/EQL transformer interface.

3.1.3 Scope Exclusions

- No allowance is included for any Energy Queensland projects that may impact Powerlink works.
- No work is required on the existing ACCO located on the first floor.
- Live Subs resources.
- This estimate does not include any costs for repairing or modifying the primary plants not listed to be replaced under the scope.
- No asbestos removal is included in the scope of this project.
- Any delays, costs or cost increases not within the control of Powerlink.
- Any work outside of normal working hours.
- Costs associated with expediting manufacturing, plant delivery, equipment and material.
- Long lead items lead time beyond nominal durations, including delays in procuring electronic equipment due to global semi-conductor shortage and any other materials or services.
- Extreme weather or impacts thereof.
- Fluctuation in foreign exchange rates.
- Any upgrades to the existing control building required to meet current building standards.

3.2 Project Execution

3.2.1 Project Schedule

A High Level Project Schedule has been developed for the project stages:

Milestones	High-Level Timing
Class 5 Project Proposal Submission	August 2025
Request for Class 3 Estimate	September 2025
Class 3 Project Proposal Submission	March 2026
RIT-T (assumed 26 weeks)	June 2026 – December 2026
Stage 1 Approval (PAN1) includes funds for design & procurement	May 2026
Project Development Phase 1 & Phase 2	June 2026 – August 2026
Reconcile Estimate and Submit PMP for Stage 2 Approval	August 2026
Full Project Approval (PAN)	December 2026
Site Mobilisation	January 2027
Project Commissioning	October 2028

3.2.2 Network Impacts

- All feeders to/from Alan Sheriff, which includes Garbutt feeders, will need to be considered. Garbutt's impact is to be considered given these feeds, EQL's new GIS board.
- Outages to be scheduled in shoulder and winter periods – Late April;/May to October.
- PLQ Outage Management to consider a prolonged bus outage (with a quick RTS) at T150 Alan Sherriff. The plan is to execute CP.02400 and CP.02841 simultaneously, given outages on Feeder 7240 & F7239 at Alan Sherriff will impact Garbutt. Awaiting response from PLQ Outage Management.

3.2.3 Resourcing

The following resource strategy is proposed:

- Design by PLQ
- Tier 2 – Minor Civil works
- MSP (core works including all cutover, testing and commissioning)

3.3 Project Estimate

		Sub Total $	Total $
Estimate Class	5		
Estimate accuracy (+% / -%)	- 50% / + 100 %		
Base Estimate		$10,701,481	
[redacted]		[redacted]	
[redacted]			[redacted]
[redacted]	[redacted]	[redacted]	
[redacted]	[redacted]	[redacted]	
[redacted]			[redacted]
[redacted]			[redacted]

4. Option 2 – Full Replacement in a New Demountable Building

4.1 Option Definition

4.1.1 Option Scope

Design, procure, construct and commission the replacement of selected 132kV secondary systems at T046 Garbutt within a new Control Building.

- Secondary Systems design based on SDM9.3.
- New foundations, cable trenches, underground conduits, pits and services.
- Replacement of the T046 Garbutt secondary systems and associated common control, protection and monitoring equipment within a new Control Building. This includes:
  - 1 x Combined control and amenities building
  - 2 x New combined SIP/Network Panel
  - 1 x Network Panel
  - 2 x Transformer Panels
  - 2 x Feeder Panels
  - 1 x 125V DC dual battery system
  - New control cables and fibre cables
  - New fire and security system
  - 2 x FTPs
  - Decommission all secondary system panels and 125V DC systems in the old EQL building. These panels and cables will not be removed due to the presence of asbestos.
- Integration of a new building fire and security system into the existing system.
- Existing EQL building alarms to be connected to station IED in the new building.

- All Current Transformer (CT) link terminals associated with CT circuits are to be replaced with a new physical disconnect terminal, as per Standards Update, SU0049.
- Replacement of GPOs for Transformer 1 & 2 Bay Marshalling Kiosk, as per Standards Update, SU0129.
- Modification to the AC Changeover board to add supplies
- Replace IONS (OpsWAN) equipment (except OpsWAN camera) and relocate all devices (except the camera) from the OpsWAN camera housing at the top of the pole to the camera patch box at the base of the pole. Refer to ASM-FRM-A4982111 and ETR 10434041.
- Sponsor has agreed per Project Scope to add telecommunication replacement/consolidation of SDH/PDH and OpsWAN (works previously scoped under CP.02811 & CP.02513
- Structures for all plant and equipment required for the secondary systems replacement.
- Footings for the new control building.
- Drainage system for buildings and surroundings to fall into the existing drainage system or off the substation platform.
- Cable trench extension to new control/amenities and telecommunication building.
- Provision of firewall to north of proposed buildings (beside the transformers).
- Water and wastewater systems, roof water drainage systems and septic systems are required for the control/amenities building.
- Minor earthworks, including road base and gravel surfacing, may be required to reinstate or reshape the existing substation platform to the design levels to accommodate the new control building and associated works.
- Substation roads that are damaged or modified as part of the works shall be reinstated to good condition.
- All necessary civil works and miscellaneous site works, including temporary road works/access for new control building installation.
- For the replacement of 132kV secondary systems into a new demountable, primary design modifications will be required, incorporating the proposed new demountable building.
- Install new 2x MMOF cables between the new Telecoms building and the new Control Building.
- Install new 2x SMOF cables between the new Telecoms building and the existing building. (PQ leases fibres from Ergon to provide connectivity to some sites; these Ergon fibres will stay in the old building.)
- Install new 2x SMOF cables between the new Telecoms building and the OCCN building.
- Run duplicated diverse new lead in cable from canister to new telecoms building for PQ existing fibre cables (FOC 538, FOC 539).
- Migration of third-party circuits and equipment
- Establish telephone services to the new Control building and the new Telecoms building
- Lease additional cores on Ergon fibres (FOCE 12, FOCE_203, FOCE 20, FOCE 3, FOCE 322) to provide connectivity for SDH Links (PQ *leases fibres from Ergon to provide connectivity to some remote sites).*
- Decommission 48V DC system in the old building.
- Decommission Telecoms equipment and fibres in the old building.
- Decommission redundant third-party circuits and equipment.
- Design of [redacted] MPLS/SIP network.

- Deployment of Site Server with virtualised firewall.
- Migration of SCADA circuits from SDH to MPLS/SIP.
- Implementation of Shared Services Network (OpsWAN).
- Integration of protection relays into OpsWAN
- Integration of VOIP
- Decommission and recover all redundant equipment.
- Update drawing records, SAP records, config files, etc., accordingly.

4.1.2 Scope Assumptions

The following key assumptions were made for the Project Estimate.

- All asbestos will be removed prior to Site Mobilisation.
- Internal design resources are available as required.
- No Restricted Access Zone will be deployed on this site during construction.
- Access to network and outage management resources is available.
- All existing equipment (including cables) is in good condition and working order.
- MSP will be available as required to complete the works.
- Interface between Energy Queensland and Powerlink.
- SPA contractor is available when required to meet the approved commissioning date.
- All works at the remote end substations will be completed by the MSP.
- Energy Queensland design and construction resources will be available when required for remote end works.
- PLQ project and support resources are available to align with the project timing to support meeting the approved commissioning date
- Timely agreement of Division of Responsibility (DOR) between Energy Queensland and Powerlink for all the works involved.
- Existing ground conditions are suitable for planned construction activities.
- The combined control/amenities building and telecommunications building can be lifted and manoeuvred within the substation and installed without modification of the existing platform.
- There is sufficient space to install a septic system and water tank.
- The existing switchyard has sufficient space to accommodate new buildings and services.
- The existing cable trench/conduit system shall be reused/extended to suit the new control building and secondary systems replacement.
- The geotechnical investigation report for the substation (carried out by Douglas Partners in 2004) is sufficient for the design of footings.
- Firewall footings are assumed to be pad footings.
- Telecommunications panels will be installed in the new building.

4.1.3 Scope Exclusions

- No allowance is included for any Energy Queensland projects that may impact Powerlink works.

- No work is required on the existing ACCO located on the first floor.
- This estimate does not include any costs for repairing or modifying the primary plants not listed to be replaced under the scope.
- Live Subs resources.
- No allowance for the upgrade of the substation earth grid.
- No consideration for the location and layout of the existing conduits and underground cables.
- Removal of rock.
- Removal of asbestos.
- Any delays, costs or cost increases not within the control of Powerlink.
- Any work outside of normal working hours.
- Costs associated with expediting manufacturing, delivery of plant, equipment and material.
- Extreme weather or impacts thereof.
- Fluctuation in foreign exchange rates.

4.1.4 Proposed Building Location

- Location of new control/amenities building and telecommunications building to be adjacent to transformers, with a firewall in between.

Figure 4: Proposed Building Location

4.2 Project Execution

4.2.1 Project Schedule

A High-Level Project Schedule has been developed for the project stages:

Milestones	High-Level Timing
Class 5 Project Proposal Submission	August 2025
Request for Class 3 Estimate	September 2025
Class 3 Project Proposal Submission	March 2026
RIT-T (assumed 26 weeks)	June 2026 – December 2026
Stage 1 Approval (PAN1) includes funds for design & procurement	May 2026
ITT Submission (8 Weeks)	September - October 2026
Evaluate Tender, Reconcile Estimate and Submit proposal for Stage 2 Approval	November 2026
Full Project Approval (PAN)	December 2027
Site Mobilisation	April 2027
Project Commissioning	October 2028

4.2.2 Network Impacts

- All feeders to/from Alan Sheriff, which includes Garbutt feeders, will need to be considered. Garbutt's impact is to be considered given these feeds, EQL's new GIS board.
- Outages to be scheduled in shoulder and winter periods – Late April;/May to October.
- PLQ Outage Management to consider a prolonged bus outage (with a quick RTS) at T150 Alan Sherriff. The plan is to execute CP.02400 and CP.02841 simultaneously, given outages on Feeder 7240 & F7239 at Alan Sherriff will impact Garbutt. Awaiting response from PLQ Outage Management.

4.2.3 Resourcing

The following resource strategy is proposed:

- Design by PLQ
- SPA – Civil works (Construct only)
- MSP (core works including all cutover, testing and commissioning)

4.3 Project Estimate

			Sub Total $	Total $
Estimate Class	5			
Estimate accuracy (+% / -%)	- 50% / + 100 %			
Base Estimate			$15,298,720	
[redacted]			[redacted]	
[redacted]				[redacted]
[redacted]	[redacted]		[redacted]	
[redacted]	[redacted]		[redacted]	
[redacted]				[redacted]
[redacted]				[redacted]

5. Risks

Description	Impact	Likelihood	Mitigation Strategy
Availability of Resources: • Contractor (Minor Civil) • MSP (OSD)	Major	Moderate	Engage in early and ongoing discussions with Network Operations and Customers.
Asbestos Management Plan Restrictions: • The existing Garbutt Control buildings' asbestos management plan does not allow the use of existing cable penetrations. • This means that pulling cables and fibres must be done via alternate pathways. Also, the asbestos management plan restricts modifications to the structure of the building. • MSP has deemed working in the building is unsafe until such time the business determines how the issues will be rectified and managed going forward to allow the completion of the project, as well as future operational requirements.	Major	Moderate	Engage in early discussions and ongoing discussions with the Network Business Development team and the the Safety Team from EQL and Powerlink.
Decommissioning Challenges: • Due to asbestos risk, the removal of cables and any equipment might not be possible. In such cases, some of this equipment may need to be signed decommissioned and left in situ.	Medium	Possible	Engage in early discussions and ongoing discussions with the Network Business Development team to include in the project scope if required.
Change in project delivery strategy due to: • Network Outage Change • Staging Change • Change of design from PLQ to design by SPA • Latent conditions for Civil Works	Medium	Possible	Review Strategy, staging, outage and design on an ongoing basis
Wet weather impacts during construction.	Major	Likely	Project timing is to be planned to minimise work during the wet season (November to early April).
RIT-T process (assumed duration 26 weeks): Any delays to this process will directly impact the commissioning date.	Major	Possible	Maintain communication with the Sponsor during RIT-T so that any foreseeable delay can be managed appropriately.
Delivery Issues: • Delivery strategy change - Outage staging and MSP Changes	Medium	Possible	Engage with EQ early for outage opportunities.

6. References

Document	Version	Date
Project Scope Report	4.0	19/03/2025

Risk Cost Summary Report

CP. 02841

Garbutt Secondary Systems Replacement

Document Control

Change Record

Issue Date	Revision	Prepared by
23/12/2025	1.0	Asset Strategies

Related Documents

Issue Date	Responsible Person	Objective Document Name

Document Purpose

The purpose of this model is to quantify the base case risk cost profiles for the secondary systems at Garbutt substation which are proposed for reinvestment under CP.02841. These risk cost profiles are then included as part of the overall cost-benefit analysis (CBA) to understand the economic benefit of the proposed infrastructure upgrades. This process provides a benchmarking and internal gate process to support Powerlink in effectively identifying prioritised infrastructure upgrades.

The CBA was designed to demonstrate and quantify the value to be gained through specific infrastructure investments. To evaluate the CBA, an NPV is derived based on the present values of costs and benefits. The flow chart in Figure 4 below designates the methodology used in designing the CBA process.

Key Assumptions

In calculating the risk cost arising from a failure of the ageing secondary systems equipment at Garbutt substation, the following modelling assumptions have been made:

- Whilst the re-investment scope of secondary system upgrade projects contains a range of supporting devices (i.e network switches, firewalls and human machine interfaces), for simplicity of risk cost modelling only main protection relays, bay controllers and RTUs were considered.
- Spares for secondary system equipment have been assumed to be available prior to the point of expected spares depletion, which coincides with the expected technical asset life (20 years). After this point the cost and time to return the secondary system back to service increases significantly.
- When calculating network risk cost, it has been assumed that after 24 hours of any network element being protected by a single protection system (due to failure of the alternate system) the Australian Energy Market Operator (AEMO) will direct Powerlink to de-energise the network element.
- A site-specific value of customer reliability (VCR) of $26,220 has been applied when calculating network risks.

Base Case Risk Analysis

Risk Categories

For this project, two main categories of risk are assessed as per Powerlink's Asset Risk Management Framework:

- Financial Risk
- Network Risk (including market impact if applicable)

Table 1: Risk categories

Risk Category	Failure Type	Equipment in Scope
Financial Risk	Failure of the equipment resulting in emergency onsite replacement	All equipment
Network Risk	Failure of equipment resulting in de-energisation of network elements after 24 hours	Main protection relays only

Base Case Risk Cost

The modelled and extrapolated total base case risk costs are shown in Figures 1 and 2 below.

Risk costs associated with the equipment in scope are expected to increase from $0.22 million in 2026 to $0.37 million in 2036 and $0.58 million by 2045. Key highlights of the analysis include:

- Financial risk accounts for approximately 72% of the overall risk cost in 2030 with network risk accounting for the remaining 28%.

Figure 1: Total risk cost

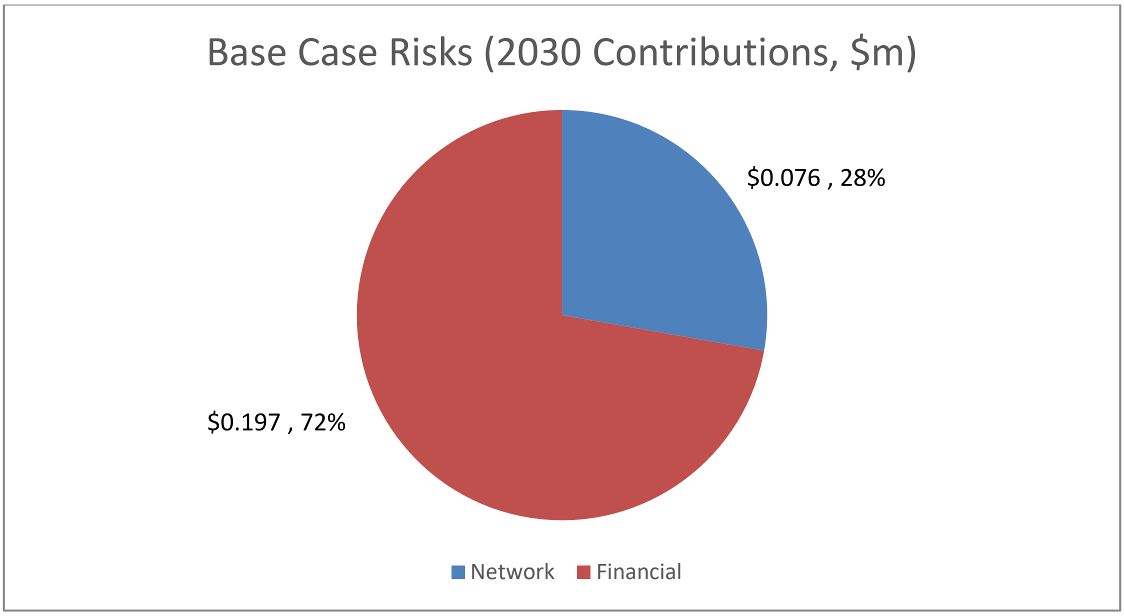

Figure 2: Base case risk cost by contributions (2030)

Option Risk Cost

For modelling purposes, the replacement of equipment at the Garbutt substation reduces the probability of failure to zero in the year after investment, resulting in a lower risk cost.

The figures below set out the total project case risk cost, and associated risk cost savings incremental to the base case.

Figure 3: Project Option Risk Cost (compared to base case)

Following the investment, risk cost grows slowly over time as it is assumed sufficient spares are available resulting in lower responsive costs and shorter outage durations.

Cost Benefit Analysis

The methodology designed for the cost benefit is set out as per Figure 4 below.

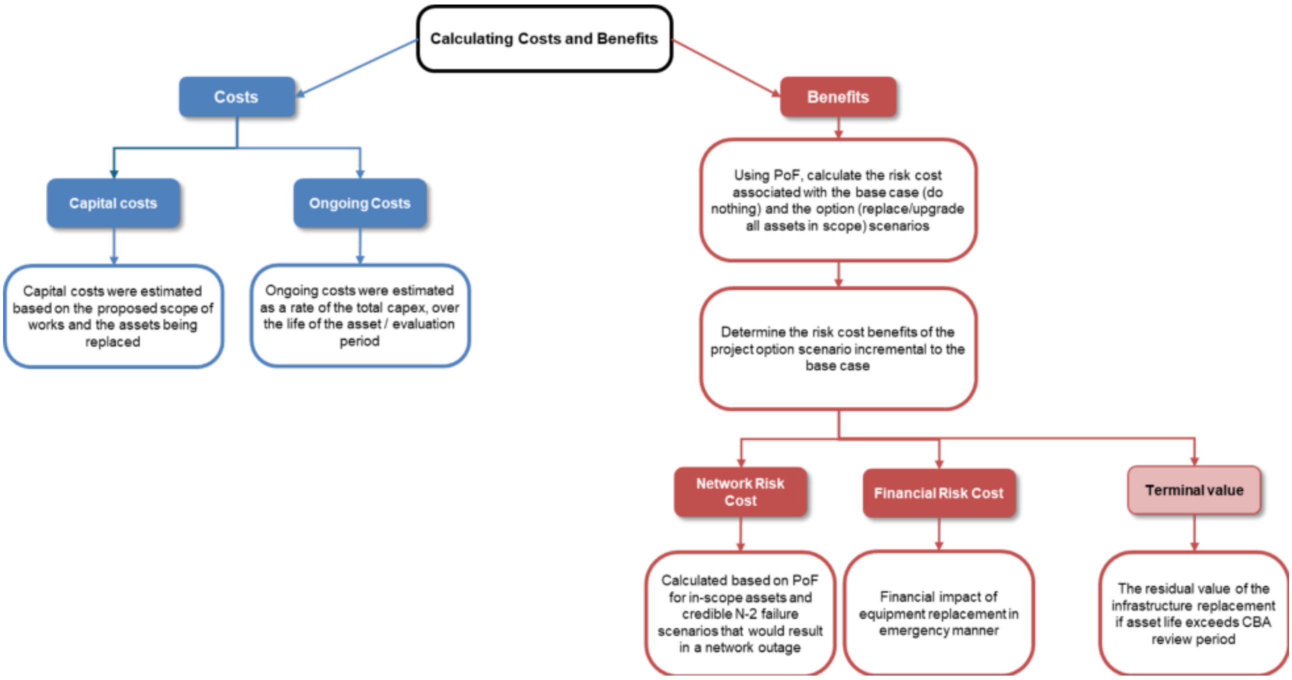

Figure 4: CBA methodology

The project is estimated to cost approximately $10.7 million resulting in a negative NPV and benefit-cost ratio (BCR) less than 1 as per table 2 below.

Table 2: Net Present Value and Benefit-Cost Ratio

		Present Value Table ($m)		
Discount rate	%	**3%**	**7%**	**10%**
NPV of Net Gain/Loss	$m	-$5.5	-$6.07	-$6.12
Benefit-Cost Ratio	ratio	0.45	0.32	0.25

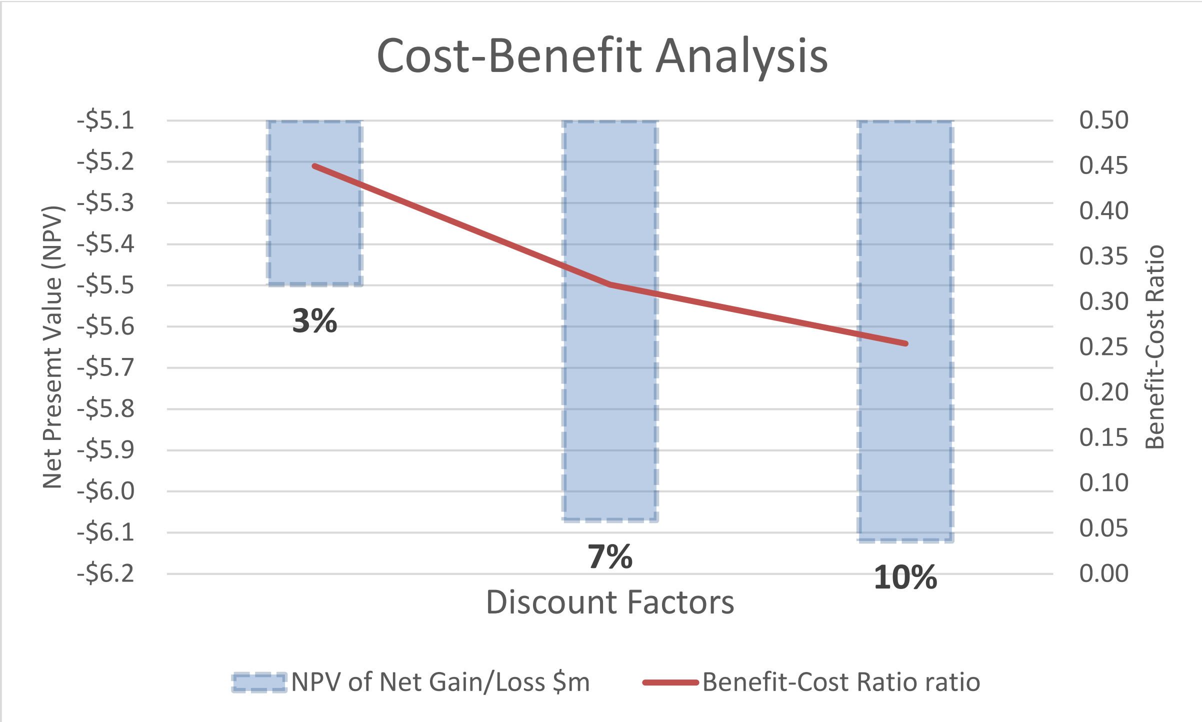

Figure 5: Cost benefit summary

Participation Factors

A sensitivity analysis was undertaken to determine the participation factors for key inputs to the risk cost models (i.e. to identify which inputs are most sensitive to overall risk cost).

The participation factor is defined as the ratio of percentage change in output (i.e. risk cost) to a percentage change in input (e.g. VCR). The participation factors for key model inputs are shown in the table below.

Due to the non-linear nature of the risk cost model (especially network risk costs, which are a function of concurrent failures), the participation factor can change depending on the magnitude of input percentage change.

The model is most sensitive to:

- **changes in the restoration time of a relay with no spares** (halving the restoration time) results in a decrease in risk cost of $0.06 million, or approximately 22.3% of the original base case risk (at 2030).
- **changes in bay controller emergency replacement cost** (halving the cost) results in a decrease in risk cost of $0.06 million, or approximately 21.95% of the original base risk (at 2030).

Table 3: Participation Factors

Input	Baseline value	Sensitivity value (-50%)	Change in risk cost at 2030 ($m)	Participation (%)
Network				
VCR ($/MWh)	26220	13110	-0.04	-13.89%
Restoration Time with spares – Relay (days)	2	1	0.00	0.0%
Restoration Time with no spares – Relay (days)	10	5	-0.06	-22.29%
Financial				
Emergency replacement cost with spares - Relay ($m)	0.02	0.01	0.00	-0.15%
Emergency replacement cost without spares – Relay ($m)	0.09	0.05	-0.04	-13.73%
Emergency replacement cost with spares – Bay Controller ($m)	0.02	0.01	0.00	-0.28%
Emergency replacement cost without spares – Bay Controller ($m)	0.20	0.10	-0.06	-21.95%