January 2026

Powerlink 2027-32 Revenue Proposal

Project Pack

CP.02756 Molendinar Secondary Systems Replacement

Project Status: Unapproved

Network Requirement

H031 Molendinar Substation, located approximately 75km south-west of the Brisbane CBD, is one of two major injection points into the Gold Coast area. It was established in 2003 and is supplied from Greenbank Substation by a 275kV double circuit transmission line. The circuits are transformer ended by two 375MVA 275/110kV transformers. The Energy Queensland 110kV network from Molendinar to Mudgeeraba links the coastal bulk supply points at Southport, Surfers Paradise, Broadbeach and Merrimac via an underground cable network. An inland overhead 110kV network supplies Robina and Nerang substations to the south and Cades County Substation to the north.

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.

A condition assessment of the Molendinar substation secondary systems identifies various secondary systems components that require replacement [1]. In addition to the site-specific impacts of obsolescence at Molendinar 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.

Powerlink's 2025 Central scenario forecast confirms there is an enduring need to maintain electricity supply into the Gold Coast zone. The removal or reconfiguration of the Molendinar 275/110kV Substation due to secondary system failure/obsolescence would violate Powerlink's N-1-50MW/600MWh Transmission Authority reliability standard and significantly impact the power transfer capability into the Gold Coast [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.

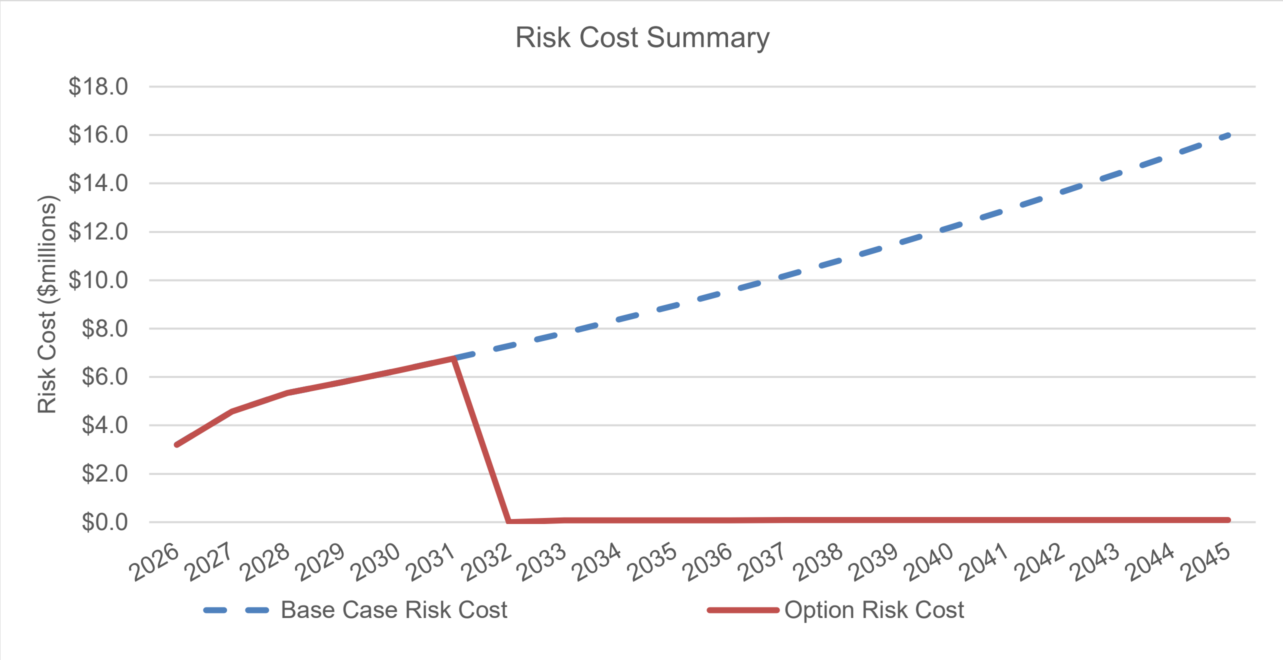
The current recommended option based on the complexity of in situ replacement and network constraints is for full replacement of secondary systems by December 2030 [3].

Options considered but not proposed include:

- Replacement of some secondary systems and decommission some functionality – this option would require additional transformer capacity at Mudgeeraba and Loganlea and additional 110kV network capacity between Mudgeeraba and Loganlea and is not cost effective.

Figure 1 shows the current recommended option reduces the forecast risk monetisation profile of the Molendinar Substation secondary systems from around $6.75 million per annum in 2031 to less than $0.05 million from 2032 [5].

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



Cost and Timing

The estimated cost to replace secondary systems at Molendinar substation is $52.6m ($2025/26) [4].

Target Commissioning Date: February 2031.

Document in CP.02860 Project Pack

Public Documents

1. H031 Molendinar Secondary Systems Condition Assessment Report
2. CP.02756 Molendinar Secondary Systems Replacement – Planning Statement
3. CP.02756 Molendinar Secondary Systems Replacement – Project Scope Report
4. CP.02756 Molendinar Secondary Systems Replacement – Concept Estimate
5. CP.02756 Molendinar Secondary Systems – Risk Cost Summary Report

H031 Molendinar
275kV / 110kV Substation

Secondary Systems Condition Assessment Report

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1. Introduction

H031 Molendinar Substation is one of two major injection points into the Gold Coast area. It was established in 2003 and is supplied from Greenbank Substation by a 275kV double circuit transmission line. There is currently no 275kV bus, with two 275/110kV transformers supplied transformer ended and each having a normal rating of approximately 375MVA. The 110kV network from Molendinar to Mudgeeraba links the coastal bulk supply points at Southport, Surfers Paradise and Broadbeach via an underground cable network and an inland overhead 110kV network supplies Robina and Nerang substations.

Molendinar substation is located at 706 Ashmore road, Nerang, approximately 75km south-west of Brisbane CBD. The substation is comprised of two switchyards:

1. The 275kV switchyard, which has a 275kV double circuit transmission lines from Greenbank substation, supply the 110kV switchyard via two 275/110kV 375MVA transformers, and

2. The 110kV switchyard, which includes 3 X 110/33 kV 100MVA transformers supplies to Energex, 2 X 110 kV connections to Energex 110/11kV transformers, two voltage support capacitor banks and 7 x 110kV feeders links the coastal bulk supply points at Southport, Surfers Paradise and Broadbeach via an underground cable network.

The main purpose of this report is to assess the condition of secondary systems assets (equipment, sub-systems and systems) and to recommend the optimal reinvestment timing for these assets. The recommendations in this report have been based on the condition of these assets only, excluding considerations for network reconfigurations, network enduring needs, economic options, engineering solutions and delivery methodologies.

Molendinar Substation primary equipment bays include:

Substation:

Table 1 – Molendinar Substation Network Elements

Local Substation (H031 Molendinar)					Remote Substation
	Voltage (kV)	**Quantity**	**Bay Designation**	**Operational Element**	
Feeders	275	2	=C02	8824	S003 - Greenbank
			=C03	8825	S003 - Greenbank
	110	9	=D12-A20	F916	SSSPD Surfers Paradise (U/ground)
			=D13-A10	F917	SSSPO Southport (U/ground)
			=D22-A10	7297	T081Cades County (Energex)
			=D22-A20	F907	SSSPO Southport (Energex)
			=D27-A10	7193	T081 Cades County (Energex)
			=D28-A10	7229	T128 Robina (Energex)
			=D31-A10	798	T075 Nerang (Energex)
			=D33-A10		SSMDR Molendinar 110/11kV T6 Transformer (Energex)
			=D34-A10		SSMDR Molendinar 110/11kV T4 Transformer (Energex)

Capacitor Banks	110	2	=D32-A20	Cap 3	
			=D04-A20	Cap 4	
			=D19-A10	Cap 5 (Mothballed)	
Reactors		0			
Transformers	275/110	2	=C01 (HV) =D04-A10 (LV)	T1 TFMR	110 kV Bay = D04
			=C02 (HV) =D07-A10 (LV)	T2 TFMR	110 kV Bay = D07
	110/33	3	=D10-A10	T10 TFMR	Energex Substation
			=D21-A10	T11 TFMR	Energex Substation
			=D26-A10	T12 TFMR	Energex Substation
Busbars	275	0			
	110	3	=KD1	1 Bus	
			=KD2	2 Bus	
			=KD3	3 Bus	

Figure 1 – 275 kV / 110kV Molendinar Substation Aerial View

2. Inclusions and Exclusions

2.1 Inclusions

Secondary systems and associated equipment provide monitoring, supervision, control and protection functions. 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 Panel 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. PLCs and Intelligent Electronic Devices (IED), regardless of their installed location (could be in transformer and circuit breaker control kiosks) are considered as secondary systems equipment.
- 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 key parts – Desktop assessment based on [1, 2] and site visual inspection. The latter is considered more subjective than the former.

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 totally depends on site visual inspection, which provides crucial information for moderation and manual update of desktop assessments to ensure that the assessment reflects the actual condition of operational equipment at site.

The desktop assessment models equipment health indices based on the optimisation of risk, cost and measured performance of Powerlink' s secondary assets over period of sixteen years – from 1999 to 2015 as detailed in [1]. Equipment health index is the key condition measurement for each equipment in service. The Health Index methodology takes into account failure rate of individual equipment makes and models, calculated based on recorded operational data (SAP and RIN), environmental conditions where the equipment is installed and the mean physical ages of a group of equipment at the bay and system (fleet) level. It was found in [1] that the physical ages of individual equipment do not provide reliable information on the reliability and availability of secondary systems assets at the bay and system level, but only reliability of individual equipment make and model. Instead, the mean physical ages of a group of equipment, at bay or system level, correlate very well with the secondary systems reliability and availability to service the power system. The failure rates of individual equipment make and model can be used to trigger projects to replace a particular equipment make and model installed at multiple sites when that model becomes obsolete and spares are depleted. In this report, the recommended reinvestment timing of secondary systems assets have been optimised based on the mean physical ages of a group of equipment, at bay or system level, taking into account of Powerlink's ability to manage the obsolescence of equipment make and model and appropriate spare holding as Business As Usual (BAU).

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 optimum replacement ages. According to [1], the optimum replacement ages for Powerlink' s secondary systems assets signify an optimal replacement time period just before the secondary systems availability and reliability, at bay level, start to transition to a rapidly declining trajectory. Generally, equipment with condition scores close to ten represent moderate increase of functional failures, but longer outage duration and significantly higher risk of impacting system's availability and reliability. Findings in [1] concluded that delaying replacement of secondary systems assets beyond the optimal replacement timeframe does not always result in higher mal-tripping of network elements, but does lower secondary systems availability and reliability. It is important to note that not every functional failure will necessarily result in an outage to a network element, but it does represent the loss of some of the normal functions of the protection and control system[1] and can contribute to forced outage events of network elements.

The key outcome of this report is the recommended optimal replacement timing for secondary systems assets and equipment, as detailed in the Asset Strategies Recommendations and the Appendix sections, 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, some equipment with health indices close to ten may not need to be replaced urgently if 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

The substation secondary systems are housed in three (3) demountable control buildings +6, +7 and +8, except a small quantity of OpsWAN equipment are still housed in the communication equipment room in building +T. Demountable control buildings and telecommunications room in building +T are air-conditioned and clean. All buildings associated with the substation are located within the substation perimeter fence, including the work shed.

Details of Substation buildings are shown in Table 2.

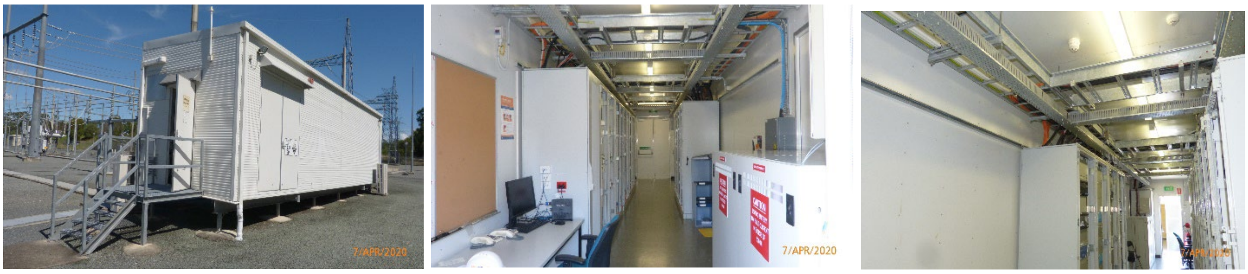
Table 2 – Molendinar Substation Buildings

Building Description	Designation	Functional Use	Spare Sec Sys Panel Spaces
Brick Control Building +T	+1	Comms and some OpsWAN equipment, amenities	0
Substation Secondary System Building +6	+6	Sec Sys Bus =KC1 (1BZ CBF BT) Sec Sys Bays =C02, =D01, =D04, =D10, =D12, =D14 Revenue Meters Mux Communications Protection Signalling Station SCADA (NSC, LCF), Common RTU & OpsWAN 125V X&Y Batteries and Chargers	11 (Includes 1 Decommissioned Panel)

[1] *The functions that could be unavailable include auto-reclose, automatic voltage control, emergency voltage control, protection signalling, SCADA, remote control or others.*

Substation Secondary System Building +7	+7	Sec Sys Bus =KC2 (2BZ CBF BT) Sec Sys Bays =C03, =D07, =D13, =D19, =D21, =D27, =D31, =D33, Revenue Meters Mux Communications Common RTU & OpsWAN 125V X&Y Batteries and Chargers	10 (Includes 1 Decommissioned Panel
Substation Secondary System Building +8	+8	Sec Sys Bus =KC3 (3BZ CBF BT) Sec Sys Bays =D02, =D22, =D26, =D28, =D32, =D34 Mux Communications Common RTU & OpsWAN 125V X&Y Batteries and Chargers	14
Work shed	+9	Maintenance Workshop	N/A

(a) Telecommunications and Amenity Building +T



(b) Demountable Control Building +6

(c) Demountable Control Building +7

(a) Demountable Control Building +8

Figure 3 – H031 275/132kV Molendinar Substation secondary systems Buildings

5. Condition Assessment

5.1 Secondary System Outdoor Marshalling Kiosks

Switchgears at Molendinar substation are PASS-M0 modules, except 12 TFMR CB 44122 in bay =D26 is a deadtank breaker. Generally, PASS-M0 switching bays do not have standalone bay marshalling kiosks. The PASS-M0 control cubicle performs as the switching bay marshalling kiosk and switchgear control cubicle. The deadtank breaker in bay =D26 has a standalone bay marshalling kiosk. Otherwise, most outdoor marshalling cubicles are for buszone CT summation, VTs, AC and DC circuitries. It is noted that the bay most AC and DC cubicles at this site are mounted on the structure of PASS-M0 switchgears.

The condition assessment of PASS-M0 control cubicles, which belong the primary plant, are not in scope of this report. Other standalone marshalling cubicles, including CTs, VT, AC and DC, were installed between 2003 and 2007. They are still in serviceable condition and should last until 2043/44. However, some internal components such as links, terminals and MCBs have shown signs of deterioration due to dust, heat and humidity environmental conditions. These cubicles have door seals and air filters to protect internal components from dust. Cubicle door seals and air filters appear to be made from low quality / unsuitable materials. Some door seals and most air filters have significantly degraded / disintegrated and should be replaced as part of routine maintenance. It is recommended that all outdoor marshalling kiosks be monitored as part of the substation routine inspection to identify any aggressive deterioration of internal components. An operational project (or maintenance work order) should be initiated to tighten up screw terminals and / or replace the degraded internal components if they deteriorate beyond Powerlink' s safety standards or pose any safety concerns.

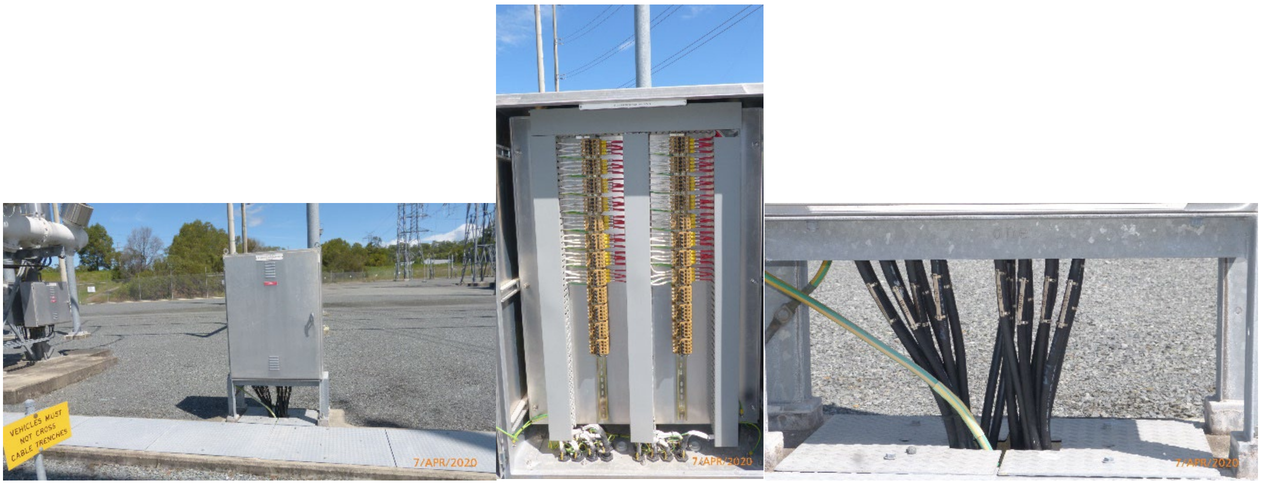
Health Indices of secondary system outdoor marshalling kiosks and recommended replacement timeframe have been detailed in **Appendix A**. Physical appearance of typical outdoor marshalling kiosks and air filters are illustrated below:

- Bay Marshalling kiosk, CT, VT, AC, DC and Interface Kiosks: in Figure 4, include:
  - 12 TFMR Deadtank CB Marshalling Kiosk (+D26-A10),
  - 2 Bus CT Summation Marshalling Kiosk (+RD2-A10),

  - Interface Marshalling Kiosk to Energex Switchyard (+U20-A10),
  - 3 Bus 8 VT Marshalling Kiosk (+KD3-A10) ,
  - CB79172 (F917 Southport) AC (+D13 A91) and DC (+D13 A92) Marshalling Kiosks mounted on PASS-M0 structure,
  - Feeder 7297 9VT (+D22-A14).

- Degraded Cubicle Air Filters: in Figure 5.
  - Degraded cubicle air filters (various bays).

(a) 12 TFMR Deadtank CB Marshalling Kiosk (+D26-A10)



(b) 2 Bus CT Summation Marshalling Kiosk (+RD2-A10)

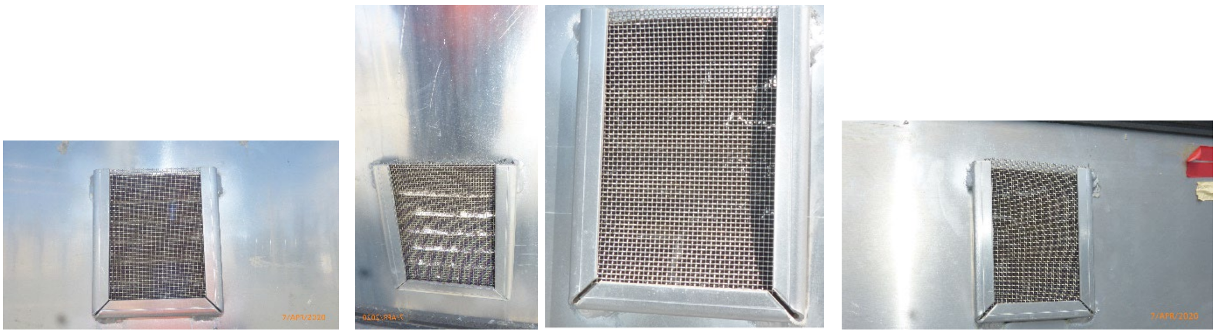
(c) Interface Marshalling Kiosk to Energex Switchyard (+U20-A10)

(d) 3 Bus 8 VT Marshalling Kiosk (+KD3-A10)

(e) CB79172 (F917 Southport) AC (+D13 A91) and DC (+D13 A92) Marshalling Kiosks

(f) Feeder 7297 9VT (+D22-A14)

Figure 5 – Physical appearance of typical outdoor CT, VT, AC and DC, Interface marshalling kiosks at Molendinar substation



(g) Degraded cubicle air filters

Figure 5 – Physical appearance of typical outdoor marshalling kiosks' degraded air filters at Molendinar substation

5.2 Outdoor Secondary System Cables

The majority of control and protection cables were terminated directly between secondary systems indoor panels and PASS-M0 switchgear control cubicles – no building termination racks. Visual inspection of these cables indicated they are still in good condition, as shown in Figure 6, and can be kept in service until 2043/44.

Figure 6 – Physical appearance of typical outdoor secondary system cables

5.3 Indoor Termination Racks / Yard Interface Cubicle

There are no termination racks at Molendinar substation. Secondary system cables were installed directly between the indoor panels and outdoor marshalling kiosks. Therefore, new external termination racks may be required and installed external to the existing control buildings to ease construction and labour efforts required for the secondary system replacement projects.

5.4 Indoor Secondary System Cables

All cables inside the control buildings are considered to be in good condition as they have been in clean and air-conditioned environment since installed between 2003 – 2007. The replacement of indoor cables is deemed unnecessary until 2043/44 unless Powerlink' s standard secondary system solutions dictate so.

5.5 Control and Protection Systems

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

5.5.1 Secondary Systems Panels

All secondary systems panels, including auxiliary parts e.g. links, terminals and internal wiring were installed between 2003 – 2007, including the High Speed Monitoring and Power Quality System (IDM Qualitrol) was installed in 2010, are currently still in good condition. Secondary systems panels, internal wirings, links and terminals can be left in service until 2043/44.

SCADA & OpSWAN =D14 1-3 Bus Coupler =D13 Feeder F917 =C03 275kV T2

=D26, T12 =KD3 – 3 Buszone High Speed Monitoring =D04 Cap 4

Figure 7 – Typical Indoor Secondary Systems Panels at Molendinar Substation

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

5.5.2.1. Control, Protection, Auxiliary, Ancillary Equipment

Molendinar Substation secondary system comprises mostly microprocessor based control and protection equipment. There is a small number of modern solid state and electro-mechanical relays being used e.g. CB Fail Bus Trip relays and high impedance bus zone relays. Health indices and recommended replacement timeframe for substation secondary system equipment and associated ancillary equipment are tabled in Appendix A.

Figure 8 – Molendinar Substation Typical Indoor Secondary System Equipment (2003 - 2007)

5.5.2.2. Revenue Metering Panels

Molendinar Substation revenue-metering panels, including auxiliary parts e.g. links, terminals and internal wiring were installed between around 2005 and currently still in good condition. Panels, internal wirings, links and terminals can be left service until 2043/44.

Figure 9 – Molendinar substation typical revenue metering panels

5.5.2.3. Revenue Metering Equipment

Molendinar Substation metering equipment was installed mostly in 2005. Revenue meters should only be replaced as part of the secondary system replacement project, anticipated in 2026/27.

Figure 10 – Molendinar substation typical revenue meters

5.5.2.4. OpsWAN Systems and Equipment

OpsWAN systems and equipment at this site were installed between 2003-2007. A number of equipment, e.g. switches, port servers and routers were replaced between 2010 – 2019. 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 impacts 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 (outdoor OpsWAN equipment) should only be replaced under corrective maintenance when they fail and shall be excluded from secondary system refurbishment projects.

+T Master OpsWAN | +6 OpsWAN, LCF NSCs | +7 OpsWAN & CommonRTU | +7 OpsWAN & CommonRTU

Figure 11 – Molendinar Substation OpsWAN Panel

Figure 12 – Molendinar 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

Molendinar Substation have three (3) sets of 125VDC X and Y batteries and associated chargers installed between 2006 and 2017 as detailed in the Appendix A. Generally, there is one set of duplicated batteries and chargers per secondary system building. According to the requirements of secondary systems and telecoms asset strategies, substation DC batteries' lifespan are now set at 12 years and chargers' lifespan would be set at 20 years. Therefore, batteries, chargers and monitors at Molendinar Substation should be replaced as per recommendation in Appendix A.

(Buildings +6 – Chargers, Monitors, DC Distribution 2009, Batteries 2017)

(Buildings +7 – Chargers, Monitors, DC Distribution 2006, Batteries 2006)

(Buildings +8 – Chargers, Monitors, DC Distribution 2006, Batteries 2006)

Figure 12 – Molendinar Substation 125VDC Batteries and Chargers

6. Secondary Systems Asset Strategies Recommendations

The recommendations below have been strategically optimised based on the replacement timing (condition based timing) of individual equipment Health Indices (HIs) in Appendix A. It represents secondary system asset strategies view for consideration only, not mandatory. 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 3 – Recommended Asset Replacement Timing and Options – Building +6									
Indoor Sec Sys Panels (11 spare panel spaces)					Possible Options	Outdoor Kiosks (Excl. Primary plant)			
ID	Functions	Panel	Equipment	Cables		ID	Functions	Panel	Cables
+6A5	1 Bus Zone CBF BT	2046	2026	2046	A, B, C	+RD1-A1	1 Bus MK	2046	2046
+6A6	Feeder 8824 Greenbank (=C02),16VT	2046	2026	2046	A, B, C	+C02-A13	16 VT	2046	2046
+6A7	Feeder 8824 Greenbank Protection Signaling	2046	2026	2046	A, B, C				
+6A8	1 TFMR (275/110kV) HV (=C02)	2046	2026 (incl. TFMR PLC)	2046	A, B, C				
+6A15	1-3 Bus Section CB 4122 (=D14)	2046	2026	2046	A, B, C	+D14-A10	Hybrid	PASS M0	2046
+6A16	1-2 Bus Section CB 4112 (=D01)	2046	2026	2046	A, B, C	+D01-A10	Hybrid	PASS M0	2046
+6A17	10 TFMR (110/33kV) HV CB 44102 (=D10)	2046	2026	2046	A, B, C	+D10-A10	Hybrid	PASS M0	2046
+6A18	Feeder F916 Surfer Paradise CB 79162 (=D12)	2046	2026	2046	A, B, C	+D12-A24	7 VT	2046	2046
+6A19	1 TFMR (275/110kV) LV CB 4412 (=D04) 3VT 4VT	2046	2026	2046	A, B, C	+D04-A10	Hybrid	PASS M0	2046
+6A20	4 Cap CB 4842 (=D04), 5VT	2046	2026	2046	A, B, C	+D04-A20	Hybrid	PASS M0	2046
+6A21	=D08 Bus Coupler (Electrically Disconnected) – To be decommissioned and removed								
+6A22	Revenue Meters (T1 110kV, F916 S/Paradise, T10 33kV)	2046	2026	2046	A, B, C				
+6A23	Building +6 - 110 kV Multiplex Communications	Please Consult Telecommunication Asset Strategies							
+6A24	Building +6 - Station SCADA (NSCs, LCF), Aux Control, Timing, OpsWAN & Common RTU	2046	2026	2046	B, C				
+6A27	Building +6 - 125VDC (X & Y) Batteries, Monitors and Chargers: X Battery		2029		B,C				
	Y Battery		2029		B,C				
	X DC Monitor & Charger		2029		B,C				
	Y DC Monitor & Charger								
	DC Distribution board								

Table 4 – Recommended Asset Replacement Timing and Options – Building +7

Indoor Sec Sys Panels (10 spare panel spaces)					Possible Options	Outdoor Kiosks (Excl. Primary plant)			
ID	**Functions**	**Panel**	**Equipment**	**Cables**		**ID**	**Functions**	**Panel**	**Cables**
+7A1	2 Bus Zone CBF BT	2046	2026	2046	A, B, C	+RD2-A10	2 Bus CT MK	2046	2046
+7A2	Feeder F917 Southport CB 79172 (=D13)	2046	2026	2046	A, B, C	+D13-A14 +D13-A91 +D13-A92 +D13-A10	10 VT AC MK DC MK Hybrid	2046 2046 2046 PASS M0	2046 2046 2046 2046
+7A3	Feeder 7193 Cades County CB71932 (=D27), 12VT	2046	2026	2046	A, B, C	+D27-A14 +D27-A10	12VT Hybrid	2046 PASS M0	2046 2046
+7A4	Feeder 798 Nerang CB7982 (=D31), 14VT	2046	2026	2046	A, B, C	+D31-A14 +D31-A10	14VT Hybrid	2046 PASS M0	2046 2046
+7A5	5 Cap CB 4852 (=D19) – To be decommissioned and removed								
+7A6	2 TFMR (110/33kV) LV CB 4422 (=D07), 15VT	2046	2026	2046	A, B, C	+D07-A14 +D07-A10	15 VT Hybrid	 PASS M0	2046 2046
+7A7	High Speed Power Monitoring and Power Quality Meters	2046	2026	2046	A, B, C				
+7B1	Building +7 - Aux Control, Timing, OpsWAN & Common RTU	2046	2026	2046	A, B, C				
+7B2	Building +7 - 110 kV Multiplex Communications	Please Consult Telecommunication Asset Strategies							
+7B3	Revenue Meters (F917 Southport, Fdr 7193 Cades County, Fder 798 Nerang, Energex TFMR 6)	2046	2026	2046	A, B, C				
+7B4	Revenue Meters (11 TFMR 33kV, 2 TFMR 110kV)	2046	2026	2046	A, B, C				
+7B5	11 TFMR (110/33kV) HV CB 44112 (=D21)	2046	2026	2046	A, B, C	+D21-A10	Hybrid	PASS M0	2046
+7B6	Stub CB 4462 (=D33) 2 Bus To Energex TFMR T6 (110/11kV)	2046	2026	2046	A, B, C	+D33-A10	Hybrid	PASS M0	2046
+7B7	Feeder 8825 Greenbank (=C03),17VT	2046	2026	2046	A, B, C	+C03-A13	17 VT	2046	2046
+7B8	2 TFMR (275/110kV) HV (=C03)	2046	2026 (incl. TFMR PLC)	2046	A, B, C				
+7C1	Building +7 - 125VDC (X& Y) Batteries, Monitors and Chargers: X Battery	ASAP (e.g. Battery OR Project)			B				
	Y Battery	ASAP (e.g. Battery OR Project)			B				
	X DC Monitor & Charger	2026			B,C				
	Y DC Monitor & Charger								
	DC Distribution board								

Table 5 – Recommended Asset Replacement Timing and Options – Building +8

Indoor Sec Sys Panels (14 spare panel spaces)					Possible Options	Outdoor Kiosks (Excl. Primary plant)			
ID	**Functions**	**Panel**	**Equipment**	**Cables**		**ID**	**Functions**	**Panel**	**Cables**
+8A1	3 Bus Zone CBF BT	2046	2026	2046	A, B, C	+RD3-A10	3 Bus CT MK	2046	2046
+8A2	Feeder 7297 Cades County CB72972 (=D22), 9VT	2046	2026	2046	A, B, C	+D22-A14 +D22-A10	9 VT Hybrid	2046 PASS M0	2046 2046
+8A3	Feeder F907 Southport CB79072 (=D22), 11VT	2046	2026	2046	A, B, C	+D22-A24 +D22-A20	11VT Hybrid	2046 PASS M0	2046 2046
+8A4	Feeder 7229 Robina CB72292 (=D28), 13VT	2046	2026	2046	A, B, C	+D28-A14 +D28-A10	13VT Hybrid	2046 PASS M0	2046 2046
+8A5	12 TFMR (110/33kV) HV CB 44122 (=D26)	2046	2026	2046	A, B, C	+D26-A10	Hybrid	PASS M0	2046
+8B1	Building +8 - Aux Control, Timing, OpsWAN & Common RTU	2046	2026	2046	A, B, C				
+8B2	Building +8 - 110 kV Multiplex Communications	Please Consult Telecommunication Asset Strategies							
+8B3	Revenue Meters (Feeder 7297 Cades County, F907 Southport, Feeder 7229 Robina, Energex T4 TFMR)	2046	2026	2046	A, B, C				
+8B4	Stub CB 4442 (=D34) 1 Bus To Energex TFMR T4 (110/11kV)	2046	2026	2046	A, B, C	+D34-A10	Hybrid	PASS M0	2046
+8B5	3 Cap CB 4832 (=D32)	2046	2026	2046	A, B, C	+D32-A20	Hybrid	PASS M0	2046
+8C1	Building +8 - 125VDC (X& Y) Batteries, Monitors and Chargers: X Battery	ASAP (e.g. Battery OR Project)			B				
	Y Battery	ASAP (e.g. Battery OR Project)			B				
	X DC Monitor & Charger	2026			B,C				
	Y DC Monitor & Charger								
	DC Distribution board								

***Notes**:*

(i). Option A: In-Situ (Equipment) Replacement - Replace equipment in existing panel.
(ii). Option B: Install new panels in existing building.
(iii). Option C: Install new panels in new building.
(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 technical asset life for batteries is 12 years, for chargers and monitors is 20 years.

7. Conclusion

This report comprehensively details the conditions of Molendinar Substation secondary systems and equipment. The primary objective of the optimal replacement time is to maintain the current network reliability and availability and to minimise operational and compliance risks associated with secondary systems assets at Molendinar Substation. Strategic asset replacement timeframe have also been recommended based on the optimisation of recommended timing of individual equipment in Appendix A.

Door seals and air filters of outdoor marshalling kiosks should be replaced as part of routine maintenance.

8. Attachments

- **Appendix A** – H031 110/275kV Molendinar Substation Secondary Systems Equipment Health Indices and Recommended Asset Placement Replacement Timeframe.

  H031-Molendinar 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 - H031 MOLENDINAR 275/110 KV SUBSTATION - 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 Condition only, Exclude consideration 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 Equipment	CABLES	YARD MARSHALLIN G 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)
1 Bus Zone	1 Buszone CBF BT	+6A5	2006	4.00	H031-SSS-1BU4-BAYCONT	REMOTE TERMINAL UNIT FOXBORO C50	FOXBORO	[redacted]	Yes	0	27362					13.33	6.66					4.00	4.00	2044-2048	2026/27 (b)	2044-2048	2044-2048
					H031-SSS-1BU4-XPROT	RELAY CB FAIL BUS TRIP RACK	RMS	[redacted]	No	29	26578	13.33	6.66														
					H031-SSS-1BU4-XPROT	RELAY CB FAIL BUS TRIP RACK	RMS	[redacted]	No	29	26578	13.33	6.66														
					H031-SSS-1BU4-XPROT	RELAY DIFF AREVA MFAC34 RANGE: 25-325VAC	AREVA	[redacted]	No	8	13754	13.33	6.66														
					H031-SSS-1BU4-XPROT	RELAY TRIPPING LOW BURDEN ALSTOM MVAJ13	AREVA	[redacted]	No	18	26689	13.33	6.66														
					H031-SSS-1BU4-XPROT	RELAY TRIPPING LOW BURDEN ALSTOM MVAJ13	AREVA	[redacted]	No	18	26689	13.33	6.66														
					H031-SSS-1BU4-XPROT	RELAY TRIPPING SUPPLY FAIL ALSTOM MVAX12	AREVA	[redacted]	No	9	26690	13.33	6.66														
					H031-SSS-1BU4-YPROT	RELAY CB FAIL BUS TRIP RACK	RMS	[redacted]	No	29	26578			13.33	6.66												
					H031-SSS-1BU4-YPROT	RELAY CB FAIL BUS TRIP RACK	RMS	[redacted]	No	29	26578			13.33	6.66												
					H031-SSS-1BU4-YPROT	RELAY DIFF AREVA MFAC34 RANGE: 25-325VAC	AREVA	[redacted]	No	8	13754			13.33	6.66												
					H031-SSS-1BU4-YPROT	RELAY TRIPPING LOW BURDEN ALSTOM MVAJ13	AREVA	[redacted]	No	18	26689			13.33	6.66												
					H031-SSS-1BU4-YPROT	RELAY TRIPPING LOW BURDEN ALSTOM MVAJ13	AREVA	[redacted]	No	18	26689			13.33	6.66												
					H031-SSS-1BU4-YPROT	RELAY TRIPPING SUPPLY FAIL ALSTOM MVAX12	AREVA	[redacted]	No	9	26690			13.33	6.66												
1 TFMR PLC	1 TFMR PLC		2003	4.86	H031-SSS-1TRF-CONTSYS	OLTC / COOLER / ALARM PLC	ALLEN BRADLEY	[redacted]	Yes							20.00	10.00								2023/24 (b)		
2 Bus Zone	2 Buszone CBF BT	+7A1	2006	4.00	H031-SSS-2BU4-BAYCONT	REMOTE TERMINAL UNIT FOXBORO C50	FOXBORO	[redacted]	Yes	0	27362					13.13	6.57					4.00	4.00	2044-2048	2026/27 (b)	2044-2048	2044-2048
					H031-SSS-2BU4-XPROT	RELAY CB FAIL BUS TRIP RACK	RMS	[redacted]	No	29	26578	13.13	6.57														
					H031-SSS-2BU4-XPROT	RELAY DIFF AREVA MFAC34 RANGE: 25-325VAC	AREVA	[redacted]	No	8	13754	13.13	6.57														
					H031-SSS-2BU4-XPROT	RELAY TRIPPING LOW BURDEN ALSTOM MVAJ13	AREVA	[redacted]	No	18	26689	13.13	6.57														
					H031-SSS-2BU4-XPROT	RELAY TRIPPING LOW BURDEN ALSTOM MVAJ13	AREVA	[redacted]	No	18	26689	13.13	6.57														
					H031-SSS-2BU4-XPROT	RELAY TRIPPING SUPPLY FAIL ALSTOM MVAX12	AREVA	[redacted]	No	9	26690	13.13	6.57														
					H031-SSS-2BU4-XPROT	RELAY CB FAIL BUS TRIP RACK	RMS	[redacted]	No	29	26578	13.13	6.57														
					H031-SSS-2BU4-YPROT	RELAY DIFF ALSTOM MFAC34 RANGE 25-325VAC	ALSTOM	[redacted]	No	8	13754			20.00	10.00												
					H031-SSS-2BU4-YPROT	RELAY TRIPPING LOW BURDEN ALSTOM MVAJ13	AREVA	[redacted]	No	18	26689			13.13	6.57												
					H031-SSS-2BU4-YPROT	RELAY TRIPPING LOW BURDEN ALSTOM MVAJ13	AREVA	[redacted]	No	18	26689			13.13	6.57												
					H031-SSS-2BU4-YPROT	RELAY TRIPPING SUPPLY FAIL ALSTOM MVAX12	AREVA	[redacted]	No	9	26690			13.13	6.57												
					H031-SSS-2BU4-YPROT	RELAY CB FAIL BUS TRIP RACK	RMS	[redacted]	No	29	26578			13.13	6.57												
					H031-SSS-2BU4-YPROT	RELAY CB FAIL BUS TRIP RACK	RMS	[redacted]	No	29	26578			13.13	6.57												
2 TFMR PLC	2 TFMR PLC		2007	3.71	H031-SSS-2TRF-CONTSYS	OLTC / COOLER / ALARM PLC	ALLEN BRADLEY	[redacted]	Yes							17.32	8.66								2027/28 (b)		
2 Bus Zone	2 Buszone CBF BT	+8A1	2007	3.71	H031-SSS-3BU4-BAYCONT	REMOTE TERMINAL UNIT FOXBORO C50	FOXBORO	[redacted]	Yes	0	27362					12.81	6.40					3.71	3.71	2045-2049	2027/28 (b)	2045-2049	2045-2049
					H031-SSS-3BU4-XPROT	RELAY CB FAIL BUS TRIP RACK	RMS	[redacted]	No	29	26578	12.81	6.40														
					H031-SSS-3BU4-XPROT	RELAY CB FAIL BUS TRIP RACK	RMS	[redacted]	No	29	26578	12.81	6.40														
					H031-SSS-3BU4-XPROT	RELAY DIFF AREVA MFAC34 RANGE: 25-325VAC	AREVA	[redacted]	No	8	13754	12.81	6.40														
					H031-SSS-3BU4-XPROT	RELAY TRIPPING LOW BURDEN ALSTOM MVAJ13	AREVA	[redacted]	No	18	26689	12.81	6.40														
					H031-SSS-3BU4-XPROT	RELAY TRIPPING LOW BURDEN ALSTOM MVAJ13	AREVA	[redacted]	No	18	26689	12.81	6.40														
					H031-SSS-3BU4-XPROT	RELAY TRIPPING SUPPLY FAIL ALSTOM MVAX12	AREVA	[redacted]	No	9	26690	12.81	6.40														
					H031-SSS-3BU4-YPROT	RELAY TRIPPING LOW BURDEN ALSTOM MVAJ13	AREVA	[redacted]	No	18	26689			14.60	7.30												
					H031-SSS-3BU4-YPROT	RELAY CB FAIL BUS TRIP RACK	RMS	[redacted]	No	29	26578			12.81	6.40												
					H031-SSS-3BU4-YPROT	RELAY DIFF AREVA MFAC34 RANGE: 25-325VAC	AREVA	[redacted]	No	8	13754			12.81	6.40												
					H031-SSS-3BU4-YPROT	RELAY TRIPPING LOW BURDEN ALSTOM MVAJ13	AREVA	[redacted]	No	18	26689			12.81	6.40												
					H031-SSS-3BU4-YPROT	RELAY TRIPPING SUPPLY FAIL ALSTOM MVAX12	AREVA	[redacted]	No	9	26690			12.81	6.40												
					H031-SSS-3BU4-YPROT	RELAY CB FAIL BUS TRIP RACK	RMS	[redacted]	No	29	26578			12.81	6.40												
1-2 Bus Section	1-2 Bus Section CB 4112 (=D01)	+6A16	2006	4.00	H031-SSS-411--BAYCONT	REMOTE TERMINAL UNIT FOXBORO C50	FOXBORO	[redacted]	Yes	4	27361					13.32	6.66					4.00	4.00	2044-2048	2026/27 (b)	2044-2048	2044-2048
					H031-SSS-411--XPROT	RELAY CB MGMT GE C60 (VER 2.93 FIRMWARE)	GE	[redacted]	Yes	9	26931	13.32	6.66														
					H031-SSS-411--YPROT	RELAY CBMAN SEL-351-1 (1A)	SCHWEITZER	[redacted]	Yes	11	25466			13.32	6.66												
1-3 Bus Section	1-3 Bus Section CB 4122 (=D14)	+6A15	2007	3.71	H031-SSS-412--BAYCONT	REMOTE TERMINAL UNIT FOXBORO C50	FOXBORO	[redacted]	Yes	4	27361					12.81	6.40					3.71	3.71	2045-2049	2027/28 (b)	2045-2049	2045-2049
					H031-SSS-412--XPROT	RELAY CB MGMT GE C60 (VER 2.93 FIRMWARE)	GE	[redacted]	Yes	9	26931	12.81	6.40														
					H031-SSS-412--YPROT	RELAY CBMAN SEL-351-1 (1A)	SCHWEITZER	[redacted]	Yes	11	25466			14.61	7.31												
10 TFMR (110/33kV) HV	10 TFMR (110/33kV) HV CB 44102 (=D10)	+6A17	2006	4.00	H031-SSS-4410-BAYCONT	REMOTE TERMINAL UNIT FOXBORO C50	FOXBORO	[redacted]	Yes	4	27361					13.32	6.66					4.00	4.00	2044-2048	2026/27 (b)	2044-2048	2044-2048
					H031-SSS-4410-XPROT	RELAY TRANSF DIFF GE T60 (3.48)	GE	[redacted]	Yes	8	27193	13.32	6.66														
					H031-SSS-4410-YPROT	RELAY BIASED DIFF SEL-387-5 (1A) (3U)	SCHWEITZER	[redacted]	Yes	4	25465			13.32	6.66												
10 TFMR (110/33kV) HV	11 TFMR (110/33kV) HV CB 44112 (=D21)	+7B5	2006	4.00	H031-SSS-4411-BAYCONT	REMOTE TERMINAL UNIT FOXBORO C50	FOXBORO	[redacted]	Yes	4	27361					13.13	6.57					4.00	4.00	2044-2048	2026/27 (b)	2044-2048	2044-2048
					H031-SSS-4411-XPROT	RELAY TRANSF DIFF GE T60 (3.48)	GE	[redacted]	Yes	8	27193	13.13	6.57														
					H031-SSS-4411-YPROT	RELAY BIASED DIFF SEL-387-5 (1A) (3U)	SCHWEITZER	[redacted]	Yes	4	25465			13.13	6.57												
12 TFMR (110/33kV) HV	12 TFMR (110/33kV) HV CB 44122 (=D26)	+8A5	2003	4.86	H031-SSS-4412-BAYCONT	REMOTE TERMINAL UNIT FOXBORO C50	FOXBORO	[redacted]	Yes	26	27350					10.19	5.10					4.86	4.86	2041-2045	2023/24 (b)	2041-2045	2041-2045
					H031-SSS-4412-XPROT	RELAY TRANSF DIFF GE T60	GE	[redacted]	Yes	8	27193	16.74	8.37														
					H031-SSS-4412-YPROT	RELAY BIASED DIFF SEL-387-5 (1A) (3U)	SCHWEITZER	[redacted]	Yes	4	25465			16.66	8.33												
T1 TFMR LV	T1 TFMR (275/110kV) LV CB 4412 (=D04)	+6A19	2003	4.86	H031-SSS-441--BAYCONT	REMOTE TERMINAL UNIT FOXBORO C50	FOXBORO	[redacted]	Yes	0	26047					16.14	8.07					4.86	4.86	2041-2045	2023/24 (b)	2041-2045	2041-2045
					H031-SSS-441--XPROT	RELAY CB MGMT GE C60 (VER 2.82)	GE	[redacted]	Yes	6	25383	17.37	8.69														
					H031-SSS-441--YPROT	RELAY CBMAN SEL-351-1 (1A)	SCHWEITZER	[redacted]	Yes	11	25466			16.14	8.07												
2 TFMR	2 TFMR (110/33kV) LV CB 4422 (=D07), 15VT	+7A6	2006	4.00	H031-SSS-442--BAYCONT	REMOTE TERMINAL UNIT FOXBORO C50	FOXBORO	[redacted]	Yes	4	27361					13.09	6.55					4.00	4.00	2044-2048	2026/27 (b)	2044-2048	2044-2048
					H031-SSS-442--XPROT	RELAY CB MGMT GE C60 (VER 2.93 FIRMWARE)	GE	[redacted]	Yes	9	26931	13.09	6.55														
					H031-SSS-442--YPROT	RELAY CBMAN SEL-351-1 (1A)	SCHWEITZER	[redacted]	Yes	11	25466			13.09	6.55												
Energex T4 Stub	Stub CB 4442 (=D34) 1 Bus To Energex TFMR T4 (110/11kV)	+8B4	2007	3.71	H031-SSS-444--BAYCONT	REMOTE TERMINAL UNIT FOXBORO C50	FOXBORO	[redacted]	Yes	4	27361					12.81	6.40					3.71	3.71	2045-2049	2027/28 (b)	2045-2049	2045-2049
					H031-SSS-444--XPROT	RELAY CB MGMT GE C60 (VER 2.93 FIRMWARE)	GE	[redacted]	Yes	9	26931	12.81	6.40														
					H031-SSS-444--YPROT	RELAY CBMAN SEL-351-1 (1A)	SCHWEITZER	[redacted]	Yes	11	25466			14.61	7.31												
Energex T6 Stub	Stub CB 4462 (=D33) 2 Bus To Energex TFMR T6 (110/11kV)	+7B6	2006	4.00	H031-SSS-446--BAYCONT	REMOTE TERMINAL UNIT FOXBORO C50	FOXBORO	[redacted]	Yes	4	27361											4.00	4.00	2044-2048	2026/27 (b)	2044-2048	2044-2048
					H031-SSS-446--XPROT	RELAY CB MGMT GE C60 (VER 2.93 FIRMWARE)	GE	[redacted]	Yes	9	26931	13.13	6.57														
					H031-SSS-446--YPROT	RELAY CBMAN SEL-351-1 (1A)	SCHWEITZER	[redacted]	Yes	11	25466			13.13	6.57												

APPENDIX A - H031 MOLENDINAR 275/110 KV SUBSTATION - 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 Condition only, Exclude consideration 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 Equipment	CABLES	YARD MARSHALLIN G KIOSKS
Function	Panel Description	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)
3 Cap	3 Cap CB 4832 (=D32)	+8B5	2007	3.71	H031-SSS-483--BAYCONT	REMOTE TERMINAL UNIT FOXBORO C50	FOXBORO	[redacted]	Yes	4	27361					12.22	6.11					3.71	3.71	2045-2049	2027/28 (b)	2045-2049	2045-2049
					H031-SSS-483--POWAVE	RELAY POINT ON WAVE ABB E213	ABB	[redacted]	Yes	0	25640					12.22	6.11										
					H031-SSS-483--XPROT	RELAY CAP PROTN ABB SPAJ160C	ABB	[redacted]	No	3	15980	12.22	6.11														
					H031-SSS-483--XPROT	RELAY CB MGMT GE C60 (VER 2.93 FIRMWARE)	GE	[redacted]	Yes	9	26931	12.22	6.11														
					H031-SSS-483--XPROT	RELAY OC & EF ABB SPAJ140C	ABB	[redacted]	No	6	12182	12.22	6.11														
					H031-SSS-483--YPROT	RELAY CBMAN SEL-351-1 (1A)	SCHWEITZER	[redacted]	Yes	11	25466			12.22	6.11												
4 Cap	4 Cap CB 4842 (=D04)	+6A20	2004	4.57	H031-SSS-484--BAYCONT	REMOTE TERMINAL UNIT FOXBORO C50	FOXBORO	[redacted]	Yes	0	26047					15.20	7.60					4.57	4.57	2042-2046	2024/25 (b)	2042-2046	2042-2046
					H031-SSS-484--POWAVE	RELAY POINT ON WAVE ABB E213	ABB	[redacted]	Yes	0	25640					15.20	7.60										
					H031-SSS-484--XPROT	RELAY OC & EF ABB SPAJ140C	ABB	[redacted]	No	6	12182	15.20	7.60														
					H031-SSS-484--XPROT	RELAY CB MGMT GE C60 (VER 2.93 FIRMWARE)	GE	[redacted]	Yes	9	26931	15.20	7.60														
					H031-SSS-484--XPROT	RELAY CAP PROTN ABB SPAJ160C	ABB	[redacted]	No	3	15980	15.20	7.60														
					H031-SSS-484--YPROT	RELAY CBMAN SEL-351-1 (1A)	SCHWEITZER	[redacted]	Yes	11	25466			15.20	7.60												
5 Cap	5 Cap CB 4852 (=D19) – To be decommissioned and removed	+7A5	2006	4.00	H031-SSS-485--BAYCONT	REMOTE TERMINAL UNIT FOXBORO C50	FOXBORO	[redacted]	Yes	4	27361					13.09	6.55					4.00	4.00	2044-2048	2026/27 (b)	2044-2048	2044-2048
					H031-SSS-485--POWAVE	RELAY POINT ON WAVE ABB E213	ABB	[redacted]	Yes	0	25640					12.85	6.43										
					H031-SSS-485--XPROT	RELAY CAP PROTN ABB SPAJ160C	ABB	[redacted]	No	3	15980	13.09	6.55														
					H031-SSS-485--XPROT	RELAY OC & EF ABB SPAJ140C	ABB	[redacted]	No	6	12182	13.09	6.55														
					H031-SSS-485--XPROT	RELAY CB MGMT GE C60 (VER 2.93 FIRMWARE)	GE	[redacted]	Yes	9	26931	13.09	6.55														
					H031-SSS-485--YPROT	RELAY CBMAN SEL-351-1 (1A)	SCHWEITZER	[redacted]	Yes	11	25466			13.09	6.55												
					H031-SSS-502--BAYCONT	REMOTE TERMINAL UNIT FOXBORO C50	FOXBORO	[redacted]	Yes	0	26047					16.14	8.07										
1 TFMR HV	1 TFMR (275/110kV) HV (=C02)	+6A8	2003	4.86	H031-SSS-541--BAYCONT	REMOTE TERMINAL UNIT FOXBORO C50	FOXBORO	[redacted]	Yes	0	26047					16.14	8.07					4.86	4.86	2041-2045	2023/24 (b)	2041-2045	2041-2045
					H031-SSS-541--XPROT	RELAY TRANSF DIFF GE T60 (3.48)	GE	[redacted]	Yes	6	25384	16.14	8.07														
					H031-SSS-541--XPROT	RELAY DIFF 25-325V 1POLE ALSTOM MFAC14	ALSTOM	[redacted]	No	4	12241	16.14	8.07														
					H031-SSS-541--XPROT	RELAY TRANSF O/LOAD GE F35	GE	[redacted]	Yes	9	25382	16.14	8.07														
					H031-SSS-541--YPROT	RELAY BIASED DIFF SEL-387-5 (1A) (3U)	SCHWEITZER	[redacted]	Yes	4	25465			16.14	8.07												
2 TFMR HV	2 TFMR (275/110kV) HV (=C03)	+7B7	2007	3.71	H031-SSS-542--BAYCONT	REMOTE TERMINAL UNIT FOXBORO C50	FOXBORO	[redacted]	Yes	4	27361					12.57	6.28					3.71	3.71	2045-2049	2027/28 (b)	2045-2049	2045-2049
					H031-SSS-542--XPROT	RELAY TRANSF DIFF GE T60 (3.48)	GE	[redacted]	Yes	8	27193	12.57	6.28														
					H031-SSS-542--XPROT	RELAY TRANSF O/LOAD GE F35 (2.93)	GE	[redacted]	Yes	6	27194	12.57	6.28														
					H031-SSS-542--XPROT	RELAY DIFF 25-325V 1POLE AREVA MFAC14	AREVA	[redacted]	No	4	12241	12.57	6.28														
					H031-SSS-542--YPROT	RELAY BIASED DIFF SEL-387-5 (1A) (3U)	SCHWEITZER	[redacted]	Yes	4	25465			12.57	6.28												
Feeder 7193	Feeder 7193 Cades County CB71932 (=D27), 12VT	+7A3	2007	3.71	H031-SSS-7193-BAYCONT	REMOTE TERMINAL UNIT FOXBORO C50	FOXBORO	[redacted]	Yes	4	27361					12.71	6.35					3.71	3.71	2045-2049	2027/28 (b)	2045-2049	2045-2049
					H031-SSS-7193-XPROT	RELAY DIFF GE L90 2T H00 N6U-SXX-U6T-W7R	GE	[redacted]	No	7	31855	13.98	6.99														
					H031-SSS-7193-YPROT	RELAY DISTANCE SEL 311C 1A	SCHWEITZER	[redacted]	Yes	28	25388			12.71	6.35												
Feeder 7229	Feeder 7229 Robina CB72292 (=D28), 13VT	+8A4	2007	3.71	H031-SSS-7229-BAYCONT	REMOTE TERMINAL UNIT FOXBORO C50	FOXBORO	[redacted]	Yes	4	27361					12.81	6.40					3.71	3.71	2045-2049	2027/28 (b)	2045-2049	2045-2049
					H031-SSS-7229-XPROT	RELAY DIFF GE L90 2TML VER 3.48 FIRMWARE	GE	[redacted]	Yes	14	26942	13.83	6.92														
					H031-SSS-7229-YPROT	RELAY DISTANCE SEL 311C 1A	SCHWEITZER	[redacted]	Yes	28	25388			12.81	6.40												
Feeder 7297	Feeder 7297 Cades County CB72972 (=D22), 9VT	+8A2	2007	3.71	H031-SSS-7297-BAYCONT	REMOTE TERMINAL UNIT FOXBORO C50	FOXBORO	[redacted]	Yes	4	27361					12.81	6.40					3.71	3.71	2045-2049	2027/28 (b)	2045-2049	2045-2049
					H031-SSS-7297-XPROT	RELAY DIFF GE L90 2T H00 N6U-SXX-U6T-W7R	GE	[redacted]	No	7	31855	13.98	6.99														
					H031-SSS-7297-YPROT	RELAY DISTANCE SEL 311C 1A	SCHWEITZER	[redacted]	Yes	28	25388			12.81	6.40												
Feeder F907	Feeder F907 Southport CB79072 (=D22), 11VT	+8A3	2007	3.71	H031-SSS-7907-BAYCONT	REMOTE TERMINAL UNIT FOXBORO C50	FOXBORO	[redacted]	Yes	4	27361					12.81	6.40					3.71	3.71	2045-2049	2027/28 (b)	2045-2049	2045-2049
					H031-SSS-7907-XPROT	RELAY DIFF GE L90 2TML VER 3.48 FIRMWARE	GE	[redacted]	Yes	14	26942	13.83	6.92														
					H031-SSS-7907-YPROT	RELAY DISTANCE SEL 311C 1A	SCHWEITZER	[redacted]	Yes	28	25388			17.06	8.53												
Feeder F916	Feeder F916 Surfer Paradise CB 79162 (=D12)	+6A18	2006	4.00	H031-SSS-7916-BAYCONT	REMOTE TERMINAL UNIT FOXBORO C50	FOXBORO	[redacted]	Yes	4	27361					13.32	6.66					4.00	4.00	2044-2048	2026/27 (b)	2044-2048	2044-2048
					H031-SSS-7916-XPROT	RELAY DIFF GE L90 2TML VER 3.48 FIRMWARE	GE	[redacted]	Yes	14	26942	13.83	6.92														
					H031-SSS-7916-YPROT	RELAY DISTANCE SEL 311C 1A	SCHWEITZER	[redacted]	Yes	28	25388			13.32	6.66												
Feeder F917	Feeder F917 Southport CB 79172 (=D13)	+7A2	2007	3.71	H031-SSS-7917-BAYCONT	REMOTE TERMINAL UNIT FOXBORO C50	FOXBORO	[redacted]	Yes	4	27361					12.71	6.35					3.71	3.71	2045-2049	2027/28 (b)	2045-2049	2045-2049
					H031-SSS-7917-XPROT	RELAY DIFF GE L90 2TML VER 3.48 FIRMWARE	GE	[redacted]	Yes	14	26942	13.83	6.92														
					H031-SSS-7917-YPROT	RELAY DISTANCE SEL 311C 1A	SCHWEITZER	[redacted]	Yes	28	25388			12.71	6.35												
Feeder 798	Feeder 798 Nerang CB7982 (=D31), 14VT	+7A4	2007	3.71	H031-SSS-798--BAYCONT	REMOTE TERMINAL UNIT FOXBORO C50	FOXBORO	[redacted]	Yes	4	27361					12.71	6.35					3.71	3.71	2045-2049	2027/28 (b)	2045-2049	2045-2049
					H031-SSS-798--XPROT	RELAY DIFF GE L90 2TML VER 3.48 FIRMWARE	GE	[redacted]	Yes	14	26942	13.83	6.92														
					H031-SSS-798--YPROT	RELAY DISTANCE SEL 311C 1A	SCHWEITZER	[redacted]	Yes	28	25388			12.71	6.35												
Feeder 8824	Feeder 8824 Greenbank (=C02),16VT	+6A6	2003	4.86	H031-SSS-8824-BAYCONT	REMOTE TERMINAL UNIT FOXBORO C50	FOXBORO	[redacted]	Yes	0	26047					16.14	8.07					4.86	4.86	2041-2045	2023/24 (b)	2041-2045	2041-2045
					H031-SSS-8824-XPROT	RELAY DIFF GE L90 2T H00 N6U-SXX-UXX-W7R	GE	[redacted]	No	0	32443	17.16	8.58														
					H031-SSS-8824-YPROT	COMMS INTERFACE UNIT ALSTOM P591	ALSTOM	[redacted]	Yes	90	26261			16.14	8.07												
					H031-SSS-8824-YPROT	COMMS INTERFACE UNIT ALSTOM P591	ALSTOM	[redacted]	Yes	90	26261			16.14	8.07												
					H031-SSS-8824-YPROT	CURR DIFF RELAY MICOM P544 + 2ND PORT	MICOM	[redacted]	Yes	9	30869			14.56	7.28												
Feeder 8824	Feeder 8824 Greenbank Protection Signalling	+6A7	2003	4.86	H031-SSS-8824-BAYCONT	REMOTE TERMINAL UNIT FOXBORO C50	FOXBORO	[redacted]	Yes	0	26047					16.91	8.45					4.86	4.86	2041-2045	2023/24 (b)	2041-2045	2041-2045
					H031-SSS-8824-PSSITA1	DEWAR DM1200 PROT SIG DIG 90-320V SUPPLY	DEWAR	[redacted]	Yes	6	17308	16.14	8.07														
					H031-SSS-8824-PSSITA2	RFL 9745 PROT SIG DIG I/O 48-125V	RFL ELECTRONICS	[redacted]	Yes	1	17268	16.14	8.07														
					H031-SSS-8824-PSSITB1	DEWAR DM1200 PROT SIG DIG 90-320V SUPPLY	DEWAR	[redacted]	Yes	6	17308			16.14	8.07												
					H031-SSS-8824-PSSITB2	RFL 9745 PROT SIG DIG I/O 48-125V	RFL ELECTRONICS	[redacted]	Yes	1	17268			16.14	8.07												
Feeder 8825	Feeder 8825 Greenbank (=C03),17VT	+7B7	2007	3.71	H031-SSS-8825-BAYCONT	REMOTE TERMINAL UNIT FOXBORO C50	FOXBORO	[redacted]	Yes	4	27361					12.57	6.28					3.71	3.71	2045-2049	2027/28 (b)	2045-2049	2045-2049
					H031-SSS-8825-PSSITA1	DEWAR DM1200 PROT SIG DIG 90-320V SUPPLY	DEWAR	[redacted]	Yes	6	17308	12.57	6.28														
					H031-SSS-8825-PSSITA2	RFL 9745 PROT SIG DIG I/O 48-125V	RFL ELECTRONICS	[redacted]	Yes	1	17268	12.57	6.28														
					H031-SSS-8825-PSSITB1	DEWAR DM1200 PROT SIG DIG 90-320V SUPPLY	DEWAR	[redacted]	Yes	6	17308			12.57	6.28												
					H031-SSS-8825-PSSITB2	RFL 9745 PROT SIG DIG I/O 48-125V	RFL ELECTRONICS	[redacted]	Yes	1	17268			12.57	6.28												
					H031-SSS-8825-XPROT	RELAY DIFF GE L90 2T H00 N6U-SXX-U6T-W7R	GE	[redacted]	No	7	31855	13.98	6.99														
					H031-SSS-8825-YPROT	COMMS INTERFACE UNIT ALSTOM P591	ALSTOM	[redacted]	Yes	90	26261			12.57	6.28												
					H031-SSS-8825-YPROT	CURR DIFF RELAY MICOM P544 + 2ND PORT	MICOM	[redacted]	Yes	9	30869			12.57	6.28												

APPENDIX A - H031 MOLENDINAR 275/110 KV SUBSTATION - 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 Condition only, Exclude consideration 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)
Revenue Meters	Revenue Meters (T1 110kV, F916 S/Paradise, T10 33kV)	+6A22	2007	3.71	H031-SSS-METR-REVMET1	METER KWH/KVARH 1A 110V3PH CL.2/.5S REVA	EDMI	[redacted]	Yes	43	24375							8.51	4.25			3.71	3.71	2045-2049	2027/28 (b)	2045-2049	2045-2049
					H031-SSS-METR-REVMET1	METER KWH/KVARH CL.2/.5S EDMI (REV B))	EDMI		Yes	43	24375							11.45	5.73								
					H031-SSS-METR-REVMET4	METER KWH/KVARH EDMI (REVENUE)	EDMI		Yes	49	15879							14.50	7.25								
					H031-SSS-METR-REVMET4	METER KWH/KVARH EDMI (CHECK)	EDMI		Yes	49	15879							14.50	7.25								
					H031-SSS-METR-REVMET3	METER KWH/KVARH EDMI (CHECK)	EDMI		Yes	21	15880							20.00	10.00								
					H031-SSS-METR-REVMET3	METER KWH/KVARH (REV)	EDMI		Yes	21	15880							10.05	5.03								
Revenue Meters	Revenue Meters (11 TFMR 33kV, 2 TFMR 110kV)	+7B4	2004	4.57	H031-SSS-METR-REVMET6	METER KWH/KVARH EDMI (REVENUE)	EDMI		Yes	21	15880							16.05	8.03			4.57	4.57	2042-2046	2024/25 (b)	2042-2046	2042-2046
					H031-SSS-METR-REVMET6	METER KWH/KVARH EDMI (CHECK)	EDMI		Yes	21	15880							16.05	8.03								
					H031-SSS-METR-REVMET14	METER KWH/KVARH EDMI (CHECK)	EDMI		Yes	49	15879							14.50	7.25								
					H031-SSS-METR-REVMET14	METER KWH/KVARH EDMI (REVENUE)	EDMI		Yes	49	15879							14.50	7.25								
Revenue Meters	Revenue Meters (Feeder 7297 Cades County, F907 Southport, Feeder 7229 Robina, Energex T4 TFMR)	+8B3	2005	4.29	H031-SSS-METR-REVMET8	METER KWH/KVARH EDMI (REVENUE)	EDMI		Yes	49	15879							14.50	7.25			4.29	4.29	2043-2047	2025/26 (b)	2043-2047	2043-2047
					H031-SSS-METR-REVMET8	METER KWH/KVARH EDMI (CHECK)	EDMI		Yes	49	15879							14.50	7.25								
					H031-SSS-METR-REVMET7	METER KWH/KVARH EDMI (REVENUE)	EDMI		Yes	49	15879							14.50	7.25								
					H031-SSS-METR-REVMET7	METER KWH/KVARH EDMI (CHECK)	EDMI		Yes	49	15879							14.50	7.25								
					H031-SSS-METR-REVMET10	METER KWH/KVARH EDMI (CHECK)	EDMI		Yes	49	15879							14.50	7.25								
					H031-SSS-METR-REVMET10	METER KWH/KVARH EDMI (REVENUE)	EDMI		Yes	49	15879							14.50	7.25								
					H031-SSS-METR-REVMET13	METER KWH/KVARH EDMI (CHECK)	EDMI		Yes	49	15879							13.58	6.79								
					H031-SSS-METR-REVMET13	METER KWH/KVARH EDMI (REVENUE)	EDMI		Yes	49	15879							13.58	6.79								
Revenue Meters	Revenue Meters (F917 Southport, Feeder 7193 Cades County, Feeder 798 Nerang, Energex T6 TFMR)	+7B3	2005	4.29	H031-SSS-METR-REVMET5	METER KWH/KVARH EDMI (REVENUE)	EDMI		Yes	49	15879							14.50	7.25			4.29	4.29	2043-2047	2025/26 (b)	2043-2047	2043-2047
					H031-SSS-METR-REVMET5	METER KWH/KVARH EDMI (CHECK)	EDMI		Yes	49	15879							14.50	7.25								
					H031-SSS-METR-REVMET9	METER KWH/KVARH EDMI (REVENUE)	EDMI		Yes	49	15879							14.50	7.25								
					H031-SSS-METR-REVMET9	METER KWH/KVARH EDMI (CHECK)	EDMI		Yes	49	15879							14.50	7.25								
					H031-SSS-METR-REVMET11	METER KWH/KVARH EDMI (REVENUE)	EDMI		Yes	49	15879							14.50	7.25								
					H031-SSS-METR-REVMET11	METER KWH/KVARH EDMI (CHECK)	EDMI		Yes	49	15879							14.50	7.25								
					H031-SSS-METR-REVMET12	METER KWH/KVARH EDMI (REVENUE)	EDMI		Yes	49	15879							14.50	7.25								
					H031-SSS-METR-REVMET12	METER KWH/KVARH EDMI (CHECK)	EDMI		Yes	49	15879							14.50	7.25								
SCADA and OpsWAN	Building +6 - Station SCADA (NSCs, LCF), Aux Control, Timing, OpsWAN & Common RTU	+6A24	2003	4.86	H031-SSS-NBAY-LCF6	LOCAL CONTROL FACILITY PC X TERMINAL	WYSE		Yes	2	35961					4.14	3.45					4.86	4.86	2041-2045	2023/24 (b)		
					H031-SSS-NBAY-LCF6	SAMSUNG SYNCMASTER 22" MONITOR	SAMSUNG		Yes							1.93	1.61										
					H031-SSS-NBAY-LCFINT	REMOTE TERMINAL UNIT FOXBORO C50	FOXBORO		Yes	0	26044					16.14	8.07										
					H031-SSS-NBAY-NSCLINK1	REMOTE TERMINAL UNIT FOXBORO C50	FOXBORO		Yes	0	26044					16.14	8.07										
					H031-SSS-NBAY-NSCLINK2	REMOTE TERMINAL UNIT FOXBORO C50	FOXBORO		Yes	0	26044					16.14	8.07										
					H031-SSS-NBAY-RTUCOM6	REMOTE TERMINAL UNIT FOXBORO C50	FOXBORO		Yes	0	26047					16.14	8.07										
					H031-SSS-NBAY-TIMING6	GPS CLOCK TEKRON TCG01-D:1	TEKRON		Yes	3	27092					8.00	4.00										
					H031-SSS-NBAY-OWCOVRT6	DC/DC CONVERTER	PHOENIX		No	8	27643									9.58	7.99						
					H031-SSS-NBAY-OWINVRT6	INVERTER 125VDC/240VAC 1800W	LATRONICS		No	2	25941									1.93	0.97						
					H031-SSS-NBAY-OWNTWK6	SWITCH E/NET 32PRT RUGGED RSG2300 OPSWAN	RUGGEDCOM		No	3	30818									9.58	7.99						
					H031-SSS-NBAY-OWNTWK6	SERVER PORT 48VDC PERLE 04030450 -OPSWAN	PERLE		No	2	27733									4.67	3.89						
					H031-SSS-NBAY-OWNTWK6	PERLE IOLAN DS1, ETHERNET 10/100, DB9M	PERLE		No	2	34320									2.45	2.04						
OpsWAN	Building +7 - Aux Control, Timing, OpsWAN & Common RTU	+7B1	2006	4.00	H031-SSS-NBAY-LCF7	LOCAL CONTROL FACILITY PC X TERMINAL	WYSE		Yes	2	35961					4.14	3.45					4.00	4.00	2044-2048	2026/27 (b)		
					H031-SSS-NBAY-LCF7	SAMSUNG MONITOR	SAMSUNG		Yes							1.93	1.61										
					H031-SSS-NBAY-RTUCOM7	REMOTE TERMINAL UNIT FOXBORO C50	FOXBORO		Yes	0	27363					13.13	6.57										
					H031-SSS-NBAY-TIMING7	GPS CLOCK TEKRON TCG01-D:1	TEKRON		Yes	3	27092					13.33	6.67										
					H031-SSS-NBAY-OWINVRT7	INVERTER	LATRONICS		No	2	25941									1.93	0.97						
					H031-SSS-NBAY-OWNTWK7	SERVER SERIAL PORT 16 x RJ-45 RS-232	PERLE		Yes	5	27633									13.13	10.00						
					H031-SSS-NBAY-OWNTWK7	SWITCH E/NET 32PRT RUGGED RSG2300 OPSWAN	RUGGEDCOM		No	3	30818									4.32	3.60						
					H031-SSS-NBAY-OWNTWK7	SERVER PORT 48VDC PERLE 04030450 -OPSWAN	PERLE		No	2	27733									4.67	3.89						
					H031-SSS-NBAY-OWNTWKT	ROUTER CISCO 2811 48VDC - OPSWAN	CISCO		Yes	0	27651									9.58	7.99						
OpsWAN	Building +8 - Aux Control, Timing, OpsWAN & Common RTU	+8B1	2006	4.00	H031-SSS-NBAY-LCF8	LOCAL CONTROL FACILITY PC X TERMINAL	WYSE		Yes	2	35961					4.14	3.45					4.00	4.00	2044-2048	2026/27 (b)		
					H031-SSS-NBAY-LCF8	MONITOR	SAMSUNG		Yes							1.93	1.61										
					H031-SSS-NBAY-RTUCOM8	REMOTE TERMINAL UNIT FOXBORO C50	FOXBORO		Yes	0	27363					12.81	6.40										
					H031-SSS-NBAY-TIMING8	GPS CLOCK TEKRON TCG01-D:1	TEKRON		Yes	3	27092					13.33	6.67										
					H031-SSS-NBAY-OWINVRT8	INVERTER 125VDC/240VAC 1800W	LATRONICS		No	2	25941									1.93	0.97						
					H031-SSS-NBAY-OWNTWK8	SWITCH E/NET 32PRT RUGGED RSG2300 OPSWAN	RUGGEDCOM		No	3	30818									4.32	3.60						
					H031-SSS-NBAY-OWNTWK8	SERVER PORT 48VDC PERLE 04030450 -OPSWAN	PERLE		No	2	27733									4.67	3.89						
					H031-SSS-NBAY-OWNTWK8	SUBRACK I/FACE IOLAN SVR TO SEL - OPSWAN	PERLE		No	10	27735									0.87	0.72						
OpsWAN Camera	OpsWAN Camera		2005	4.29	H031-SSS-IONS-HARDWARE	AXIS ETHERNET CAMERA ASSEMBLY H031WCOA	Take a Look		No	10	33869									16.14	10.00						
					H031-SSS-IONS-HARDWARE	AXIS ETHERNET CAMERA ASSEMBLY H031WCOB	Take a Look		No	10	33869									12.81	10.00						
OpsWAN	Building T - Aux Control, Timing, OpsWAN & Common RTU	+T-OPSWAN	2010	2.86	H031-SSS-NBAY-LCFT	LOCAL CONTROL FACILITY PC X TERMINAL	WYSE		Yes	2	35961					4.14	3.45					2.86	2.86	2048-2052	2030/31 (b)		
					H031-SSS-NBAY-LCFT	MONITOR	SAMSUNG		Yes							1.93	1.61										
					H031-SSS-NBAY-OWNTWKT	SWITCH E/NET 32PRT RUGGED RSG2300 OPSWAN	RUGGEDCOM		No	3	30818									9.58	7.99						
					H031-SSS-NBAY-OWPRINTT	PRINTER	HEWLETT PACKARD		Yes	0	26840									9.58	7.99						
					H031-SSS-NBAY-OWSERVT	OPSWAN GEN 3 SERVER	TLC IT SOLUTIONS		Yes	0	37040									5.28	4.40						
Power System Monitoring	High Speed Monitoring and Power Quality System (IDM Qualitrol)	+7A7	2010	2.86	H031-SSS-NBAY-PSPM	LOCAL STORAGE UNIT HATHAWAY LSU 125VDC	HATHAWAY		Yes	0	30162					9.58	4.79					2.86	2.86	2048-2052	2030/31 (b)	2048-2052	2048-2052
					H031-SSS-NBAY-PSPM	RECORDER HATHAWAY IDM HSM 16CH 2A	HATHAWAY		Yes	0	30159					9.62	4.81										
					H031-SSS-NBAY-PWRQUAL1	PQ ANALYSER UNIPOWER UP-2210-R VT 32MB	UNIPOWER		Yes	4	37441					2.66	1.33										
					H031-SSS-NBAY-PWRQUAL1	1VT HARMONIC MONITOR DEVICE TRENCH A	TRENCH		No	3	33219					2.67	1.33										
					H031-SSS-NBAY-PWRQUAL1	1VT HARMONIC MONITOR DEVICE TRENCH B	TRENCH		No	3	33219					2.67	1.33										
					H031-SSS-NBAY-PWRQUAL1	1VT HARMONIC MONITOR DEVICE TRENCH C	TRENCH		No	3	33219					2.67	1.33										
					H031-SSS-NBAY-PWRQUAL2	PQ ANALYSER UNIPOWER UP-2210-R VT 32MB	UNIPOWER		Yes	4	37441					2.66	1.33										

APPENDIX A - H031 MOLENDINAR 275/110 KV SUBSTATION - 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 Condition only, Exclude consideration 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)
BLDG +6 DC AUXILIARY SUPPLY	BUILDING +6 125V DC X BATTERY		2017	2.50		BUILDING +6 125V DC X BATTERY	CENTURY YUASA	[redacted]																	2029		
	BUILDING +6 125V DC X BATTERY MONITOR AND CHARGER	+6A27	2009	5.50		BUILDING +6 125V DC X BATTERY MONITOR AND CHARGER	RECTIFIER TECHNOLOGIES																		2029		
	BUILDING +6 125V DC Y BATTERY		2017	2.50		BUILDING +6 125V DC Y BATTERY	EXIDE																		2029		
	BUILDING +6 125V DC Y BATTERY MONITOR AND CHARGER	+6A27	2009	5.50		BUILDING +6 125V DC Y BATTERY MONITOR AND CHARGER	RECTIFIER TECHNOLOGIES																		2029		
	BUILDING +6 125V DC DISTRIBUTION BOARD		2009	5.50		BUILDING +6 125V DC DISTRIBUTION BOARD																			2029		
BLDG +7 DC AUXILIARY SUPPLY	BUILDING +7 125V DC X BATTERY		2006	10.00		BUILDING +7 125V DC X BATTERY	EXIDE																		2018		
	BUILDING +7 125V DC X BATTERY MONITOR AND CHARGER	+7C1	2006	7.00		BUILDING +7 125V DC X BATTERY MONITOR AND CHARGER	RECTIFIER TECHNOLOGIES																		2026		
	BUILDING +7 125V DC Y BATTERY		2006	10.00		BUILDING +7 125V DC Y BATTERY	EXIDE																		2018		
	BUILDING +7 125V DC Y BATTERY MONITOR AND CHARGER	+7C1	2006	7.00		BUILDING +7 125V DC Y BATTERY MONITOR AND CHARGER	RECTIFIER TECHNOLOGIES																		2026		
	BUILDING +7 125V DC DISTRIBUTION BOARD		2006	7.00		BUILDING +7 125V DC DISTRIBUTION BOARD																			2026		
BLDG +8 DC AUXILIARY SUPPLY	SVC BUILDING +8 125V DC X BATTERY		2006	10.00		SVC BUILDING +8 125V DC X BATTERY	CENTURY YUASA																		2018		
	SVC BUILDING +8 125V DC X BATTERY MONITOR AND CHARGER	+8C1	2006	7.00		SVC BUILDING +8 125V DC X BATTERY MONITOR AND CHARGER	RECTIFIER TECHNOLOGIES																		2026		
	SVC BUILDING +8 125V DC Y BATTERY		2006	10.00		SVC BUILDING +8 125V DC Y BATTERY	EXIDE																		2018		
	SVC BUILDING +8 125V DC Y BATTERY MONITOR AND CHARGER	+8C1	2006	7.00		SVC BUILDING +8 125V DC Y BATTERY MONITOR AND CHARGER	RECTIFIER TECHNOLOGIES																		2026		
	SVC BUILDING +8 125V DC DISTRIBUTION BOARD		2006	7.00		SVC BUILDING +8 125V DC DISTRIBUTION BOARD																			2026		

Planning Report		29 August 2025
Title	CP.02756 – H031Molendinar Secondary Systems Replacement	
Zone	Gold Coast	
Need Driver	Emerging compliance risks arising from condition and obsolescence of Molendinar's ageing secondary systems.	
Network Limitations and statutory requirements	Molendinar Substation is required to meet Powerlink Queensland's N-1-50MW/600MWh Transmission Authority reliability standards and maintain power transfer capability to the Gold Coast.	
Pre-requisites	None	

Executive Summary

Ageing and obsolete secondary systems at Molendinar 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 Gold Coast zone. The removal or reconfiguration of the Molendinar 275/110kV Substation due to secondary system failure/obsolesce would violate Powerlink's N-1-50MW/600MWh Transmission Authority reliability standard and significantly impact the power transfer capability into the Gold Coast.

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

Table of Contents

[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)).

1. Introduction

The Molendinar Substation (H031) was established in 2003. It is located approximately 75km south-east of Brisbane and is one of two major injection points into the Gold Coast zone.

Molendinar Substation is a 275/110kV transformer ended substation, supplied from Greenbank Substation by a 275kV double circuit transmission line into two 375MVA 275/110kV transformers.

The 110kV network from Molendinar to Mudgeeraba links the coastal bulk supply points at Southport, Surfers Paradise and Broadbeach via an underground cable network and an inland 110kV overhead double circuit that supplies Robina and Nerang substations. The 110kV overhead and cable network is owned and operated by Energy Queensland.

Figure 1 and Figure 2 show the geographic location of the Molendinar Substation within south east Queensland.

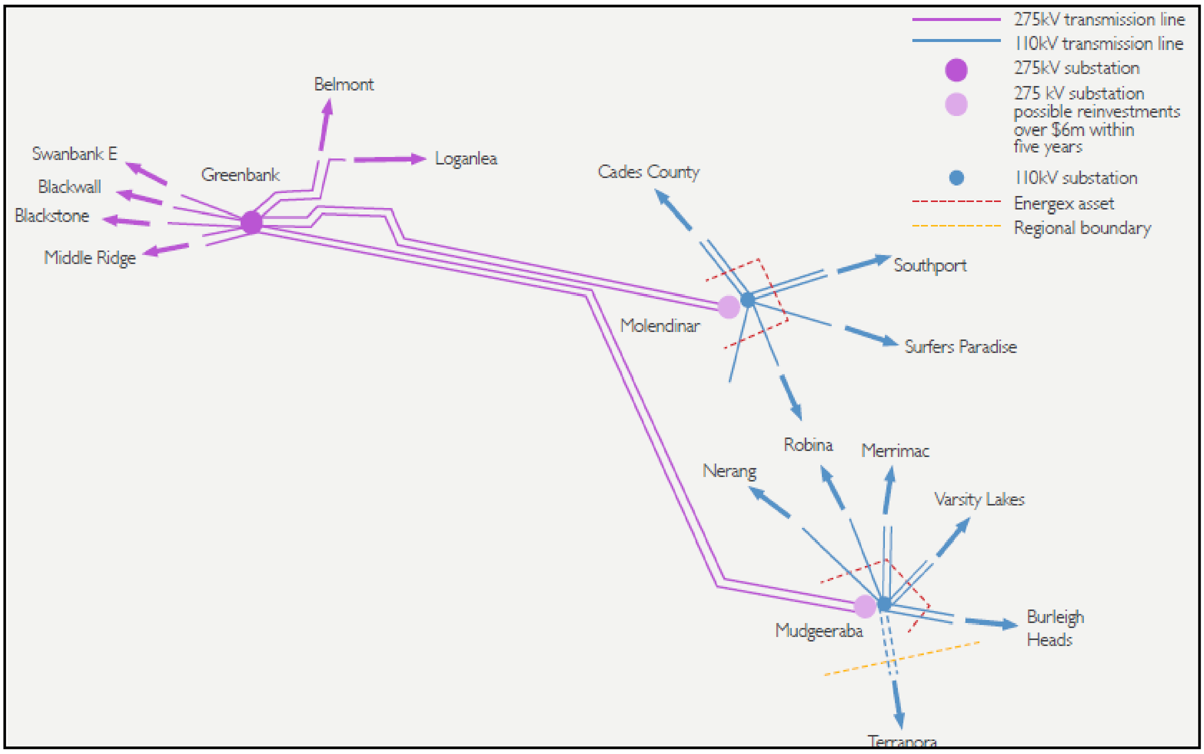


Figure 1. Molendinar Substation – Gold Coast

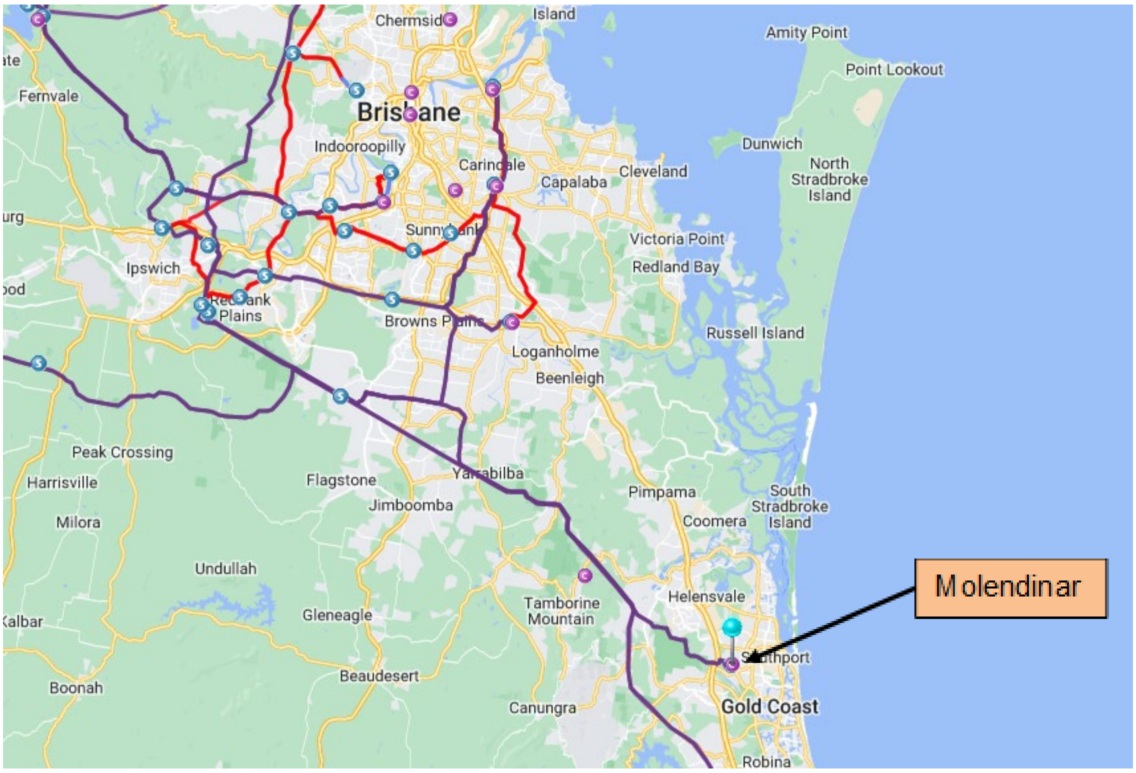


Figure 2. Molendinar Substation – Gold Coast

The condition assessment confirmed end of technical service life, with many components no longer supported by the manufacturer and limited spares availability. Increasing failure rates, along with the increased time to rectify faults due to the obsolescence of the equipment, significantly affects the availability and reliability of these systems and their ability to continue to meet the requirements of the National Electricity Rules (the Rules).

In addition to the site-specific impacts of obsolescence at Molendinar 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 Molendinar Substation.

2. H013 Molendinar Substation configuration

Figure 3 shows the operational configuration of the Molendinar Substation. The substation consists of:

1. Two 275/110kV transformer ended feeders from Greenbank Substation, and
2. A 110kV switchyard which provides 2 x 275/110kV transformer bays, 12 x 110kV feeder/transformer bays for Energex and 3 x capacitor bank bays.

[redacted]

Figure 3. Molendinar Substation operational diagram

3. Gold Coast zone Demand Forecast

Figure 3 shows that the maximum demand in the Gold Coast (connected to Mudgeeraba and Molendinar) is forecasted to experience continuous growth in the coming years.

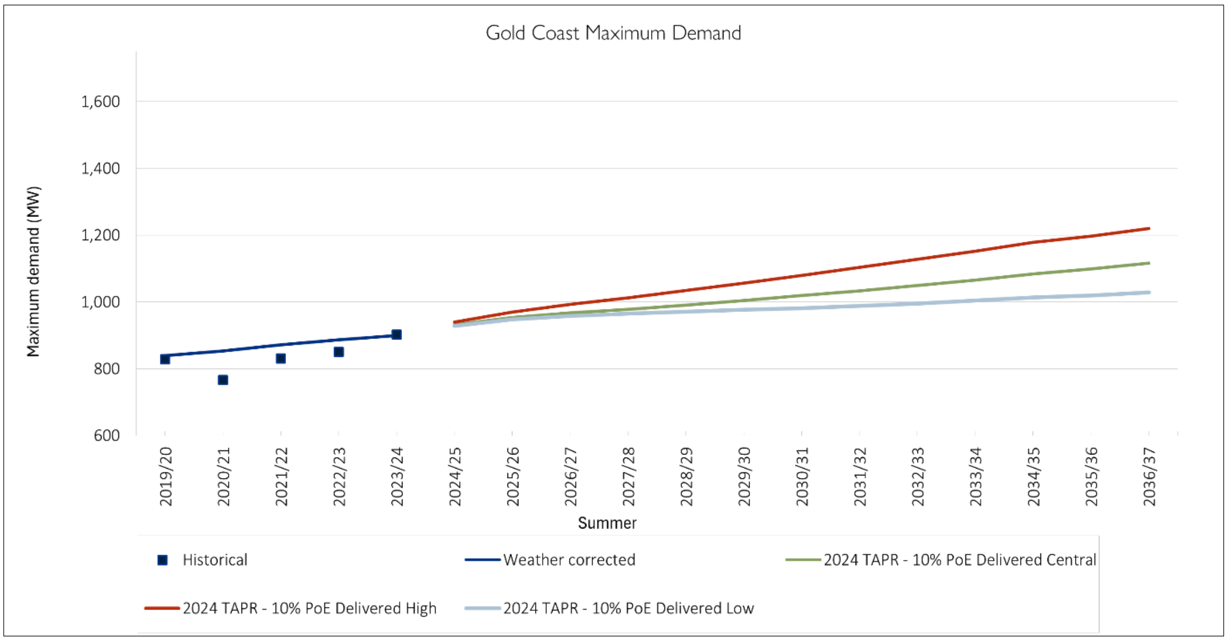


Figure 2 – Gold Coast zone Maximum Demand

With consideration of rooftop PV within the Energex network supplied from Molendinar and Mudgeeraba substations, the maximum customer load is significantly higher. Figure 4 shows that rooftop PV meets up to 400MW of underlying demand.

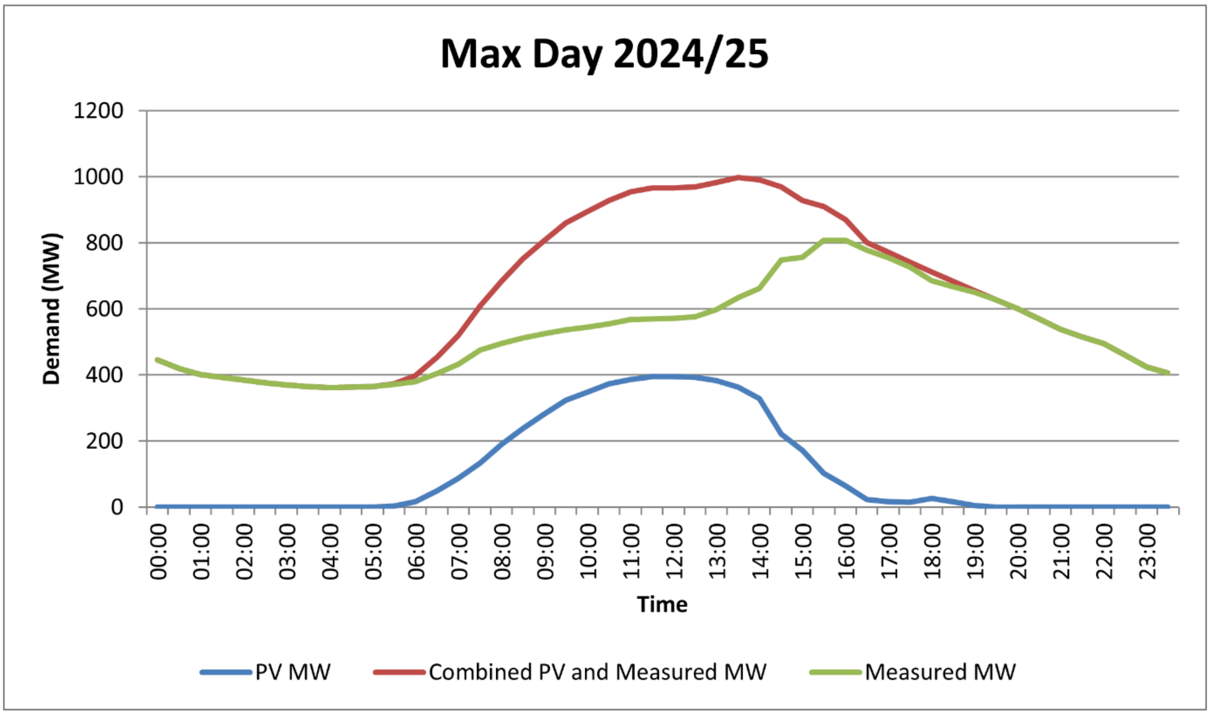


Figure 3. Max Day Profile 2024/25

Figure 5, shows the historical load duration curve of the Gold Coast zone with the contribution of rooftop PV excluded.

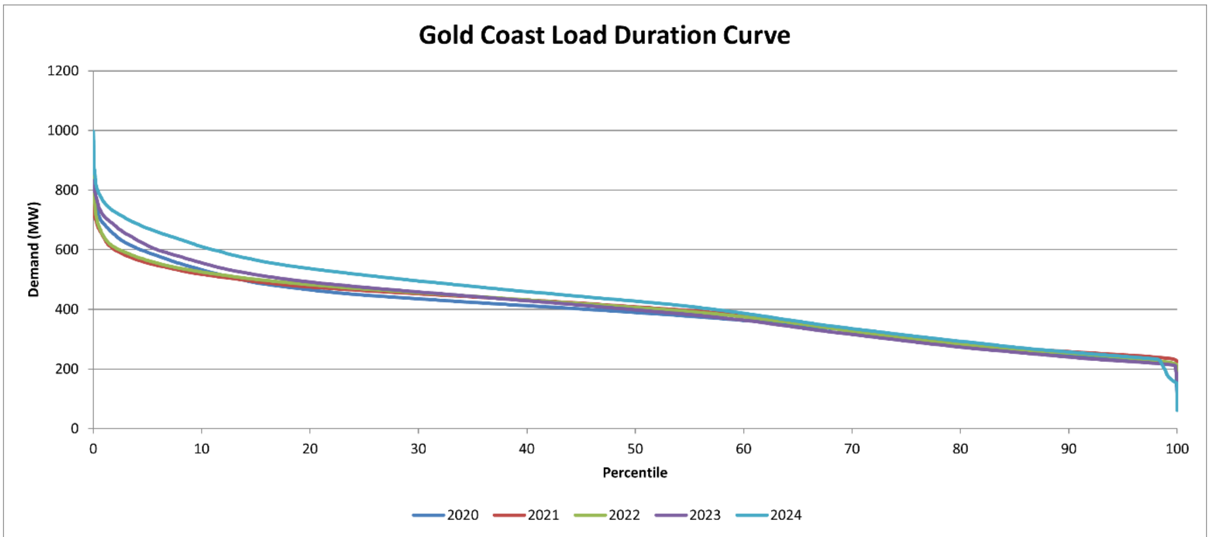


Figure 5. Gold Coast zone Load (rooftop PV out-of-service)

Figure 6, shows the comparative load duration curve for the delivered demand (i.e. with the contribution from the rooftop PV included).

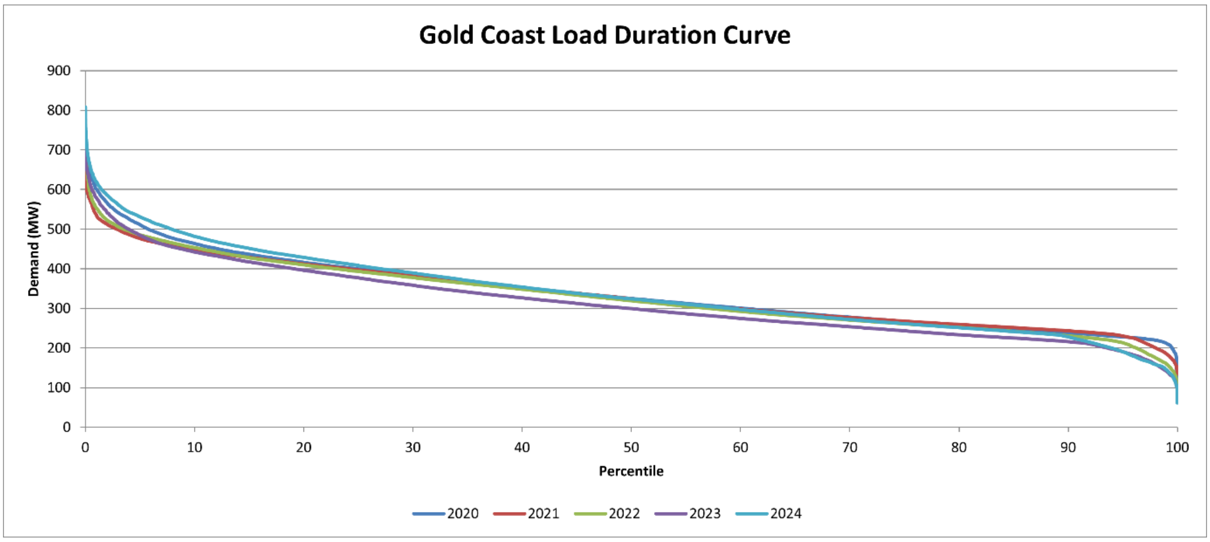


Figure 4 - Gold Coast zone Load (rooftop PV in-service)

There are no new large block loads committed in the Gold Coast zone for the Central scenario forecast. However, there is an existing load that is investigating a potential 20MVA increase in its maximum demand within the forecast period. This is not yet committed but would be supplied from Varsity Lakes and Terranora.

4. Statement of Investment Need

The Molendinar Substation is a major bulk supply point for Energex (Energy Queensland) loads in the Gold Coast zone. Therefore, addressing the risks arising from the condition of the secondary systems by removing the functionality of the Molendinar Substation would have a major impact on the performance of the Gold Coast grid section as well as impact the reliability of supply to the loads in the Northern Gold Coast zone (particularly loads at Cades County, Molendinar and Southport).

Therefore, replacement of the secondary systems at Molendinar Substation is required to allow continued operation of the substation and avoid system failures that would result in loss of load exceeding Powerlink's N-1-50MW / 600MWh Transmission Authority reliability standard and power transfer capability into the God Coast zone.

5. Network Risk

Table 1 defines the maximum and average forecast load suppled from the 110kV at Molendinar for summer 2027/28. The underlying load values represent the actual customer load (i.e. exclude the contribution for rooftop PV).

Table 2 summarises the results of analysis to determine the load and energy at risk for loads connected to the Molendinar Substation at 110kV. The estimates take into account the expected level of rooftop PV connected to the Energex network supplied from Molendinar. This level of rooftop PV is discounted to capture the total level of customer load at risk of not being supplied.

Table 1. Load Data

Measure	2027/28
Max Underlying Load (MW)	530
Avg Underlying Load (MW)	199
Max Delivered Load (MW)	388
Avg Delivered Load (MW)	148

Table 2. Molendinar underlying 110kV Load at Risk

At Risk	Contingency	Metric	2027/28
Molendinar, Cades County and Southport	1T 275/110kV sec sys and outage of 2T caused by (2T sec sys or trip 8825) 2T 275/110kV sec sys and outage of 1T caused by (1T sec sys or trip 8824)	Max (MW) > capacity limit	530
		Average Annual (MW) > capacity limit	199
		24h Potential Energy Constrained Max (MWh)	7004
		24h Potential Energy Constrained Annual Average (MWh)	4776
Molendinar 33kV[1]	10T 110/33kV sec sys and outage of 11T or 12T caused by (sec sys or trip of 11T or 12T) Note: there are 3 combinations to be considered	Max (MW) > capacity limit	121
		Average Annual (MW) > capacity limit	1
		24h Potential Energy Constrained Max (MWh)	587
		24h Potential Energy Constrained Annual Average (MWh)	22
Molendinar 11kV	4T 110/11kV sec sys and outage of 6T caused by (sec sys or trip of 6T) 6T 110/11kV sec sys and outage of 4T caused by (sec sys or trip of 4T)	Max (MW) > capacity limit	104
		Average Annual (MW) > capacity limit	32
		24h Potential Energy Constrained Max (MWh)	1119
		24h Potential Energy Constrained Annual Average (MWh)	779

Nerang	798 sec sys and outage of trip of 706 caused by (sec sys at H004 or trip of 706)	Max (MW) > capacity limit	96
		Average Annual (MW) > capacity limit	35
		24h Potential Energy Constrained Max (MWh)	1260
		24h Potential Energy Constrained Annual Average (MWh)	828
Robina	7229 sec sys and outage of trip of 794 caused by (sec sys at H004 or trip of 794)	Max (MW) > capacity limit	58
		Average Annual (MW) > capacity limit	25
		24h Potential Energy Constrained Max (MWh)	1158
		24h Potential Energy Constrained Annual Average (MWh)	610
Cades County	7193 sec sys and outage of 7297 caused by (sec sys or trip of 7297) 7193 sec sys and outage of 7297 caused by (sec sys or trip of 7297)	Max (MW) > capacity limit	118
		Average Annual (MW) > capacity limit	37
		24h Potential Energy Constrained Max (MWh)	1375
		24h Potential Energy Constrained Annual Average (MWh)	890
Southport	F907 sec sys and outage of F917 caused by (sec sys or F917 trip) F917 sec sys and outage of F907 caused by (sec sys or F907 trip)	Max (MW) > capacity limit	90
		Average Annual (MW) > capacity limit	46
		24h Potential Energy Constrained Max (MWh)	1633
		24h Potential Energy Constrained Annual Average (MWh)	1111

[1] *There remains one transformer with a cyclic normal rating of 108 MVA.*

6. Non-Network Options

The Molendinar Substation facilitates 275kV flow between Brisbane and the Gold Coast zone. The substation hosts two 275/132kV transformers to supply to Energex loads in the northern area of the Gold Coast (Cades County, Molendinar, Southport, Surfers Paradise and Nerang).

To meet the Molendinar demand, potential non-network solutions must be capable of delivering up to 530 MW and 7004 MWh per day.

Powerlink is not aware of any Demand Side solutions (DSM) in the Gold Coast zone supplied from Molendinar Substation. 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.

7. Network Options

7.1 Proposed Option to Address Identified Need

To address the emerging age and obsolescence of the Molendinar Substation secondary systems it is recommended that all secondary systems reaching end of life be replaced. This ensures that Powerlink's Transmission Authority reliability standard is maintained.

This option ensures that reliability of supply and asset condition criteria are met as well as maintaining the power transfer capability into the Gold Coast zone.

Powerlink considers the proposed network solution will not have any material inter-network impact, and as such does not need to formally consult with other Market Participants.

7.2 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 driver (secondary systems condition and obsolescence) and associated safety, reliability and compliance risks are not addressed.

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 System Standards of the National Electricity Rules and its Transmission Authority.

6.2.2 Decommission some functionality of Molendinar Substation

Table 2 shows that the 275/110kV injection into Molendinar is critical for Powerlink maintaining the N-1-50MW/600MWh Transmission Authority reliability standard. Without this injection

- greater transformation capacity would need to be provided at Mudgeeraba and Loganlea substation. This itself would drive transmission limitations between Mudgeeraba and Greenbank and between Loganlea and Molendinar

- more 110kV tie capacity would need to be established between Mudgeeraba and Loganlea.

This is not a viable cost-effective option and has not been considered further.

In addition, not replacing the secondary systems related to the 110/33kV or 110/11kV transformer bays is also not cost-effective as there is little to no 11kV transfer capacity from Molendinar. There is 40MW of 33kV transfer between Molendinar and Coomera. However, the peak load at risk is 121MW (refer Table 2) and transferring 40MW is sufficient to exceed the capability of the Coomera network.

The conclusion is that excluding any of the 110/33kV or 110/11kV transformer bays from the secondary system replacement would require significant investment in additional tie capacity and transformation capacity at the neighbouring Energex substations.

There are three 110kV 50MVAr capacitor bank bays at Molendinar. Number 5 Capacitor bank is to be decommissioned. The remaining two capacitor banks have from 20-years of remaining service life. The two capacitor banks are switched to maintain acceptable voltage profile and reactive power dispatch within the Gold Coast zone. Both have been switched in up to 5% of time and either capacitor bank has been switched in greater than 20% of time. The capacitors are also required to support the Gold Coast zone following contingency events.

Figure 3 shows that the maximum demand in the Gold Coast zone is forecast to experience continuous growth in the coming years. Therefore, there is a growing need for this capacitive compensation. Reactive power needs to be supplied locally. Given the scarcity and value of land it is also very unlikely that large-scale battery energy storage systems will locate in the vicinity of Molendinar and replace the enduring need for these capacitor banks.

8. Recommendation

Powerlink has assessed the condition of the secondary systems at Molendinar Substation and concludes they will reach end of technical service life from 2026.

It is recommended that all secondary systems reaching end of life be replaced.

Retaining the Molendinar Substation capacity and functionality will allow Powerlink to continue to meet its required reliability obligations (N-1-50MW/600MWh) and maintain the power transfer capability from Brisbane into the Gold Coast zone.

9. References

1. H031 Molendinar 275/110kV Substation – Secondary Systems Condition Assessment Report
2. Project Scope Report CP.02756 H031 Molendinar Secondary Systems Replacement
3. 2025 Transmission Annual Planning Report (A6049612)
4. Asset Planning Criteria - Framework (ASM-FRA-A2352970)
5. Powerlink Queensland's Transmission Authority T01/98

10. Appendix A – Network Risk methodology

Feeders 8824 & 8825

When the Gold Coast load exceeds approximately 550MW and one of the 275kV transformer-ended feeders is out-of-service (8824 or 8825), then the 110kV Energy Queensland network between Molendinar and Mudgeeraba must be opened to return the system to a secure state. The 110kV coastal underground cable system is opened between Molendinar and Surfers Paradise. The inland 110kV overhead lines are also opened, supplying Nerang and Robina from Mudgeeraba. The 110kV network to the north is also opened between Cades County and Coomera. As a result, for the outage of the remaining 275kV transformer-ended feeder the large load centres at Molendinar, Cades County, Southport and Surfers Paradise will be lost. This arrangement is shown in Figure 5.

A non-network proponent would need to continuously (pre-contingent) reduce the Gold Coast load to less than 550MW to avoid the need to split.

[redacted]

Figure 5 - Molendinar Transformer-ended Feeder Outage Switching

Molendinar 110/33kV Transformers

With a 110/33kV transformer out-of-service, the 33kV Molendinar load would have to be made ready to shed for the loss of another transformer in order to maintain system security. This means that (at least post-contingent) the load would need to be reduced to the rating of the smallest remaining transformer (i.e. either T10 or T11).

Molendinar 110/11kV Transformers

With a 110/11kV transformer out-of-service all 11kV Molendinar load is lost following a trip of the remaining transformer.

Project Scope Report

CP.02756 Molendinar Secondary Systems Replacement

Concept – Version 3

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 Details

1. Project Need & Objective

H031 Molendinar Substation, located approximately 75km south-west of the Brisbane CBD, is one of two major injection points into the Gold Coast area. It was established in 2003 and is supplied from Greenbank Substation by a 275kV double circuit transmission line. The circuits are transformer ended by two 375MVA 275/110kV transformers. The 110kV network from Molendinar to Mudgeeraba links the coastal bulk supply points at Southport, Surfers Paradise and Broadbeach via an underground cable network. An inland overhead 110kV network supplies Robina and Nerang substations.

A condition assessment of the Molendinar substation secondary systems identifies various secondary systems components be replaced. The recommended timing of the various equipment is outlined in detail in the condition assessment report and shall inform the basis for project staging and the priority of replacement timing to both manage the need and risk.

The objective of this project is to complete replacement of the secondary systems at Molendinar by December 2030.

This project will follow the two (2) stage approval process.

2. Project Drawing

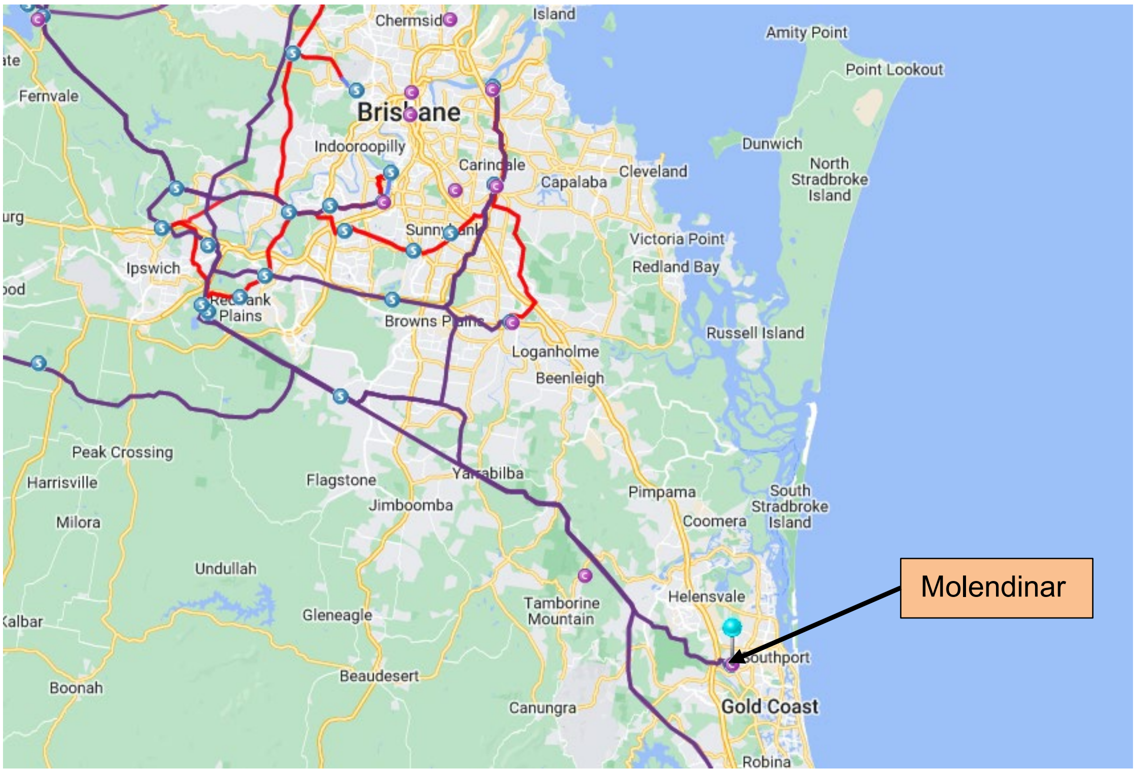


Diagram 1 – Locality of H031 Molendinar Substation

3. Deliverables

The following deliverables must be provided in response to this Project Scope Report:

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. As this project will follow the two (2) stage approval process, provide a separate estimate for stage 1 development phase costs which include project planning, design and preliminary works. Also provide the schedule and time information to align with 2-stage approval.

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 6 Special Considerations*.

Briefly, the project consists of the replacement of secondary systems equipment at H031 Molendinar Substation. Three options, replacement in a new building, replacement in the existing building, and an in-panel replacement option shall be investigated and estimated within the scope of this project.

4.1.1. Transmission Line Works

Not applicable

4.1.2. H031 Molendinar Substation Works

Design, procure, construct and commission replacement of the following secondary systems equipment and selected CVT replacements for the three options outlined in Section 11:

- Priority 1 Works – Replacement of the secondary systems and auxiliary equipment including:
  - 1 Transformer PLC;
  - X and Y Protection Relays and [redacted] RTU - 12 Transformer HV CB bay;
  - X and Y Protection Relays and [redacted] RTU - 1 Transformer LV CB bay;
  - X and Y Protection Relays, [redacted] RTU and Point on wave - 4 Cap CB bay;
  - X and Y Protection Relays and [redacted] RTU - 1 Transformer HV CB bay;
  - X and Y Protection Relays, [redacted] - Feeder 8824;
  - Revenue Meter - 2T (110kV); and
  - SCADA and OpsWAN - Building +6.

- Priority 2 Works – Replacement of the secondary systems and auxiliary equipment including
  - 2 Transformer PLC;
  - X and Y Protection Relays and [redacted] RTU - 1 Bus Zone, 2 Bus Zone
  - X and Y Protection Relays and [redacted] RTU - 1-2 Bus Section CB bay, 1-3 Bus Section CB bay;
  - X and Y Protection Relays and [redacted] RTU - 10 Transformer HV CB bay, 11 Transformer HV CB bay;

- X and Y Protection Relays and [redacted] RTU - 2 Transformer LV CB bay;
- X and Y Protection Relays and [redacted] RTU - Stub CB bay, 1 Bus to Energex Transformer 4, and Stub CB bay, 2 Bus to Energex Transformer 6;
- X and Y Protection Relays, [redacted] RTU and Point on wave - 3 Cap CB bay;
- Decommission 5 CAP X and Y Protection Relays and [redacted] RTU and removal of HV bay equipment, structures, and capacitor bank;
- X and Y Protection Relays and [redacted] RTU - 2 Transformer HV CB bay;
- X and Y Protection Relays and [redacted] RTU - F7193, F7229, F7297, F907, F916, F917, F798;
- X and Y Protection Relays, [redacted] RTU – Feeder 8825;
- Revenue Meter - 1T (110kV);
- OpsWAN - Building +7, Building +8;
- Battery charger,monitor and DC distribution boards (excluding batteries) - Building +7, Building +8;
- Establish WAMPAC schemes for the control of Gold Coast load blocks
- 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.
- Decommissioning of metering equipment – Feeder F916, F917, 907, 7292, 7193, 7229, 798, Transformer T6, Transformer T4, 33kV 12 Transformer 3T121, Transformer 10 33kV*, Transformer 11 33kV*, Transformer 12 33kV*, Future 110/33kV Transformer*

* Meters located in the Energex building and belong to Yurika

- Replacement of Trench CVT's;
  - 7VT, 8VT, 9VT, 10VT, 11VT, 12VT, 13VT, and 14VT.

Decommission and recover all redundant equipment, and update drawing records, SAP records, config files, etc. accordingly.

4.1.3. Remote End Substation Works

Modify protection, control, automation and communications systems as necessary. Liaise and coordinate remote end works nominally for connections to Energy Queensland substations at Broadbeach, Molendinar, Nerang, Robina and Cades County substations

4.1.4. Telecoms Works

As required to ensure functionality of the new protection equipment.

4.1.5. Easement/Land Acquisition & Permits Works

Not applicable

4.2. Key Scope Assumptions

Not Applicable

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).

Refer to the Condition Assessment Report for detailed replacement timing. The priority of replacements shall align to the stated replacement timings.

6. Project Timing

6.1. Stage 1 Project Approval Date

The anticipated date by which the project will be approved is 30/06/2026. Note this project is subject to the RIT-T process.

6.2. Site Access Date

The expected site access date (SAD), when the site is available for Powerlink construction works to commence, is from date of project approval.

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;

- Priority 1 Works 30/06/2029; and
- Priority 2 and CVT Replacement Works 31/12/2030.

7. Special Considerations

Not applicable

8. Asset Management Requirements

Equipment shall be in accordance with Powerlink equipment strategies.

Unless otherwise advised [redacted] 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.

9. Asset Ownership

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

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

Provide class 5 estimate for the scope of work outlined in 4.1.2 for the following three options:

- Option 1 – Complete replacement in new buildings
- Option 2 – Complete replacement in the existing buildings
- Option 3 – In-situ replacement of the equipment.

12. Division of Responsibilities

Not applicable

13. Related Projects

Project No.	Project Description	Planned Comm Date	Comment
Pre-requisite Projects			
Co-requisite Projects			
CP.02984	Trench CVT Replacement – South Phase 1	Dec 2027	
Other Related Projects			
CP.02929	Sumner Secondary Systems Replacement	June 2024	Trials in panel replacement
OR.02428	SDM7 Insitu relay Replacement Trial	June 2023	Develops methodology for in panel replacement

CP.02756 H031 Molendinar Secondary Systems Replacement

Concept Estimate

Table of Contents

1. Executive Summary

This concept estimate has been developed based on the CP.02756 H031 Molendinar Secondary Systems Replacement PSR.

H031 Molendinar Substation, located approximately 75km south-west of the Brisbane CBD, is one of two major injection points into the Gold Coast area. It was established in 2003 and is supplied from Greenbank Substation by a 275kV double circuit transmission line into two 375MVA 275/110kV transformers. The 110kV network from Molendinar to Mudgeeraba links the coastal bulk supply points at Southport, Surfers Paradise and Broadbeach via an underground cable network, and an inland overhead 110kV network supplies Robina and Nerang substations to the south and Cades County Substation to the north.

A condition assessment of the Molendinar substation secondary systems identified various secondary systems components to be replaced.

The assessment in this proposal has established that the project can be delivered by February 2031.

The project will follow the two (2) stage approval process.

1.1 Project Estimate

No escalation costs have been considered in this estimate.

		Total ($)
Estimate Class	5	
Base Estimate – Un-escalated (2025/2026)		52,605,071
TOTAL		**52,605,071**

1.2 Project Financial Year Cash Flows

No escalation costs have been considered in this estimate.

DTS Cash Flow Table	Un-Escalated Cost ($)
To June 2026	127,881
To June 2027	170,509
To June 2028	13,825,172
To June 2029	13,842,002
To June 2030	14,440,313
To June 2031	9,817,648
To June 2032	381,546
TOTAL	**52,605,071**

2. Project and Site-Specific Information

2.1 Project Dependencies & Interactions

This project is related to the following projects:

Project No.	Project Description	Planned Commissioning Date	Comment
Dependencies			
OR.02404	H031 Molendinar PASS M0 Refurbishment	September 2030	Upgrades of all PASS M0 units at H031 Molendinar.
Interactions			
CP.02813	Telecommunications Network Consolidation RAN4	June 2032	SDH and PDH Multiplexer replacement program.
CP.02822	OpsWAN and MPLS Replacement RAN4	June 2032	OpsWAN and MPLS Router replacement program.
Other Related Projects			
CP.02984	Trench CVT Replacement – South Phase 1	December 2027	Statewide CVT Replacement

2.2 Site Specific Issues

- H031 Molendinar substation is located on Ashmore Rd, in the Gold Coast. The substation is comprised of a Powerlink switchyard, and an Energex switchyard, separated by a fence boundary.
- The Gold Coast area is subject to the following average number of days of rain. Consideration was given to this when developing the project schedule.

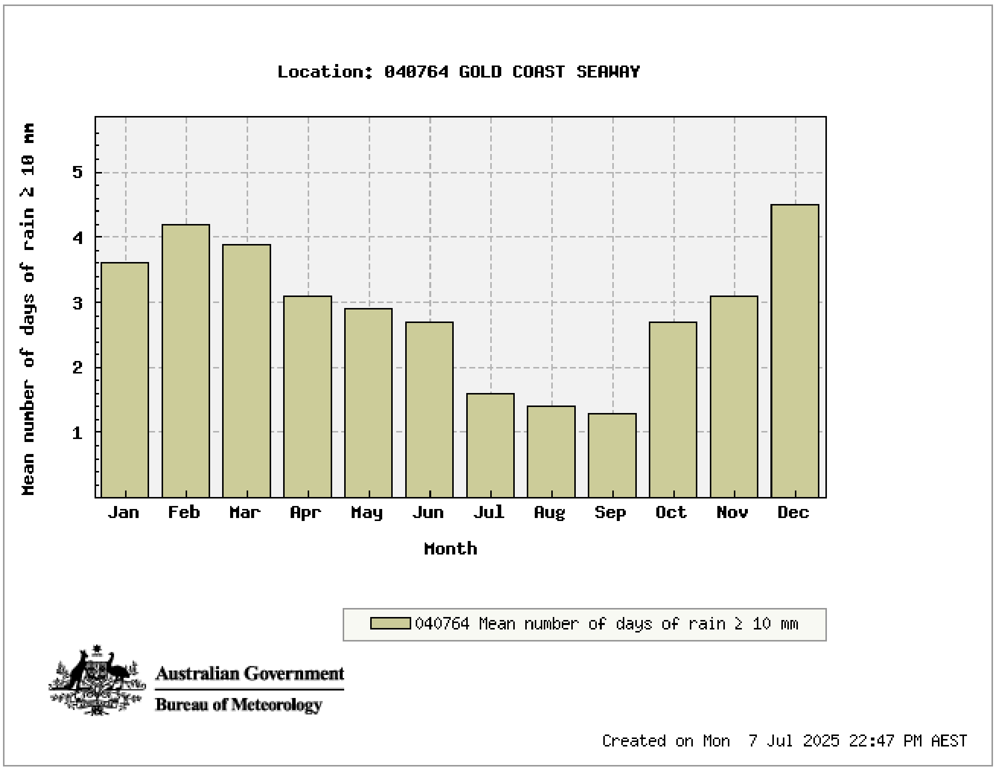


Figure 1 - Number of Days of Rain >10mm Gold Coast (Source: Bureau of Meteorology 7th July 2025)

3. Project Scope

3.1 Substation Works

H031 Molendinar

Design, procure, construct and commission complete replacement of the H031 Molendinar substation secondary systems equipment and selected CVT replacements.

Establish new secondary systems panels and associated common control, protection and monitoring equipment in new buildings replacing buildings +6, +7 and +8 with two new buildings. These require:

- New foundations for the new control building and marshalling kiosks.
- Trenching from the control building to the existing trenches in the yard including cable pits.
- Underground conduits where cables are leaving or entering trenches or trenches are not suitable.
- Decommission and removal of CAP Bank 5 and associated HV bay equipment and structures.
- Replacement of the secondary systems and auxiliary equipment for the following assets:
  - 1T PLC
  - 275kV 1T HV – X and Y Protection Relays and [redacted] RTU
  - 110kV 1T LV – X and Y Protection Relays and [redacted] RTU
  - 110kV 12T HV – X and Y Protection Relays and [redacted] RTU
  - 4CAP – X and Y Protection Relays, [redacted] RTU, and POW Relay
  - 275kV Fdr 8824 – X and Y Protection Relays, [redacted] RTU
  - Revenue Metering for 2T

  - Building +6 – SCADA and OpsWAN
- Replacement of the secondary systems and auxiliary equipment for the following assets:
  - 2T PLC
  - 1BUS, 2BUS, 3 BUS – X and Y Protection Relays and [redacted] RTU
  - 1-2 Bus Section, 1-3 Bus Section – X and Y Protection Relays and [redacted] RTU
  - 110kV 2T LV – X and Y Protection Relays and [redacted] RTU
  - 110kV 10T & 11T HV – X and Y Protection Relays and [redacted] RTU
  - Stub CB4462 & CB4442 - X and Y Protection Relays and [redacted] RTU
  - 3CAP & 5CAP - X and Y Protection Relays, [redacted] RTU and POW Relay
  - 275kV 2T HV – X and Y Protection Relays and [redacted]
  - 110kV Fdr 7193, Fdr 7229, Fdr 7297, Fdr 907, Fdr 916, Fdr 917, Fddr 798 – X and Y Protection Relays and [redacted] RTU
  - 275kV Fdr 8825 – X and Y Protection Relays and [redacted] RTU
  - Revenue Metering for 1T
  - Building +7 & +8 – SCADA and OpsWAN
  - Battery charger, monitor and DC distribution boards
  - Control Building Infrastructure
- Establishment of WAMPAC schemes for control of Gold Coast load blocks.
- 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.
- Coordinate modification of protection, control, automation and communications systems for Energy Queensland assets at H031 Molendinar.
- Decommission and recover all redundant equipment.
- Update drawing records, SAP records, config files, etc. accordingly.

Trench CVT Replacement

- 7VT, 8VT, 9VT, 10VT, 11VT, 12VT, 13VT and 14VT are to be replaced.

Remote Ends

Coordinate modification of protection, control, automation and communications systems for:

- Feeders 8824 & 8825 from S003 Greenbank substation.
- At the following Energex substations.
  - T075 Nerang
  - T081 Cades County
  - T128 Robina
  - SSSPO – Energex Southport Substation
  - SSSPD – Energex Surfers Paradise Substation

3.2 Telecommunication Works

An allowance has been made for telecommunications work. This includes the design, procure, construct and commissioning of the following equipment:

- Powerlink standard SDH equipment.
- Powerlink standard PDH equipment.
- Powerlink standard MPLS routers.
- Fibre optic cable, pits and associated termination panels.
- Voice gateways and associated interface panels.

3.3 Major Scope Assumptions

The following key assumptions were made for this Project Estimate.

- Minor Secondary Systems works only is expected to integrate the remote end substation with the new H031 Molendinar Secondary Systems. All works at the remote end substations will be completed by the MSP.
- Powerlink Internal Design teams and Design Services Panel contractors will carry out the design work.
- Estimate is based on Powerlink architectures, standards and equipment in place and available at the time of development.
- No Restricted Access Zone will be deployed on this site during construction.
- Outages will be available on request. Please refer to Section 4.2 Network Impacts for further details.
- MSP resources will be available to complete the works.
- Procurement of long lead items align with project delivery requirements. Funds will be required in stage 1 approval process to place the order for long lead items.
- Energy Queensland design and construction resources will be available when required to carry out design and construction works on their assets. Timely agreement of Division of Responsibility (DOR) between Energy Queensland and Powerlink for all the works involved.

The following assumptions have been made with respect to Secondary Systems design:

- Design standard of the new secondary systems will be of SDM9.3.
- All new secondary systems and auxiliary equipment will fit within two (2) new control buildings.
- There will be space within the new control buildings to house panels for WAMPAC schemes.
- New cables will be required between the new control building termination racks and bay marshalling kiosks.
- Bay kiosks to be re-used.
- The existing AC supplies for the substation are sufficient for the current and future loads post the completion of the secondary systems replacement, and the AC changeover boards are fit for purpose and will be re-used.
- New relays considered for the upgrade of the remote sites will be suitable for the customer’s needs and requirements.
- All existing panels and equipment located in existing buildings +6, +7, and +8 shall be decommissioned, buildings removed from site and redundant secondary systems cabling to be removed.

The following assumptions have been made with respect to Civil design:

- The existing substation platform and yard drainage system drains freely and is fit for purpose.

- The existing internal substation road is fit for purpose.
- New building foundations will include the provision of bored piers and geo-tech costs.
- Drainage for any new pits shall be provided into the existing drainage system or off the substation platform.
- The CVTs will be replaced utilising existing foundations with use of either new structures or adaptor plates.

3.4 Scope Exclusions

- Easement acquisitions work, including permits, approvals, development applications or the like. All works are within Powerlink-owned land.
- No allowance is included for any Energy Queensland projects that may impact Powerlink works.
- Additional time and cost for Design, Planning and Implementation of any restoration plans required for outages is not included in this estimate.
- No major modification to the earth grid is included in this estimate.
- Removal of rock or unsuitable material, including asbestos and other contaminants.
- This estimate does not include any costs for repairing or modification to the primary plants or secondary systems not listed to be replaced under the scope. That also includes the replacement of CTs on PASS M0 circuit breakers, breaker's control cubicles and associated CT links.
- No modification and upgrading of the internal roads, lights, fences and gates.
- No modification on the existing transmission lines or HV underground cables is considered in this estimate.
- Replacement or upgrade to existing Diesel Generator.
- Replacement of the 50V DC battery system in Telecoms building.
- No allowance has been made for Live Substation works.
- Substation Electrical Design team has determined a bench extension is not required.

4. Project Execution

4.1 Project Schedule

This project will follow the two (2) stage approval process.

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

Milestone	High-Level Timing
Request for Class 5 Estimate	May 2026
Class 5 Project Proposal Submission	August 2026
Request for Class 3 Estimate	October 2026
Class 3 Project Proposal Submission	April 2027
Stage 1 Approval (PAN1) includes funds for design, procurement & ITT preparation	June 2027

RIT-T (assumed 26 weeks)	August 2027 – January 2028
Project Development Phase 1 & Phase 2	June 2027 – January 2028
ITT Submission (8 Weeks)	November 2027 – January 2028
Evaluate Tender, Reconcile Estimate and Submit PMP for Stage 2 Approval	February 2028
Stage 2 Approval (PAN2)	April 2028
Execute Delivery (including award of SPA contract)	April 2028
SPA/MSP Site Establishment	June 2028
SPA Civil Works and Construction	June 2028 – December 2028
Staged Bay Construction and Commissioning	December 2028 – December 2030
Project Commissioning	December 2030
Final Decommissioning & Removal of Redundant Assets	February 2031

4.2 Network Impacts

Powerlink Net Ops – Operating Manual 02 – SE QLD provides the following recommendations for outages of H031 Molendinar feeders and transformers.

- Outages for T1 and T2 are to avoid Summer and only one can be taken out at a time. The feeders associated to these transformers are Category E and will require a recall of ≤12 hours.
- F7193 and F7297 will require confirmation with EQL for a Summer outage before planning.
- Load at Risk – Energy Queensland Gold Coast load

4.3 Resourcing

Resources for the project will be completed by internal design resources with support from external design partners. The construction works will be completed by a combination of the Maintenance Service Providers and Substation Panel contractors.

5. Project Asset Classification

Asset Class	Base ($)	Base (%)
Substation Primary Plant	3,597,097	7%
Substation Secondary Systems including New Buildings and associated civil works.	47,712,123	91%
Telecommunications	1,284,169	2%
Overhead Transmission Line	11,681	0%
TOTAL	**52,605,071**	**100**

6. References

Document name and hyperlink	Version	Date
Project Scope Report	3.0	25/05/2025

Risk Cost Summary Report

CP. 02756

Molendinar 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 Molendinar substation which are proposed for reinvestment under CP.02756. 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 Molendinar 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 $25,060 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 $3.2 million in 2026 to $9.56 million in 2036 and $16 million by 2045. Key highlights of the analysis include:

- Network risk accounts for approximately 78% of the overall risk cost in 2030 with financial risk accounting for the remaining 22%.

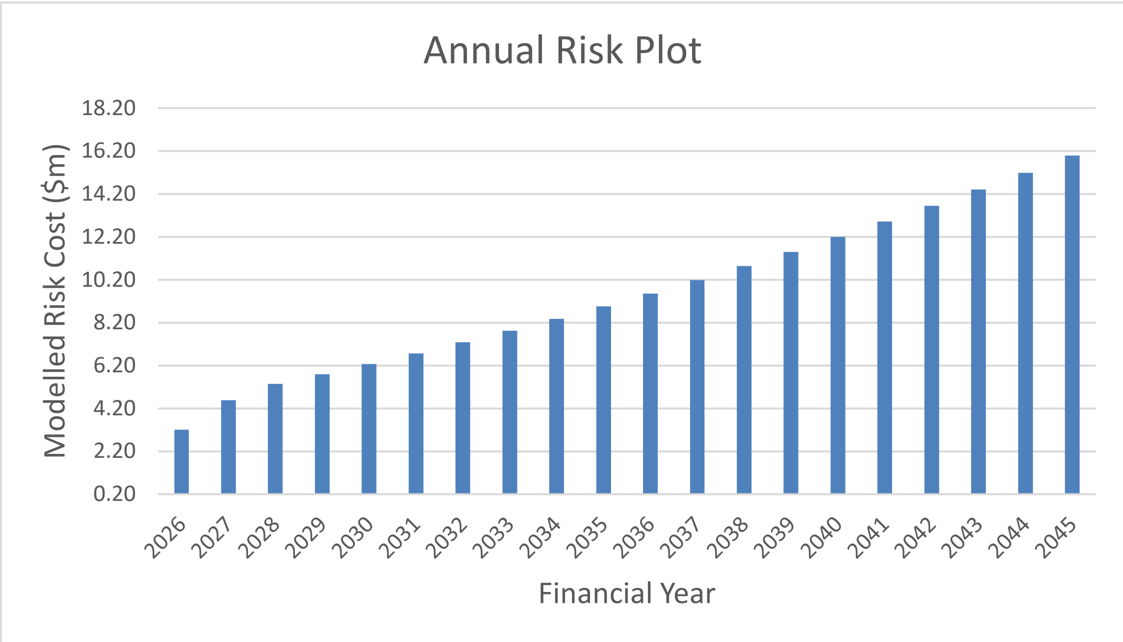


Figure 1: Total risk cost

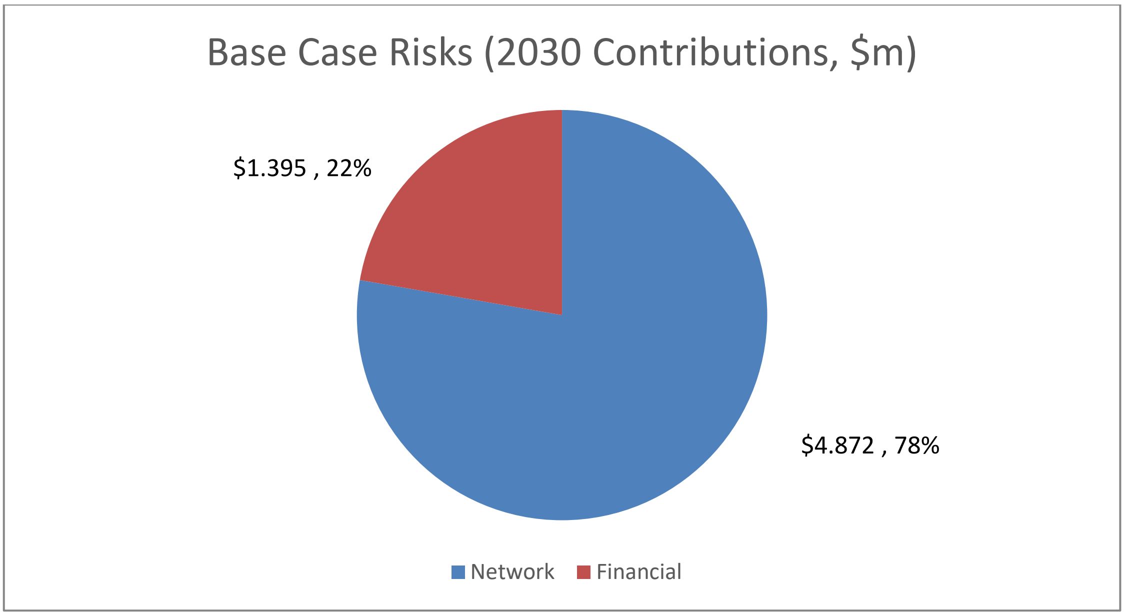


Figure 2: Base case risk cost by contributions (2030)

Option Risk Cost

For modelling purposes, the replacement of equipment at the Molendinar 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.

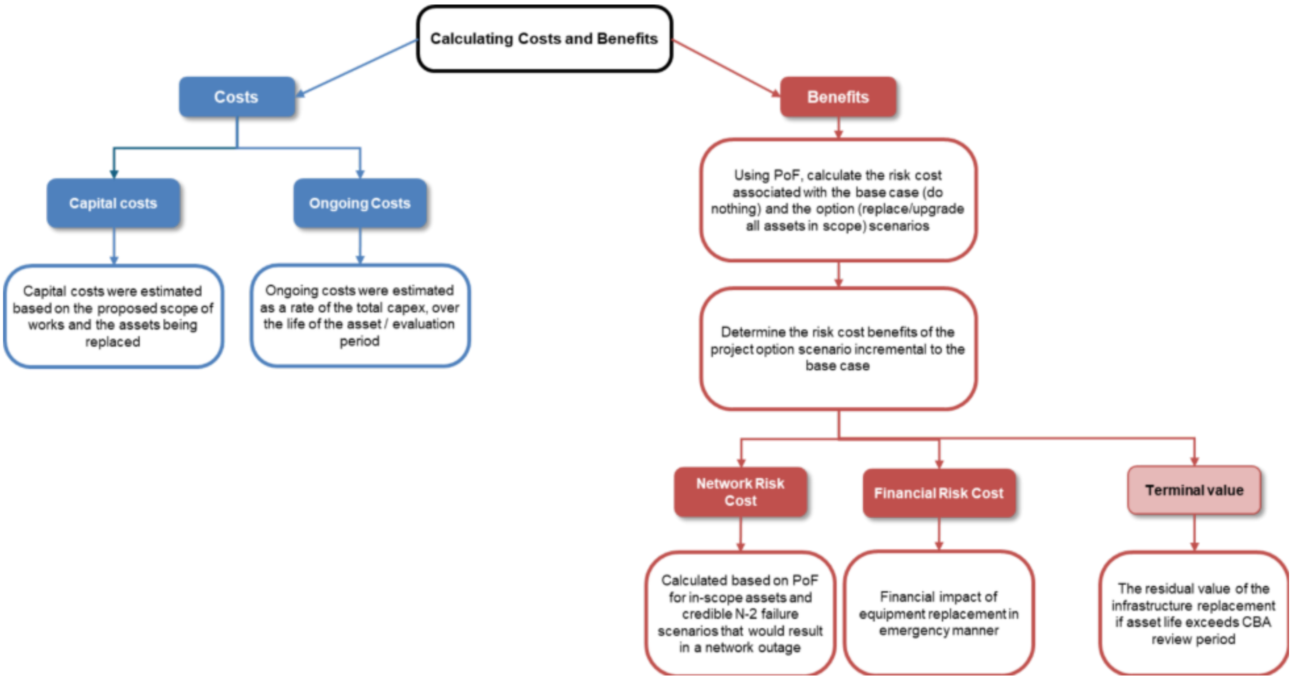


Figure 4: CBA methodology

The project is estimated to cost approximately $52.61 million resulting in a positive NPV and benefit-cost ratio (BCR) greater 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	59.0	25.5	12.1
Benefit-Cost Ratio	ratio	2.29	1.70	1.39

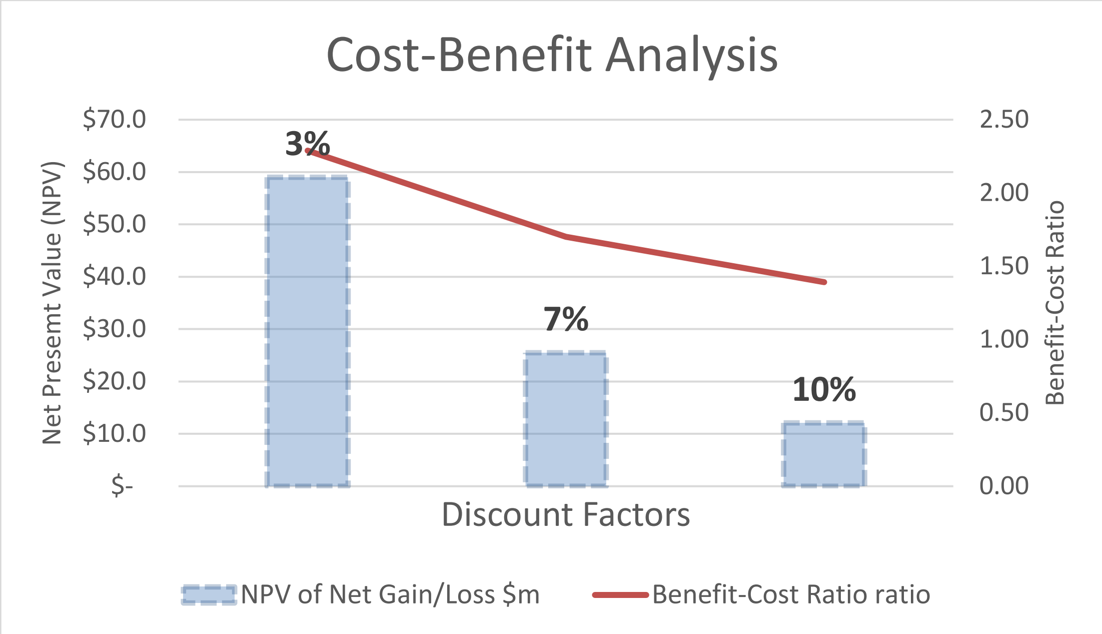


Figure 5: Cost benefit summary

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 $3.91 million, or approximately 62.4% of the original base case risk (at 2030).
- **changes in the value of customer reliability** (halving the value) results in a decrease in risk cost of $2.44 million, or approximately 38.9% of the original base case risk (at 2030).

Table 3: Participation Factors

Input	Baseline value	Sensitivity value (-50%)	Change in risk cost at 2030 ($m)	Participation (%)
Network				
VCR ($/MWh)	25060	12530	-2.44	-38.87%
Restoration Time with spares – Relay (days)	2	1	0.00	0.0%

Restoration Time with no spares – Relay (days)	10	5	-3.91	-62.38%
Financial				
Emergency replacement cost with spares - Relay ($m)	0.02	0.01	0.00	0.00%
Emergency replacement cost without spares – Relay ($m)	0.09	0.05	-0.34	-5.47%
Emergency replacement cost with spares – Bay Controller ($m)	0.02	0.01	0.00	0.00%
Emergency replacement cost without spares – Bay Controller ($m)	0.20	0.10	-0.36	-5.67%