2023-27
POWERLINK QUEENSLAND REVENUE PROPOSAL

Project Pack – PUBLIC

CP.02756
Molendinar Secondary Systems Replacement

CP.02756 – Molendinar Secondary Systems Replacement

Project Status: Not Approved

1. Network Requirement

The 275/110kV Molendinar Substation, approx. 75km south-east of Brisbane, was established in 2003 and is one of two major injection points for the Gold Coast area and supports Terranora Interconnector power transfers. An outage of this asset would leave up to 336MW and up to 3,490MWh of customer load per day at risk[2].

A Condition Assessment (CA) carried out in May 2020 identified that most secondary system assets will reach the end of their technical service lives by 2026[1]. The equipment is, or is becoming, obsolete with no support from the manufacturer and limited spares available. Beyond their 20 year nominal service life, secondary systems suffer increased failure rates. Increasing failure rates, along with the increased time to rectify the faults due to equipment obsolescence, significantly affects the availability and reliability of these systems. There is therefore a need for Powerlink to address this emerging risk to ensure ongoing compliance with Schedule 5.1.9(c) of the National Electricity Rules (NER) and AEMO's Power System Security Guidelines (V95, 2019).

Energy Queensland forecasts confirm there is an enduring need to maintain electricity supply to the Gold Coast area. The removal or reconfiguration of the Molendinar Substation due to secondary system failure or obsolescence would violate Powerlink's Transmission Authority reliability obligations (N-1-50MW / maximum 600MWh unserved energy) and significantly impact the power transfer capability into the Gold Coast[6].

2. Recommended Option

As this project is currently 'Not Approved', project need and options will be subjected to the public Regulatory Investment Test for Transmission (RIT-T) consultation process to identify the preferred option closer to the time of investment.

The current recommended option is to replace all secondary systems at Molendinar Substation by 2026[2].

The following options were considered but not proposed:

- Do Nothing – rejected due to non-compliance with reliability obligations.
- Non-Network Option parameters identified – at this stage no viable non-network options have been identified.

Figure 2-1 shows the current recommended option reduces the forecast risk monetisation profile of the Molendinar Substation secondary systems to less than approx. $20k per annum from 2028. The recommended option will extend the asset life by 20 years.

Where a 'Do Nothing' scenario is adopted, the forecast level of risk associated with the asset rapidly escalates from approximately $20k per annum in 2023 to an estimated $0.45m per annum in 2028 and continues to rise each year thereafter. The significant increase in risk cost in 2026 coincides with the depletion of available spares, which result in financial risks to replace the failed secondary systems in an unplanned (emergency) manner and network risks (unserved energy) from concurrent network outages due to equipment failures[3].

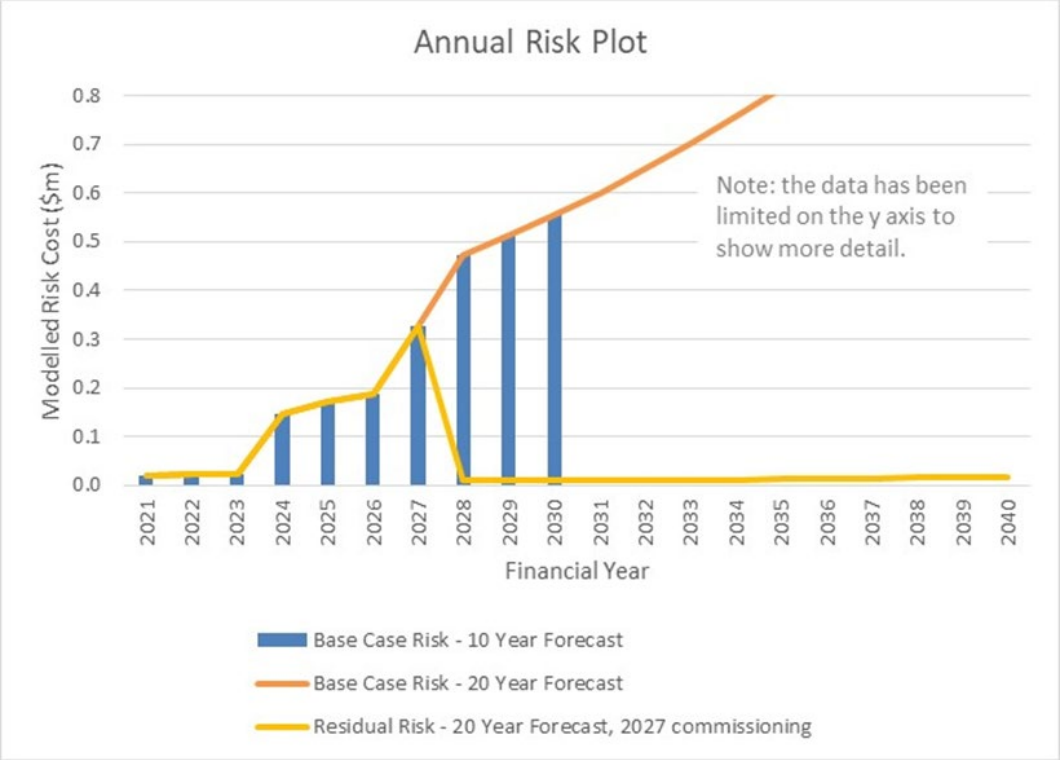

Figure 2-1 Annual Risk Monetisation Profile (Nominal)

3. Cost and Timing

The estimated cost to replace the secondary systems at Molendinar Substation is $22.5m ($2019/20 Base)[5].

Target Commissioning Date: February 2027

4. Documents in CP.02756 Project Pack

Public Documents

1. Secondary Systems Condition Assessment Report - H031 Molendinar 275kV / 110kV Substation
2. CP.02756 Molendinar Secondary Systems Replacement – Planning Statement
3. Base Case Risk and Maintenance Costs Summary Report CP.02756 Molendinar Secondary Systems Replacement
4. Project Scope Report CP.02756 Molendinar Secondary Systems Replacement
5. Concept Estimate for CP.02756 - Molendinar Secondary Systems Replacement

Supporting Documents

6. Asset Reinvestment Criteria - Framework
7. Asset Management Plan 2021

H031 Molendinar
275kV / 110kV Substation

Secondary Systems Condition Assessment Report

Document Details			
Version Number	1.0	**Principal Author**	[redacted]
Objective ID	A3359019	**Authorised by**	[redacted]
Issue Date	08/05/2020	**Team**	Sec Sys and Telecom Strategies
Previous Document	N/A		

Date	Version	Nature of Change	Author	Authorisation
08/05/2020	1.0	Final	[redacted]	[redacted]

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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 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 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:

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)

Table 1 – Molendinar Substation Network Elements					
Local Substation (H031 Molendinar)					Remote Substation
	Voltage (kV)	Quantity	Bay Designation	Operational Element	
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

Figure 2 – 275kV / 110kV Molendinar Substation Electrical Single Line Diagram

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 desktop assessment is limited only to assets recorded in SAP asset database, e.g. protection relays, RTUs and IEDs. It is important to note that a significant number of secondary systems equipment, including cables, kiosks, terminals, links, panels, termination racks, auxiliary equipment and some IEDs are not recorded in SAP. The condition assessment of these depends solely on 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. 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.

Health indices are modelled in the range from zero (0) to ten (10), where zero represents newly installed equipment and ten indicates equipment that have reached the end of their technical service life. 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 due to the obsolescence.

The key outcome of this report is the recommended 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.

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.

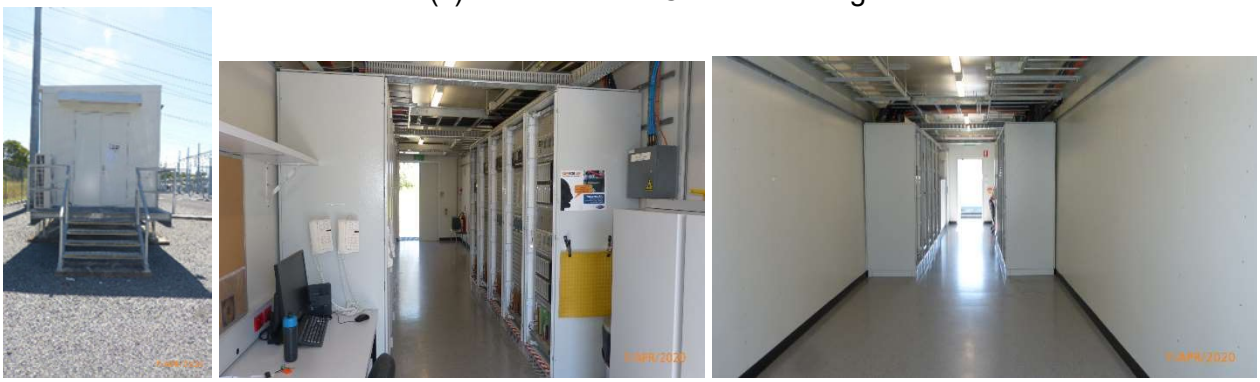
Table 2 – Molendinar Substation Buildings

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)
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



(d) 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 most AC and DC cubicles at this site are mounted on the structure of PASS-M0 switchgears.

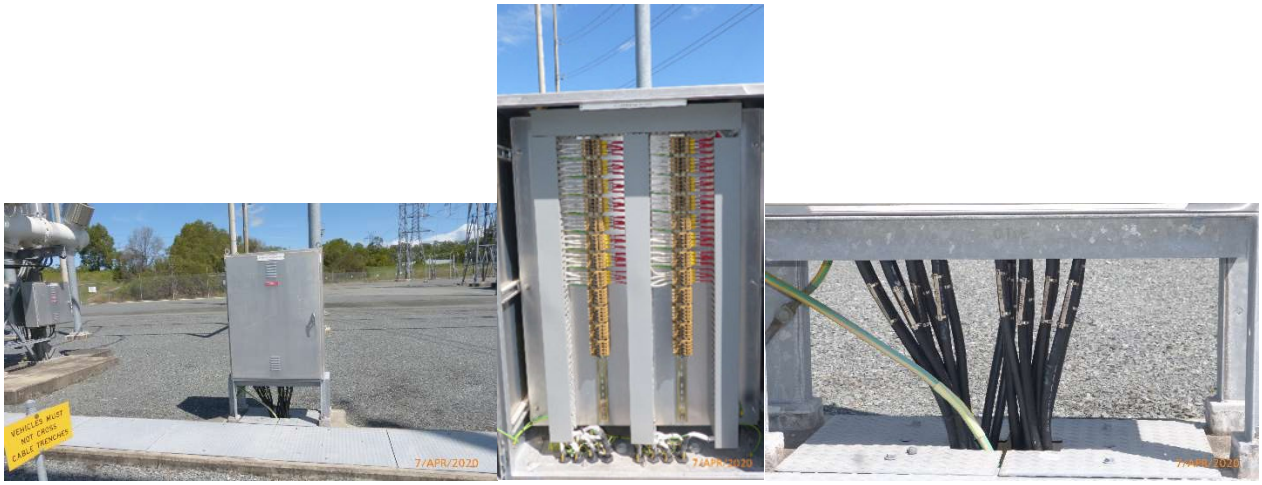
The condition assessment of PASS-M0 control cubicles, which belong the primary plant, are not in scope of this report. Other standalone marshalling cubicles, including CTs, VT, AC and DC, were installed between 2003 and 2007. They are still in serviceable condition and should last until 2043/44. However, 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:

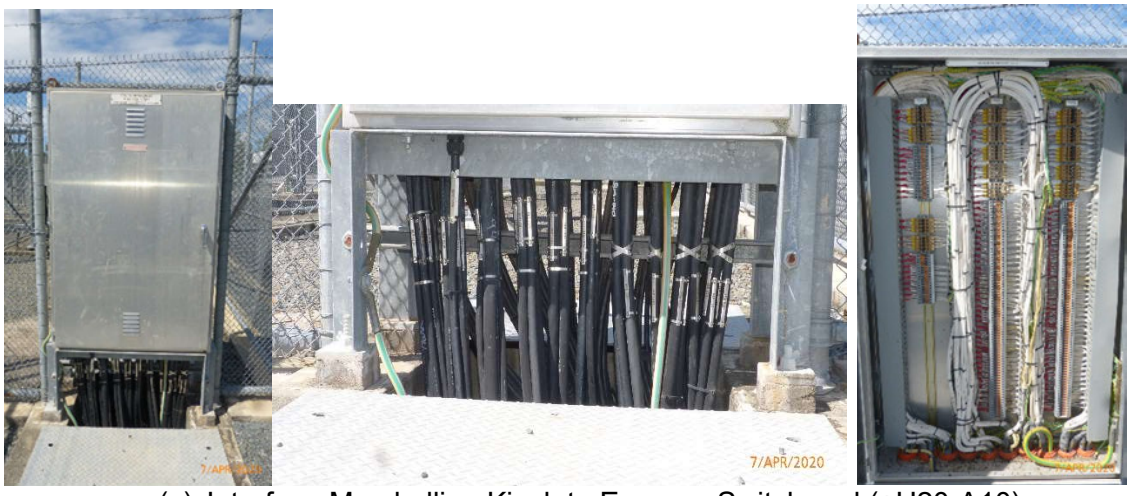
- Bay Marshalling kiosk, CT, VT, AC, DC and Interface Kiosks: in Figure 4, include:
  - 12 TFMR Deadtank CB Marshalling Kiosk (+D26-A10),
  - 2 Bus CT Summation Marshalling Kiosk (+RD2-A10),
  - Interface Marshalling Kiosk to Energex Switchyard (+U20-A10),
  - 3 Bus 8 VT Marshalling Kiosk (+KD3-A10) ,
  - 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)



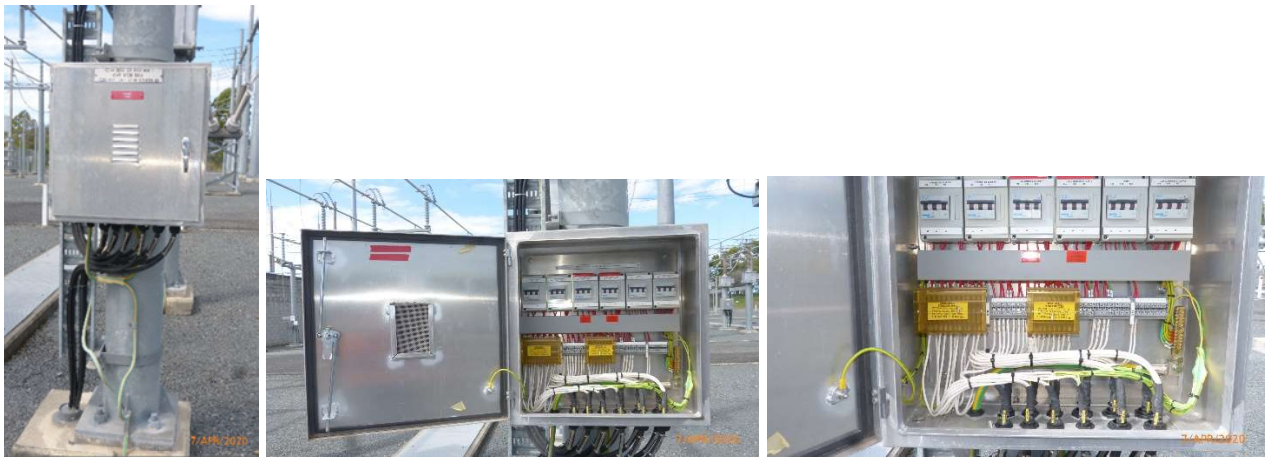
(b) 2 Bus CT Summation Marshalling Kiosk (+RD2-A10)



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

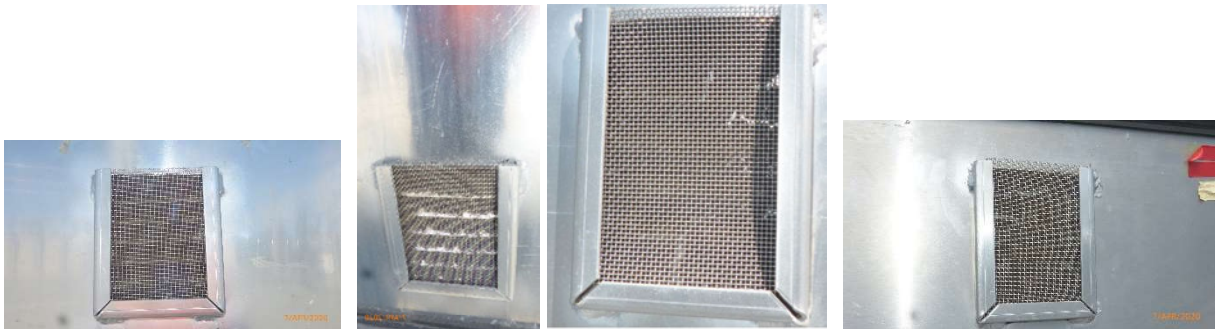
(d) 3 Bus 8 VT Marshalling Kiosk (+KD3-A10)

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



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

Figure 4 – 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 and 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 and 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 and SVC's metering equipment were 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 and 2007. A number of equipment, e.g. switches, port servers and routers were replaced between 2010 and 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. Based on contemporary performance and experiential failures of equipment, substation DC batteries' expected lifespan is 12 years and a chargers' expected lifespan is 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 13 – Molendinar Substation 125VDC Batteries and Chargers

6. Secondary Systems Asset Strategies Recommendations

The recommendations below have been 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. 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 details the conditions of Molendinar Substation secondary systems and equipment. The primary objective of the recommended 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 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.

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 secondary 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 required 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 replaced by the recommended timeframe. New Marshalling Kiosks should be considered if Exsiting Cables are to be replaced.

BAY	C&P PANEL				SECONDARY SYSTEMS EQUIPMENT							X-PROT		Y-PROT		AUX & CTRL		REVENUE METERING		OPSWAN		CABLES (HI)	YARD MARSHALLING KIOSKS (HI)	RECOMMENDED REPLACEMENT TIMMING (Based on Trigger Condition only, Exclude consideration for Solutions, implementation methodologies)			
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 (Chassis)	Sec Sys Eqiipment	CABLES	YARD MARSHALLING KIOSKS
																								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	C50	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	CB FAIL TRIP RACK	No	29	26578	13.33	6.66														
					H031-SSS-1BU4-XPROT	RELAY CB FAIL BUS TRIP RACK	RMS	CB FAIL TRIP RACK	No	29	26578	13.33	6.66														
					H031-SSS-1BU4-XPROT	RELAY DIFF AREVA MFAC34 RANGE: 25-325VAC	AREVA	MFAC34	No	8	13754	13.33	6.66														
					H031-SSS-1BU4-XPROT	RELAY TRIPPING LOW BURDEN ALSTOM MVAJ13	AREVA	MVAJ13	No	18	26689	13.33	6.66														
					H031-SSS-1BU4-XPROT	RELAY TRIPPING LOW BURDEN ALSTOM MVAJ13	AREVA	MVAJ13	No	18	26689	13.33	6.66														
					H031-SSS-1BU4-XPROT	RELAY TRIPPING SUPPLY FAIL ALSTOM MVAX12	AREVA	MVAX12	No	9	26690	13.33	6.66														
					H031-SSS-1BU4-YPROT	RELAY CB FAIL BUS TRIP RACK	RMS	CB FAIL TRIP RACK	No	29	26578			13.33	6.66												
					H031-SSS-1BU4-YPROT	RELAY CB FAIL BUS TRIP RACK	RMS	CB FAIL TRIP RACK	No	29	26578			13.33	6.66												
					H031-SSS-1BU4-YPROT	RELAY DIFF AREVA MFAC34 RANGE: 25-325VAC	AREVA	MFAC34	No	8	13754			13.33	6.66												
					H031-SSS-1BU4-YPROT	RELAY TRIPPING LOW BURDEN ALSTOM MVAJ13	AREVA	MVAJ13	No	18	26689			13.33	6.66												
					H031-SSS-1BU4-YPROT	RELAY TRIPPING LOW BURDEN ALSTOM MVAJ13	AREVA	MVAJ13	No	18	26689			13.33	6.66												
					H031-SSS-1BU4-YPROT	RELAY TRIPPING SUPPLY FAIL ALSTOM MVAX12	AREVA	MVAX12	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	SLC3/03	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	C50	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	CB FAIL TRIP RACK	No	29	26578	13.13	6.57														
					H031-SSS-2BU4-XPROT	RELAY DIFF AREVA MFAC34 RANGE: 25-325VAC	AREVA	MFAC34	No	8	13754	13.13	6.57														
					H031-SSS-2BU4-XPROT	RELAY TRIPPING LOW BURDEN ALSTOM MVAJ13	AREVA	MVAJ13	No	18	26689	13.13	6.57														
					H031-SSS-2BU4-XPROT	RELAY TRIPPING LOW BURDEN ALSTOM MVAJ13	AREVA	MVAJ13	No	18	26689	13.13	6.57														
					H031-SSS-2BU4-XPROT	RELAY TRIPPING SUPPLY FAIL ALSTOM MVAX12	AREVA	MVAX12	No	9	26690	13.13	6.57														
					H031-SSS-2BU4-XPROT	RELAY CB FAIL BUS TRIP RACK	RMS	CB FAIL TRIP RACK	No	29	26578	13.13	6.57														
					H031-SSS-2BU4-YPROT	RELAY DIFF ALSTOM MFAC34 RANGE 25-325VAC	ALSTOM	MFAC34	No	8	13754			20.00	10.00												
					H031-SSS-2BU4-YPROT	RELAY TRIPPING LOW BURDEN ALSTOM MVAJ13	AREVA	MVAJ13	No	18	26689			13.13	6.57												
					H031-SSS-2BU4-YPROT	RELAY TRIPPING LOW BURDEN ALSTOM MVAJ13	AREVA	MVAJ13	No	18	26689			13.13	6.57												
					H031-SSS-2BU4-YPROT	RELAY TRIPPING SUPPLY FAIL ALSTOM MVAX12	AREVA	MVAX12	No	9	26690			13.13	6.57												
					H031-SSS-2BU4-YPROT	RELAY CB FAIL BUS TRIP RACK	RMS	CB FAIL TRIP RACK	No	29	26578			13.13	6.57												
					H031-SSS-2BU4-YPROT	RELAY CB FAIL BUS TRIP RACK	RMS	CB FAIL TRIP RACK	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	SLC500	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	C50	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	CB FAIL TRIP RACK	No	29	26578	12.81	6.40														
					H031-SSS-3BU4-XPROT	RELAY CB FAIL BUS TRIP RACK	RMS	CB FAIL TRIP RACK	No	29	26578	12.81	6.40														
					H031-SSS-3BU4-XPROT	RELAY DIFF AREVA MFAC34 RANGE: 25-325VAC	AREVA	MFAC34	No	8	13754	12.81	6.40														
					H031-SSS-3BU4-XPROT	RELAY TRIPPING LOW BURDEN ALSTOM MVAJ13	AREVA	MVAJ13	No	18	26689	12.81	6.40														
					H031-SSS-3BU4-XPROT	RELAY TRIPPING LOW BURDEN ALSTOM MVAJ13	AREVA	MVAJ13	No	18	26689	12.81	6.40														
					H031-SSS-3BU4-XPROT	RELAY TRIPPING SUPPLY FAIL ALSTOM MVAX12	AREVA	MVAX12	No	9	26690	12.81	6.40														
					H031-SSS-3BU4-YPROT	RELAY TRIPPING LOW BURDEN ALSTOM MVAJ13	AREVA	MVAJ13	No	18	26689			14.60	7.30												
					H031-SSS-3BU4-YPROT	RELAY CB FAIL BUS TRIP RACK	RMS	CB FAIL TRIP RACK	No	29	26578			12.81	6.40												
					H031-SSS-3BU4-YPROT	RELAY DIFF AREVA MFAC34 RANGE: 25-325VAC	AREVA	MFAC34	No	8	13754			12.81	6.40												
					H031-SSS-3BU4-YPROT	RELAY TRIPPING LOW BURDEN ALSTOM MVAJ13	AREVA	MVAJ13	No	18	26689			12.81	6.40												
					H031-SSS-3BU4-YPROT	RELAY TRIPPING SUPPLY FAIL ALSTOM MVAX12	AREVA	MVAX12	No	9	26690			12.81	6.40												
					H031-SSS-3BU4-YPROT	RELAY CB FAIL BUS TRIP RACK	RMS	CB FAIL TRIP RACK	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	C50	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	C60 (VER 2.93)	Yes	9	26931	13.32	6.66														
					H031-SSS-411--YPROT	RELAY CBMAN SEL-351-1 (1A)	SCHWEITZER	SEL-351-1 (1A)	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	C50	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	C60 (VER 2.93)	Yes	9	26931	12.81	6.40														
					H031-SSS-412--YPROT	RELAY CBMAN SEL-351-1 (1A)	SCHWEITZER	SEL-351-1 (1A)	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	C50	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	T60 (3.48)	Yes	8	27193	13.32	6.66														
					H031-SSS-4410-YPROT	RELAY BIASED DIFF SEL-387-5 (1A) (3U)	SCHWEITZER	SEL-387-5 (1A) (3U)	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	C50	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	T60 (3.48)	Yes	8	27193	13.13	6.57														
					H031-SSS-4411-YPROT	RELAY BIASED DIFF SEL-387-5 (1A) (3U)	SCHWEITZER	SEL-387-5 (1A) (3U)	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	C50	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	T60	Yes	8	27193	16.74	8.37														
					H031-SSS-4412-YPROT	RELAY BIASED DIFF SEL-387-5 (1A) (3U)	SCHWEITZER	SEL-387-5 (1A) (3U)	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	C50	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	C60 (2.82)	Yes	6	25383	17.37	8.69														
					H031-SSS-441--YPROT	RELAY CBMAN SEL-351-1 (1A)	SCHWEITZER	SEL-351-1 (1A)	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	C50	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	C60 (VER 2.93)	Yes	9	26931	13.09	6.55														
					H031-SSS-442--YPROT	RELAY CBMAN SEL-351-1 (1A)	SCHWEITZER	SEL-351-1 (1A)	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	C50	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	C60 (VER 2.93)	Yes	9	26931	12.81	6.40														
					H031-SSS-444--YPROT	RELAY CBMAN SEL-351-1 (1A)	SCHWEITZER	SEL-351-1 (1A)	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	C50	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	C60 (VER 2.93)	Yes	9	26931	13.13	6.57														
					H031-SSS-446--YPROT	RELAY CBMAN SEL-351-1 (1A)	SCHWEITZER	SEL-351-1 (1A)	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 secondary 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 required 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 replaced 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 MARSHALLING 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	C50	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	SWITCHSYNC E213	Yes	0	25640					12.22	6.11										
					H031-SSS-483--XPROT	RELAY CAP PROTN ABB SPAJ160C	ABB	SPAJ160C	No	3	15980	12.22	6.11														
					H031-SSS-483--XPROT	RELAY CB MGMT GE C60 (VER 2.93 FIRMWARE)	GE	C60 (VER 2.93)	Yes	9	26931	12.22	6.11														
					H031-SSS-483--XPROT	RELAY OC & EF ABB SPAJ140C	ABB	SPAJ140C	No	6	12182	12.22	6.11														
					H031-SSS-483--YPROT	RELAY CBMAN SEL-351-1 (1A)	SCHWEITZER	SEL-351-1 (1A)	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	C50	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	SWITCHSYNC E213	Yes	0	25640					15.20	7.60										
					H031-SSS-484--XPROT	RELAY OC & EF ABB SPAJ140C	ABB	SPAJ140C	No	6	12182	15.20	7.60														
					H031-SSS-484--XPROT	RELAY CB MGMT GE C60 (VER 2.93 FIRMWARE)	GE	C60 (VER 2.93)	Yes	9	26931	15.20	7.60														
					H031-SSS-484--XPROT	RELAY CAP PROTN ABB SPAJ160C	ABB	SPAJ160C	No	3	15980	15.20	7.60														
					H031-SSS-484--YPROT	RELAY CBMAN SEL-351-1 (1A)	SCHWEITZER	SEL-351-1 (1A)	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	C50	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	SWITCHSYNC E213	Yes	0	25640					12.85	6.43										
					H031-SSS-485--XPROT	RELAY CAP PROTN ABB SPAJ160C	ABB	SPAJ160C	No	3	15980	13.09	6.55														
					H031-SSS-485--XPROT	RELAY OC & EF ABB SPAJ140C	ABB	SPAJ140C	No	6	12182	13.09	6.55														
					H031-SSS-485--XPROT	RELAY CB MGMT GE C60 (VER 2.93 FIRMWARE)	GE	C60 (VER 2.93)	Yes	9	26931	13.09	6.55														
					H031-SSS-485--YPROT	RELAY CBMAN SEL-351-1 (1A)	SCHWEITZER	SEL-351-1 (1A)	Yes	11	25466			13.09	6.55												
					H031-SSS-502--BAYCONT	REMOTE TERMINAL UNIT FOXBORO C50	FOXBORO	C50	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	C50	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	T60 (3.48)	Yes	6	25384	16.14	8.07														
					H031-SSS-541--XPROT	RELAY DIFF 25-325V 1POLE ALSTOM MFAC14	ALSTOM	MFAC14	No	4	12241	16.14	8.07														
					H031-SSS-541--XPROT	RELAY TRANSF O/LOAD GE F35	GE	F35 (2.82)	Yes	9	25382	16.14	8.07														
					H031-SSS-541--YPROT	RELAY BIASED DIFF SEL-387-5 (1A) (3U)	SCHWEITZER	SEL-387-5 (1A) (3U)	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	C50	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	T60 (3.48)	Yes	8	27193	12.57	6.28														
					H031-SSS-542--XPROT	RELAY TRANSF O/LOAD GE F35 (2.93)	GE	F35 (2.93)	Yes	6	27194	12.57	6.28														
					H031-SSS-542--XPROT	RELAY DIFF 25-325V 1POLE AREVA MFAC14	AREVA	MFAC14	No	4	12241	12.57	6.28														
					H031-SSS-542--YPROT	RELAY BIASED DIFF SEL-387-5 (1A) (3U)	SCHWEITZER	SEL-387-5 (1A) (3U)	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	C50	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	L90 2T : H00 N6U U6T	No	7	31855	13.98	6.99														
					H031-SSS-7193-YPROT	RELAY DISTANCE SEL 311C 1A	SCHWEITZER	SEL-311C (1A)	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	C50	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	L90 2T : D00 N6U U6T	Yes	14	26942	13.83	6.92														
					H031-SSS-7229-YPROT	RELAY DISTANCE SEL 311C 1A	SCHWEITZER	SEL-311C (1A)	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	C50	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	L90 2T : H00 N6U U6T	No	7	31855	13.98	6.99														
					H031-SSS-7297-YPROT	RELAY DISTANCE SEL 311C 1A	SCHWEITZER	SEL-311C (1A)	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	C50	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	L90 2T : D00 N6U U6T	Yes	14	26942	13.83	6.92														
					H031-SSS-7907-YPROT	RELAY DISTANCE SEL 311C 1A	SCHWEITZER	SEL-311C (1A)	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	C50	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	L90 2T : D00 N6U U6T	Yes	14	26942	13.83	6.92														
					H031-SSS-7916-YPROT	RELAY DISTANCE SEL 311C 1A	SCHWEITZER	SEL-311C (1A)	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	C50	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	L90 2T : D00 N6U U6T	Yes	14	26942	13.83	6.92														
					H031-SSS-7917-YPROT	RELAY DISTANCE SEL 311C 1A	SCHWEITZER	SEL-311C (1A)	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	C50	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	L90 2T : D00 N6U U6T	Yes	14	26942	13.83	6.92														
					H031-SSS-798--YPROT	RELAY DISTANCE SEL 311C 1A	SCHWEITZER	SEL-311C (1A)	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	C50	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	L90 2T : H00 N6U UXX	No	0	32443	17.16	8.58														
					H031-SSS-8824-YPROT	COMMS INTERFACE UNIT ALSTOM P391	ALSTOM	P391 (50VDC)	Yes	90	26261			16.14	8.07												
					H031-SSS-8824-YPROT	COMMS INTERFACE UNIT ALSTOM P391	ALSTOM	P391 (50VDC)	Yes	90	26261			16.14	8.07												
					H031-SSS-8824-YPROT	CURR DIFF RELAY MICOM P544 + 2ND PORT	MICOM	P544 (+ 2nd Port)	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	C50	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	DM1200 DIGITAL	Yes	6	17308	16.14	8.07														
					H031-SSS-8824-PSSITA2	RFL 9745 PROT SIG DIG I/O 48-125V	RFL ELECTRONICS	9745 DIGITAL	Yes	1	17268	16.14	8.07														
					H031-SSS-8824-PSSITB1	DEWAR DM1200 PROT SIG DIG 90-320V SUPPLY	DEWAR	DM1200 DIGITAL	Yes	6	17308			16.14	8.07												
					H031-SSS-8824-PSSITB2	RFL 9745 PROT SIG DIG I/O 48-125V	RFL ELECTRONICS	9745 DIGITAL	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	C50	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	DM1200 DIGITAL	Yes	6	17308	12.57	6.28														
					H031-SSS-8825-PSSITA2	RFL 9745 PROT SIG DIG I/O 48-125V	RFL ELECTRONICS	9745 DIGITAL	Yes	1	17268	12.57	6.28														
					H031-SSS-8825-PSSITB1	DEWAR DM1200 PROT SIG DIG 90-320V SUPPLY	DEWAR	DM1200 DIGITAL	Yes	6	17308			12.57	6.28												
					H031-SSS-8825-PSSITB2	RFL 9745 PROT SIG DIG I/O 48-125V	RFL ELECTRONICS	9745 DIGITAL	Yes	1	17268			12.57	6.28												
					H031-SSS-8825-XPROT	RELAY DIFF GE L90 2T H00 N6U-SXX-U6T-W7R	GE	L90 2T : H00 N6U U6T	No	7	31855	13.98	6.99														
					H031-SSS-8825-YPROT	COMMS INTERFACE UNIT ALSTOM P391	ALSTOM	P391 (50VDC)	Yes	90	26261			12.57	6.28												
					H031-SSS-8825-YPROT	CURR DIFF RELAY MICOM P544 + 2ND PORT	MICOM	P544 (+ 2nd Port)	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 secondary 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 required 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 replaced by the recommended timeframe. New Marshalling Kiosks should be considered if Existing Cables are to be replaced.

BAY	C&P PANEL				SECONDARY SYSTEMS EQUIPMENT							X-PROT		Y-PROT		AUX & CTRL		REVENUE METERING		OPSWAN		CABLES (HI)	YARD MARSHALLING KIOSKS (HI)	RECOMMENDED REPLACEMENT TIMMING (Based on Trigger Condition only, Exclude consideration for Solutions, implementation methodologies)			
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 (Chassis)	Sec Sys Equipment	CABLES	YARD MARSHALLING KIOSKS
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	2000-0420 1A Cl 0.2	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	2000-0420 1A Cl 0.2	Yes	43	24375							11.45	5.79								
					H031-SSS-METR-REVMET4	METER KWH/KVARH EDMI (REVENUE)	EDMI	2000-0400 1A Cl 0.5	Yes	49	15879							14.50	7.25								
					H031-SSS-METR-REVMET4	METER KWH/KVARH EDMI (CHECK)	EDMI	2000-0400 1A Cl 0.5	Yes	49	15879							14.50	7.25								
					H031-SSS-METR-REVMET3	METER KWH/KVARH EDMI (CHECK)	EDMI	2000-0400 5A Cl 0.5	Yes	21	15880							20.00	10.00								
					H031-SSS-METR-REVMET3	METER KWH/KVARH (REV)	EDMI	2000-0400 5A Cl 0.5	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	2000-0400 5A Cl 0.5	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	2000-0400 5A Cl 0.5	Yes	21	15880							16.05	8.03								
					H031-SSS-METR-REVMET14	METER KWH/KVARH EDMI (CHECK)	EDMI	2000-0400 1A Cl 0.5	Yes	49	15879							14.50	7.25								
					H031-SSS-METR-REVMET14	METER KWH/KVARH EDMI (REVENUE)	EDMI	2000-0400 1A Cl 0.5	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	2000-0400 1A Cl 0.5	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	2000-0400 1A Cl 0.5	Yes	49	15879							14.50	7.25								
					H031-SSS-METR-REVMET7	METER KWH/KVARH EDMI (REVENUE)	EDMI	2000-0400 1A Cl 0.5	Yes	49	15879							14.50	7.25								
					H031-SSS-METR-REVMET7	METER KWH/KVARH EDMI (CHECK)	EDMI	2000-0400 1A Cl 0.5	Yes	49	15879							14.50	7.25								
					H031-SSS-METR-REVMET10	METER KWH/KVARH EDMI (CHECK)	EDMI	2000-0400 1A Cl 0.5	Yes	49	15879							14.50	7.25								
					H031-SSS-METR-REVMET10	METER KWH/KVARH EDMI (REVENUE)	EDMI	2000-0400 1A Cl 0.5	Yes	49	15879							14.50	7.25								
					H031-SSS-METR-REVMET13	METER KWH/KVARH EDMI (CHECK)	EDMI	2000-0400 1A Cl 0.5	Yes	49	15879							13.58	6.79								
					H031-SSS-METR-REVMET13	METER KWH/KVARH EDMI (REVENUE)	EDMI	2000-0400 1A Cl 0.5	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	2000-0400 1A Cl 0.5	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	2000-0400 1A Cl 0.5	Yes	49	15879							14.50	7.25								
					H031-SSS-METR-REVMET9	METER KWH/KVARH EDMI (REVENUE)	EDMI	2000-0400 1A Cl 0.5	Yes	49	15879							14.50	7.25								
					H031-SSS-METR-REVMET9	METER KWH/KVARH EDMI (CHECK)	EDMI	2000-0400 1A Cl 0.5	Yes	49	15879							14.50	7.25								
					H031-SSS-METR-REVMET11	METER KWH/KVARH EDMI (REVENUE)	EDMI	2000-0400 1A Cl 0.5	Yes	49	15879							14.50	7.25								
					H031-SSS-METR-REVMET11	METER KWH/KVARH EDMI (CHECK)	EDMI	2000-0400 1A Cl 0.5	Yes	49	15879							14.50	7.25								
					H031-SSS-METR-REVMET12	METER KWH/KVARH EDMI (REVENUE)	EDMI	2000-0400 1A Cl 0.5	Yes	49	15879							14.50	7.25								
					H031-SSS-METR-REVMET12	METER KWH/KVARH EDMI (CHECK)	EDMI	2000-0400 1A Cl 0.5	Yes	49	15879							14.50	7.25								
SCADA and OpsWAN	Building +6 - Station SCADA (NICs, LCP), Aux Control, Timing, OpsWAN & Common RTU	+6A24	2003	4.86	H031-SSS-NBAY-LCF6	LOCAL CONTROL FACILITY PC X TERMINAL	WYSE	Z90D7	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	2243BW	Yes							1.93	1.61										
					H031-SSS-NBAY-LCFINT	REMOTE TERMINAL UNIT FOXBORO C50	FOXBORO	C50	Yes	0	26044					16.14	8.07										
					H031-SSS-NBAY-NSCLINK1	REMOTE TERMINAL UNIT FOXBORO C50	FOXBORO	C50	Yes	0	26044					16.14	8.07										
					H031-SSS-NBAY-NSCLINK2	REMOTE TERMINAL UNIT FOXBORO C50	FOXBORO	C50	Yes	0	26044					16.14	8.07										
					H031-SSS-NBAY-RTUCOM6	REMOTE TERMINAL UNIT FOXBORO C50	FOXBORO	C50	Yes	0	26047					16.14	8.07										
					H031-SSS-NBAY-TIMING6	GPS CLOCK TEKRON TCG01-D:1	TEKRON	TCG01-D09.009	Yes	3	27092					8.00	4.00										
					H031-SSS-NBAY-OWCOVRT6	DC/DC CONVERTER	PHOENIX	QUINT-PS-100	No	8	27643									9.58	7.99						
					H031-SSS-NBAY-OWINVRT6	INVERTER 125VDC/240VAC 1800W	LATRONICS	IRM18120C	No	2	25941									1.93	0.97						
					H031-SSS-NBAY-OWNTWK6	[redacted]			No	3	30818									9.58	7.99						
					H031-SSS-NBAY-OWNTWK6	SERVER PORT 48VDC PERLE 04030450 -OPSWAN	PERLE	IOLAN ST516DC	No	2	27733									4.67	3.89						
					H031-SSS-NBAY-OWNTWK6	PERLE IOLAN DS1, ETHERNET 10/100, DB9M	PERLE	DS1	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	Z90D7	Yes	2	35961					4.14	3.45					4.00	4.00	2044-2048	2026/27 (b)		
					H031-SSS-NBAY-LCF7	SAMSUNG MONITOR	SAMSUNG	B2240W	Yes							1.93	1.61										
					H031-SSS-NBAY-RTUCOM7	REMOTE TERMINAL UNIT FOXBORO C50	FOXBORO	C50	Yes	0	27363					13.13	6.57										
					H031-SSS-NBAY-TIMING7	GPS CLOCK TEKRON TCG01-D:1	TEKRON	TCG01	Yes	3	27092					13.33	6.67										
					H031-SSS-NBAY-OWINVRT7	INVERTER	LATRONICS	LITRO 100	No	2	25941									1.93	0.97						
					H031-SSS-NBAY-OWNTWK7	[redacted]			Yes	5	27633									13.13	10.00						
					H031-SSS-NBAY-OWNTWK7				No	3	30818									4.32	3.60						
					H031-SSS-NBAY-OWNTWK7				No	2	27733									4.67	3.89						
					H031-SSS-NBAY-OWNTWK7				Yes	0	27631									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	Z90D7	Yes	2	35961					4.14	3.45					4.00	4.00	2044-2048	2026/27 (b)		
					H031-SSS-NBAY-LCF8	MONITOR	SAMSUNG	SA450	Yes							1.93	1.61										
					H031-SSS-NBAY-RTUCOM8	REMOTE TERMINAL UNIT FOXBORO C50	FOXBORO	C50	Yes	0	27363					12.81	6.40										
					H031-SSS-NBAY-TIMING8	GPS CLOCK TEKRON TCG01-D:1	TEKRON	TCG01	Yes	3	27092					13.33	6.67										
					H031-SSS-NBAY-OWINVRT8				No	2	25941									1.93	0.97						
					H031-SSS-NBAY-OWNTWK8				No	3	30818									4.32	3.60						
					H031-SSS-NBAY-OWNTWK8				No	2	27733									4.67	3.89						
					H031-SSS-NBAY-OWNTWK8				No	10	27735									0.87	0.72						
OpsWAN Camera	OpsWAN Camera		2005	4.29	H031-SSS-IONS-HARDWARE	AXIS ETHERNET CAMERA ASSEMBLY H031WC0A	Take a Look	P5532-E	No	10	33869									16.14	10.00						
					H031-SSS-IONS-HARDWARE	AXIS ETHERNET CAMERA ASSEMBLY H031WC0B	Take a Look	P5532-E	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	Z90D7	Yes	2	35961					4.14	3.45					2.86	2.86	2048-2052	2030/31 (b)		
					H031-SSS-NBAY-LCFT	MONITOR	SAMSUNG	22C450BW	Yes							1.93	1.61										
					H031-SSS-NBAY-OWNTWKT	[redacted]			No	3	30818									9.58	7.99						
					H031-SSS-NBAY-OWPRINTT	PRINTER	HEWLETT PACKARD	HP5200TN	Yes	0	26840									9.58	7.99						
					H031-SSS-NBAY-OWSERVT	OPSWAN GEN 3 SERVER	TLC IT SOLUTIONS	INTEL XEON E3-120	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	LSU	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	IDM T3 HSM 16CH	Yes	0	30159					9.62	4.81										
					H031-SSS-NBAY-PWRQUAL1	PQ ANALYSER UNIPOWER UP-2210-R VT 32MB	UNIPOWER	UP-2210-R VT 32MB	Yes	4	37441					2.66	1.33										
					H031-SSS-NBAY-PWRQUAL1	1VT HARMONIC MONITOR DEVICE TRENCH A	TRENCH	FR12	No	3	33219					2.67	1.33										
					H031-SSS-NBAY-PWRQUAL1	1VT HARMONIC MONITOR DEVICE TRENCH B	TRENCH	FR12	No	3	33219					2.67	1.33										
					H031-SSS-NBAY-PWRQUAL1	1VT HARMONIC MONITOR DEVICE TRENCH C	TRENCH	FR12	No	3	33219					2.67	1.33										
					H031-SSS-NBAY-PWRQUAL2	PQ ANALYSER UNIPOWER UP-2210-R VT 32MB	UNIPOWER	UP-2210-R VT 32MB	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.

BAY	C&P PANEL				SECONDARY SYSTEMS EQUIPMENT							X-PROT		Y-PROT		AUX & CTRL		REVENUE METERING		OPSWAN		CABLES (HI)	YARD MARSHALLING KIOSKS (HI)	RECOMMENDED REPLACEMENT TIMMING (Based on Trigger Condition only, Exclude consideration for Solutions, implementation methodologies)			
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 (Chassis)	Sec Sys Eqiupment	CABLES	YARD MARSHALLING KIOSKS
																						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	UXL330-2																	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	RT48-110V/12A & MINICSU-2 125V																	2029		
	BUILDING +6 125V DC Y BATTERY		2017	2.50		BUILDING +6 125V DC Y BATTERY	EXIDE	VRLA (MODEL 90A09)																	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	RT48-110V/12A & MINICSU-2 125V																	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	90A09																	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	RT48-110V/12A & MINICSU-2 125V																	2026		
	BUILDING +7 125V DC Y BATTERY		2006	10.00		BUILDING +7 125V DC Y BATTERY	EXIDE	VRLA (MODEL 90A09)																	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	RT48-110V/12A & MINICSU-2 125V																	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	UXL330-2																	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	RT48-110V/12A & MINICSU-2 125V																	2026		
	SVC BUILDING +8 125V DC Y BATTERY		2006	10.00		SVC BUILDING +8 125V DC Y BATTERY	EXIDE	VRLA (MODEL 90A09)																	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	RT48-110V/12A & MINICSU-2 125V																	2026		
	SVC BUILDING +8 125V DC DISTRIBUTION BOARD		2006	7.00		SVC BUILDING +8 125V DC DISTRIBUTION BOARD																			2026		

Planning Statement	**26 June 2020**
Title	CP.02756 Molendinar Secondary Systems Replacement – Planning Statement [1]
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 needed to meet Powerlink Queensland's N-1-50MW/600MWh reliability obligations 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[2].

Energy Queensland forecasts confirm there is an enduring need to maintain electricity supply into the Gold Coast area. 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.

The preferred network solution for Powerlink to continue to meet its statutory obligations is the replacement of the at-risk secondary systems by 2027.

[1] *This report contains confidential information, which is the property of Powerlink, and the Registered Participant mentioned in the report, and has commercial value. It qualifies as Confidential Information under the National Electricity Rules (NER). The NER provides that Confidential Information:*

- *must not be disclosed to any person except as permitted by the NER;*
- *must only be used or copied for the purpose intended in this report;*
- *must not be made available to unauthorised persons*

[2] AEMO, Power System Operating Procedure SO_OP_3715, Power System Security Guidelines, V95, September 2019 (the Rules require AEMO to develop and publish Power System Operating Procedures pursuant to clause 4.10.1(b) of the Rules, which Powerlink must comply with per clause 4.10.2(b)).

Table of Contents

1. Introduction

The Molendinar Substation (H031) is located approximately 75km south-east of Brisbane. It is one of two major injection points into the Gold Coast area. The substation was established in 2003. It 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 overhead 110kV network supplies Robina and Nerang substations.

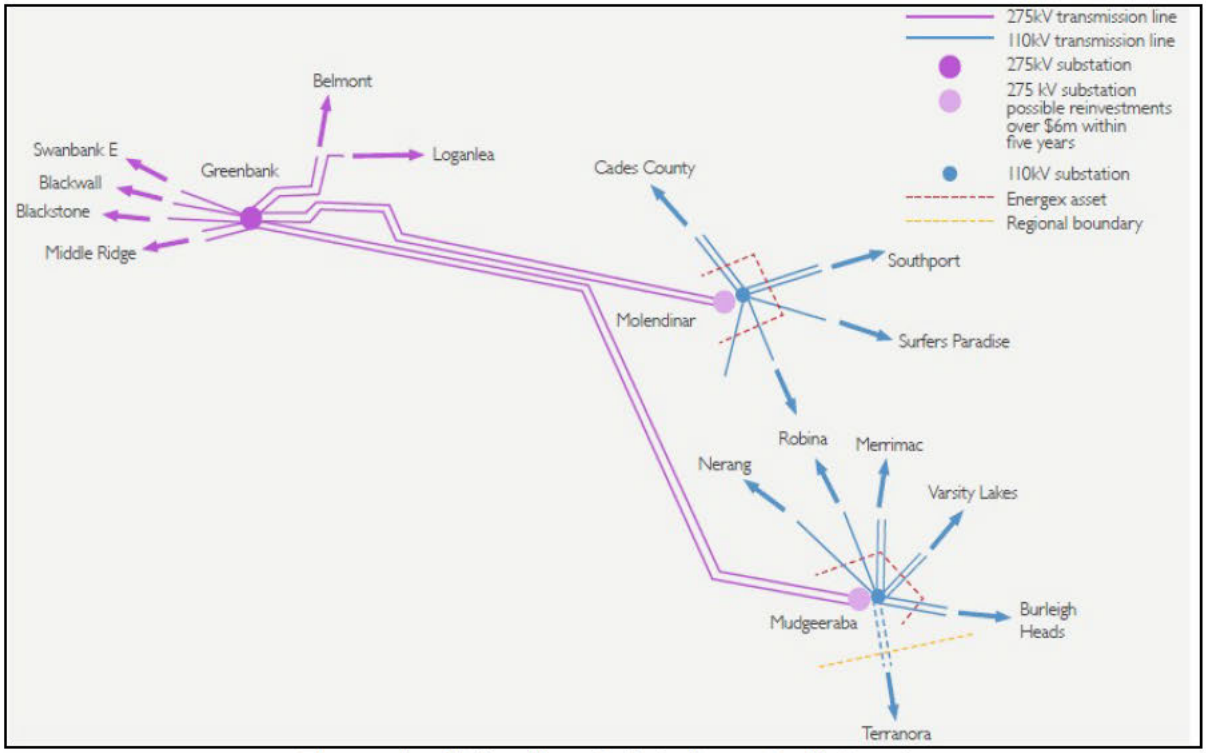


Figure 1 – Molendinar Substation – Gold Coast

A condition assessment of the secondary systems at Molendinar Substation has determined many components are obsolete, or becoming obsolete, and that they are expected to reach the end of their technical service lives between 2024 and 2028. As secondary systems age they become more susceptible to failure which 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 for network reliability and safety.

This condition driver has triggered the need to assess the enduring network need for the Molendinar Substation configuration and function.

This report assesses the impact that removal of the at-risk 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. Molendinar Demand Forecast

The Molendinar Substation was established in 2003 to reinforce the Northern Gold Coast area. The substation consists of:

1. Two 275/110kV transformer ended feeders from Greenbank Substation, and
2. A 110kV switchyard which provides 2 x 275/132kV transformer bays, 12 x 110kV feeder/transformer bays for Energex and 3 x capacitor bank bays.

Figure 2 shows the existing connection configuration of the Molendinar Substation.

Figure 2 Molendinar 275/110kV Substation Line Dagram

Figure 3 shows that the maximum demand for the Gold Coast loads (connected to Mudgeeraba and Molendinar) are not expected to change materially in coming years.

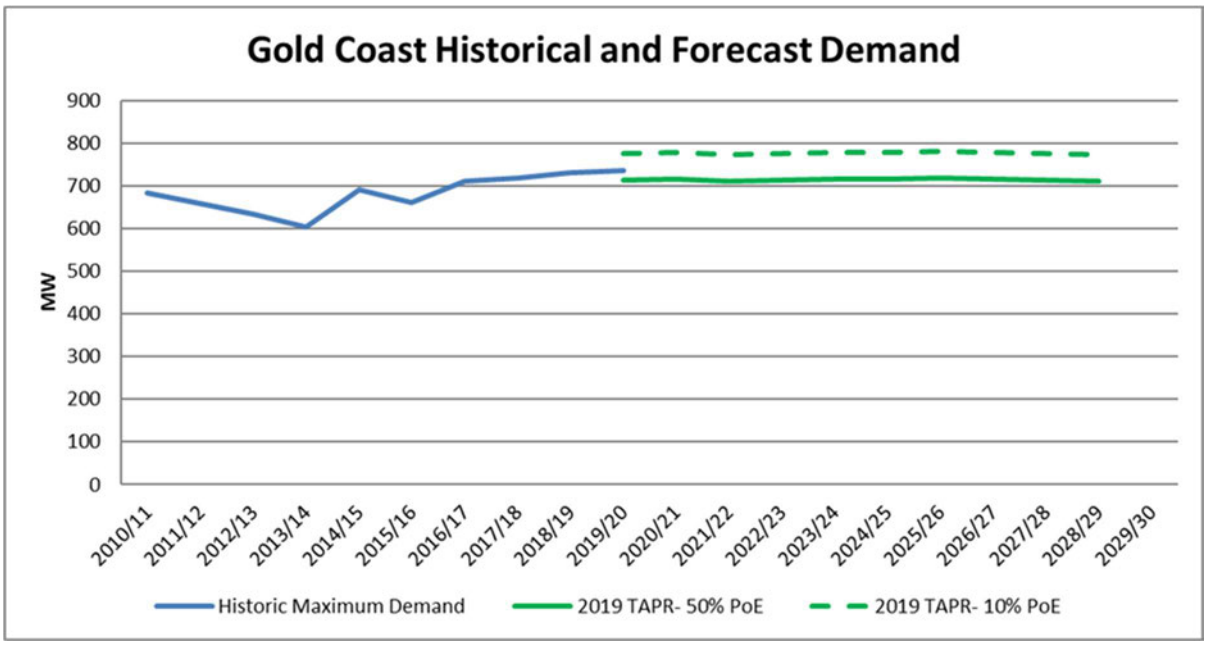


Figure 3 – Molendinar 110kV Maximum Demand

Figure 4 is the duration curve for the loads connected to Molendinar (& Mudgeeraba) network.

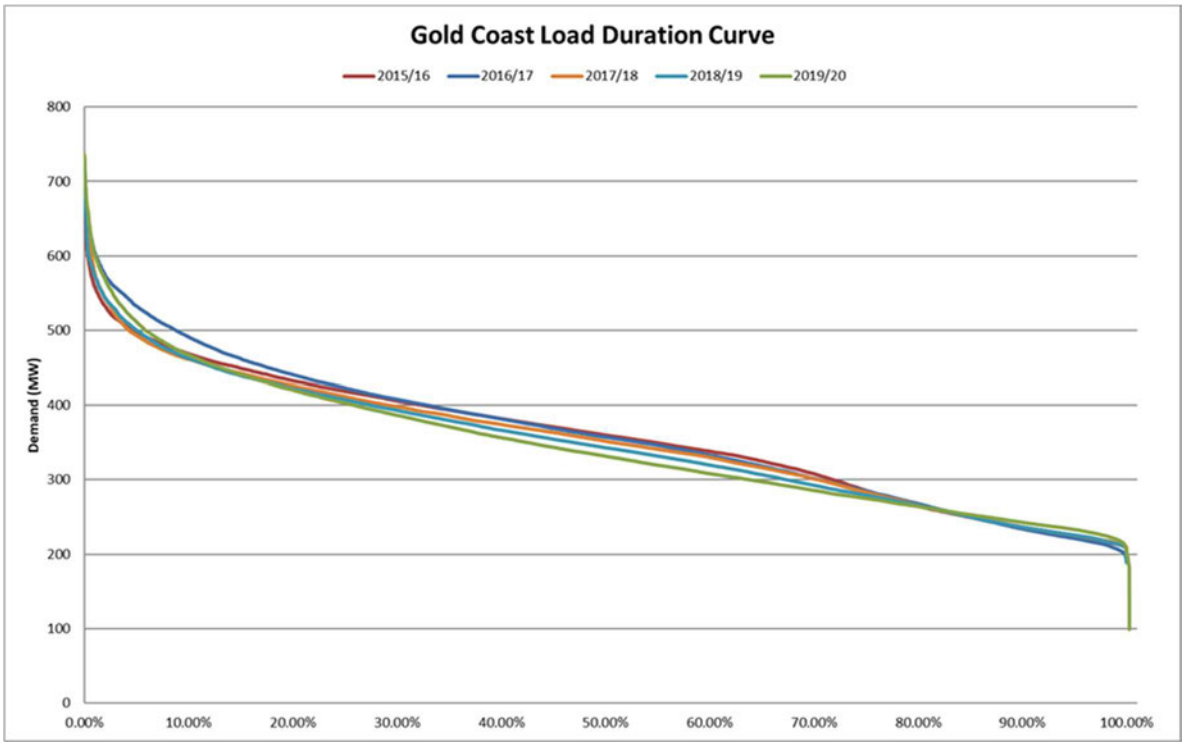


Figure 4 – Gold Coast 110kV Load Duration Curve

There are no major additional loads proposed or committed in the Gold Coast area.

3. Statement of Investment Need

As outlined in the Section 2, the Molendinar Substation is a major bulk supply point for Energex (Energy Queensland) loads in the Gold Coast area.

Removing the functionality of this substation would have a major impact on the performance of the Gold Coast grid section as well as impacting the reliability of supply to the loads in the Northern Gold Coast area (particularly loads at Cades County, Molendinar and Southport).

As shown in Figure 2 there are only 2 x 275/110kV transformer bays supplying power to the Molendinar 110kV bus whilst there are 12 x 110kV feeder/transformer bays supplying power to Energy Queensland bulk supply points. Given only 2 x 275kV sources of power (plus possibly 2 x 110kV feeders from Cades County) it is not technically feasible to configure circuits to supply all of the load connections without a 110kV bus. Therefore, the Molendinar Substation must retain the 110kV bus and the 275kV is already minimalist with transformer-ended feeders from Greenbank Substation. Removing individual feeder bays would also have a significant impact on the reliability of supply to Energex Queensland's Gold Coast bulk supply points. In all cases load would be at risk for the next credible contingency.

The secondary systems are required to operate the Molendinar Substation. Therefore, the secondary systems at Molendinar Substation is required to avoid system failures that would result in loss of load in excess of Powerlink's N-1-50MW / 600MWh reliability standard. There would also be significant impact to the capacity of the power transfer capability into the Terranora Interconnector.

4. Network Risk

The table below presents the load at risk as well as the energy at risk for loads connected to the Molendinar Substation at 110kV.

Table 1 – Molendinar 110kV Load at Risk

At Risk	Contingency	Metric	2026
Molendinar, Cades County and South Port	275kV Feeders into Molendinar (8824 & 8825) or two 275/110kV transfs. (1T & 2T)	Max (MW)	336
		Average (MW)	10
		24h Energy Unserved Max (MWh)	3490
		24h Energy Unserved Average (MWh)	237
Molendinar 33kV	Loss of two 110/33kV transformers (10T / 11T / 12T)	Max (MW)	20
		Average (MW)	0.02
		24h Energy Unserved Max (MWh)	59
		24h Energy Unserved Average (MWh)	0.5
Molendinar 11kV	Loss of 110/11kV transformers (4T and 6T)	Max (MW)	74
		Average (MW)	38
		24h Energy Unserved Max (MWh)	1337
		24h Energy Unserved Average (MWh)	904

5. Non Network Options

The Molendinar Substation facilitates 275kV flow between Brisbane and the Gold Coast area. The substation hosts two 275/132kV transformers to facilitate 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, the non-network solution must be capable of delivering up to 336MW of power and 3490MWh of energy each day.

Powerlink is not aware of any Demand Side Solutions (DSM) in the Gold Coast area 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.

6. Network Options

6.1 Proposed Option to address the identified need

Planning recommends the replacement of all secondary systems reaching end of life at Molendinar Substation by 2027. This option ensures that all reliability of supply and asset condition criteria are met as well as maintaining the power transfer capability into the Gold Coast area.

Further details of condition assessment for the Molendinar Substation secondary systems and their recommended replacement timing can be found in Reference 1.

6.2 Option Considered but Not Proposed

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

6.2.1 Do Nothing

“Do Nothing” would not be an acceptable option as the primary driver (secondary systems condition and obsolescence) and associated safety, reliability and compliance risks would not be resolved. Furthermore, the “Do Nothing” option would not be consistent with good industry practice and would result in Powerlink breaching their obligations with the requirements of the System Standards of the National Electricity Rules and its Transmission Authority.

7. Recommendations

Powerlink has reviewed the condition of the secondary systems at Molendinar Substation and anticipates they will reach end of technical service life by 2026/27. It is therefore recommended that the systems be replaced by 2027.

Retaining Molendinar Substation 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 area.

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

8. References

1. H031 Molendinar 275/110kV Substation – Secondary Systems Condition Assessment Report
2. Transmission Annual Planning Report 2020
3. Asset Planning Criteria Framework

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 further 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. These are the values in section 4.

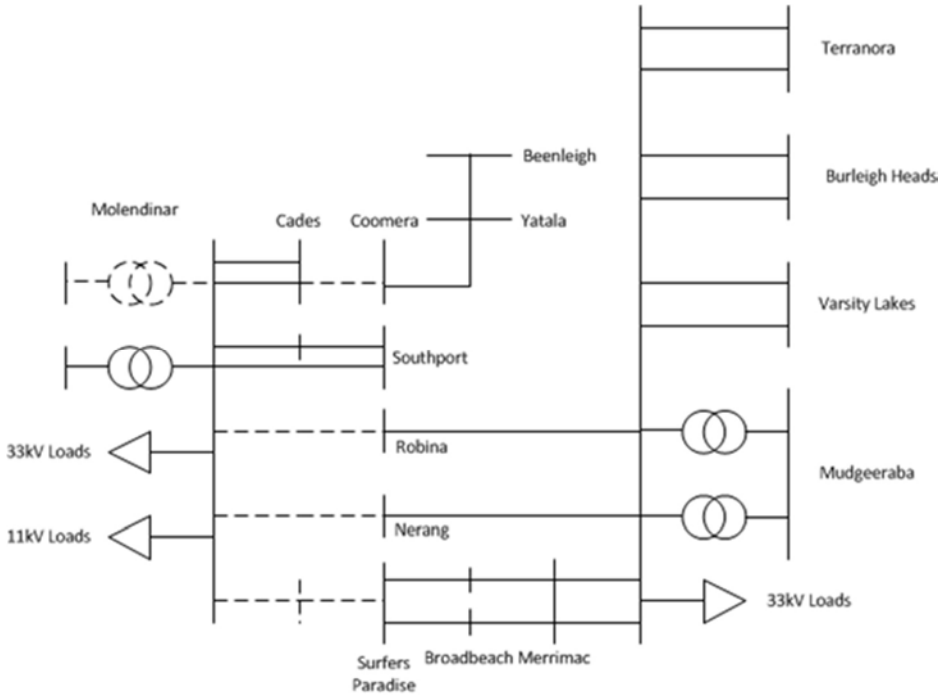


Figure 5 - Molendinar Transformer-ended Feeder Outage Switching

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.

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.

Base Case Risk and Maintenance Costs Summary Report

CP.02756 Molendinar Secondary Systems Replacement

Version Number	Objective ID	Date	Description
1.0	A4403842	04/11/2020	Original document.

1 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.

Base case risk costs have been analysed over a ten-year study horizon.

2 Key Assumptions

In calculating the potential unserved energy (USE) arising from a failure of the ageing and obsolete secondary systems at Molendinar substation, the following modelling assumptions have been made:

- Spares for secondary system equipment items have been assumed to be available prior to the point of expected spares depletion, which coincides with the expected technical asset life. After this point the cost and time to return the secondary system back to service increases significantly;
- Historical load profiles have been used when assessing the likelihood of unserved energy under failure events;
- Due to the network and substation configuration, unserved energy generally accrues under concurrent failure events and consideration has been given to potential feeder trip events within the wider south west Queensland area;
- Molendinar substation primarily supplies the northern part of the greater Gold Coast area, comprising of a mixture of residential, commercial and light industrial loads. Historical load data and estimates have been used to analyse the proportion of these load types; and
- VCRs within the relevant climate zone published within the AER's 2019 Value of Customer Reliability Review Final Report have been used within this risk cost assessment. A weighted average VCR of $32,312/MWh has been used when evaluating network risk cost derived from the proportions identified from historical data.

3 Base Case Risk Analysis

3.1 Risk Categories

Four main categories of risk are assessed within Powerlink's risk approach; safety, network, financial and environmental. For the secondary systems at Molendinar, network and financial risks are considered material and are modelled in the risk cost analysis.

3.2 Secondary Systems Analysis

This section analyses the risks presented by the relevant secondary systems at Molendinar substation.

Table 1 - Risks associated with at risk secondary systems

	Mode of failure	
Equipment	**Peaceful**	**Explosive**
Secondary systems	Network risks (unserved energy due to concurrent network element outages). Financial risks to respond on-site and replace failed secondary systems in an emergency manner[1].	N/A

[1] Secondary systems spares are modelled as being available until equipment reaches 20 years of age. After this time, the cost to replace obsolete spares in an emergency manner is higher which is modelled as increased financial risk cost.

3.3 Base Case Risk Cost

The modelled and extrapolated total base case risk costs are shown in the following figures.

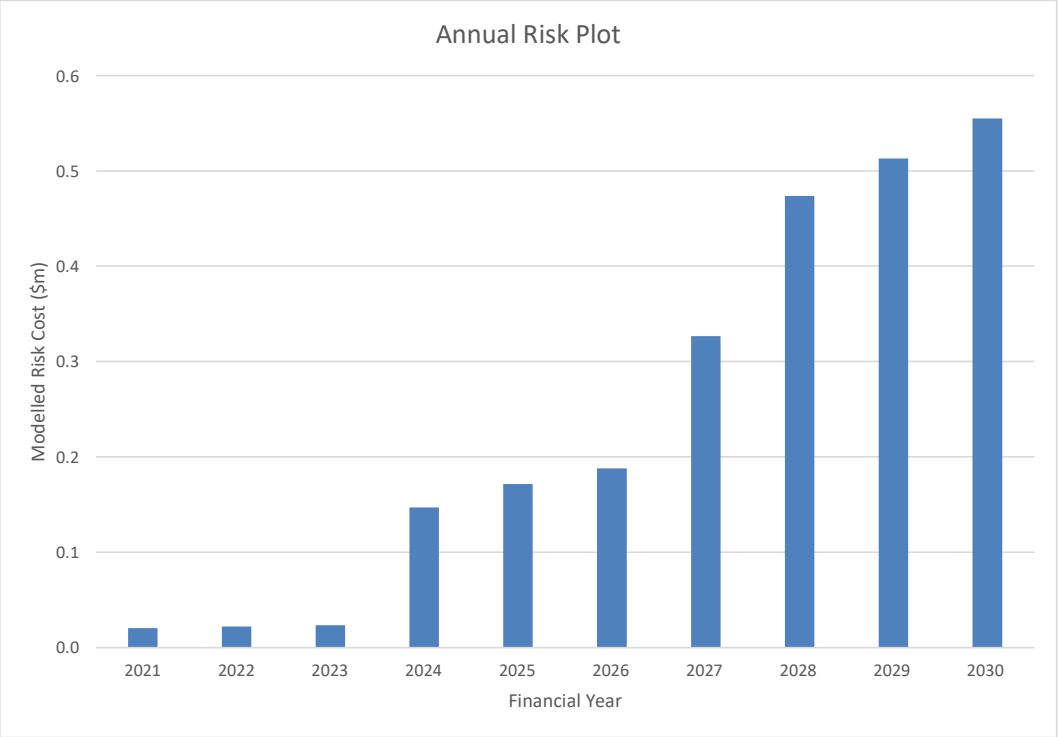


Figure 1 – Molendinar secondary systems total risk cost

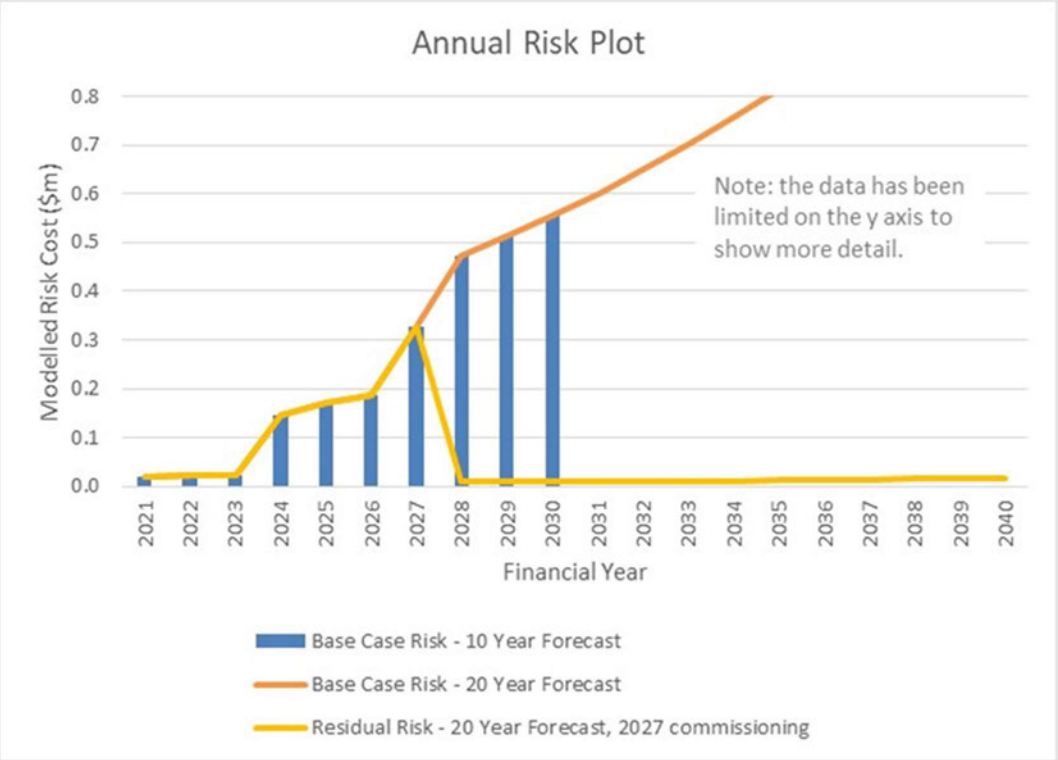


Figure 2 – Molendinar secondary systems risk cost (10 and 15 years)[2]

[2] The significant increase in risk cost in 2024 and 2027 coincides with the depletion of available spares.

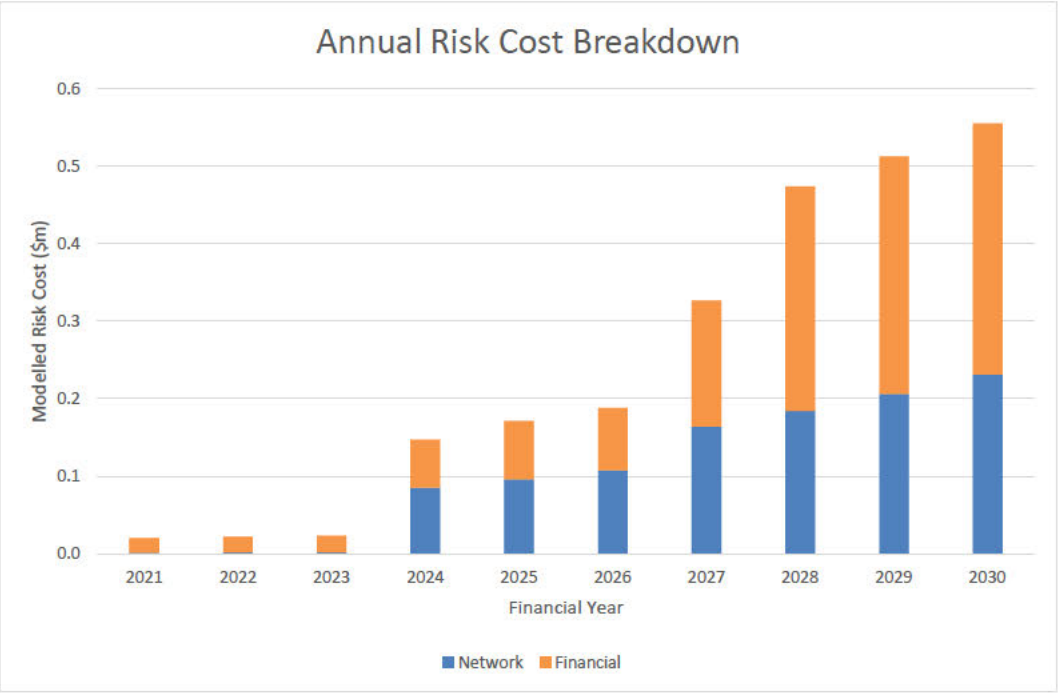


Figure 3 – Molendinar secondary systems risk cost by category

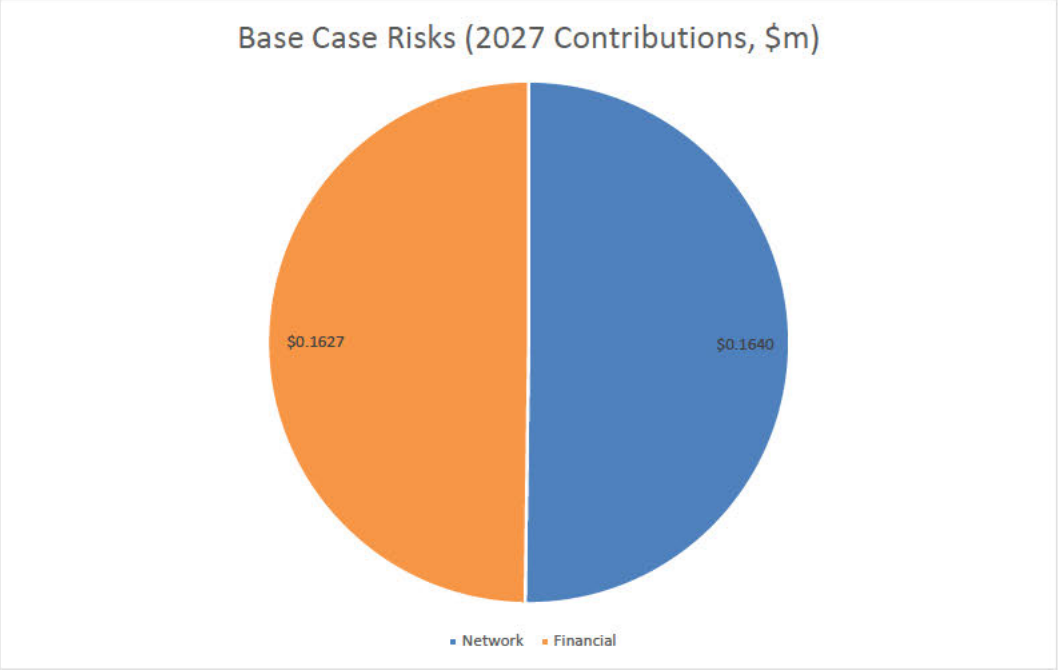


Figure 4 – Molendinar 2027 risk cost by category

3.4 Base case risk statement

The main base case risks for the secondary systems at Molendinar substation are associated with financial risks to replace the failed secondary systems in an unplanned (emergency) manner, and network risks (unserved energy) resulting from concurrent network outages associated with equipment failures.

4 Maintenance costs

Maintenance costs are still being developed. For the purposes of this report, maintenance has been modelled as 1.5% of the project capital. This is consistent with historical maintenance costs as a percentage of capital cost.

The total base case risk and maintenance cost is show below:

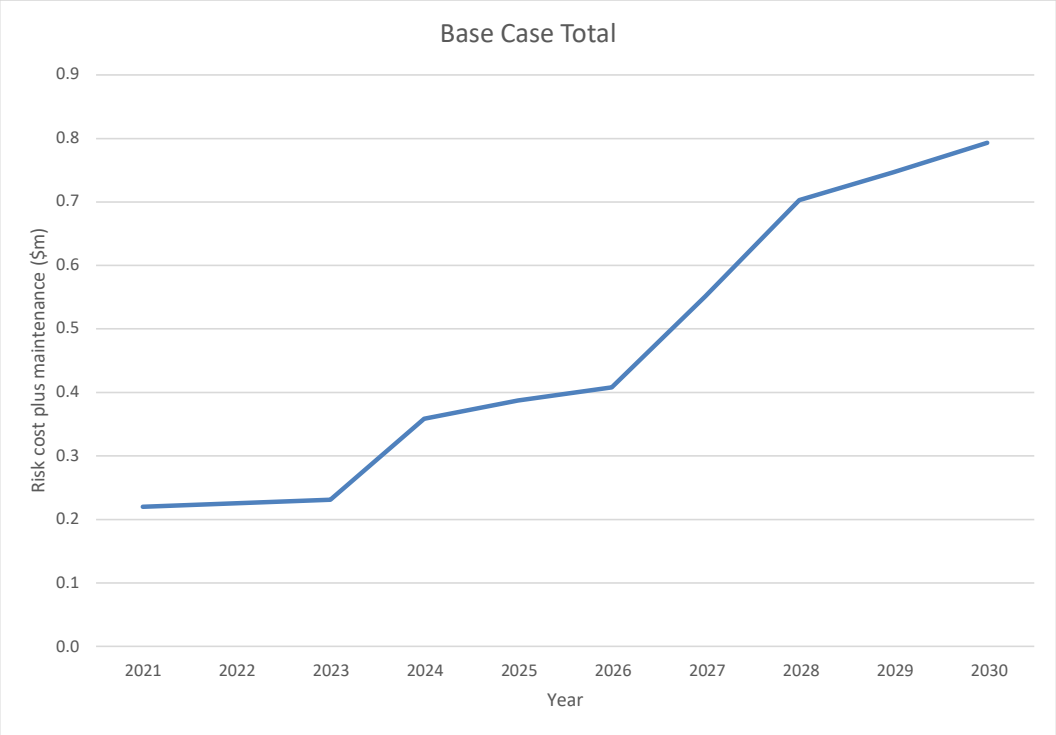


Figure 5 - Base Case Total (Risk Cost + Maintenance)

5 Participation factors

A sensitivity analysis was carried out 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 following figures. As an example, the participation of VCR to risk cost post obsolescence is approximately 39%. Hence, an increase in VCR of 100% would increase the overall risk cost by around 39%.

Due to the non-linear nature of the risk cost model (specifically network risk costs which are a function of concurrent failures), the participation factor can change depending on the magnitude of input percentage change. The participation factors calculated below are based on an increase of input by 100%.

The model is most sensitive to emergency replacement cost followed by plant restoration time for both pre-secondary systems obsolescence and post-secondary systems obsolescence states. The sensitivity to assumptions on VCR is higher when secondary systems obsolescence is reached.

Table 2 - Input values, secondary systems model

	Item	Value	Unit
Network	VCR	32,312	$/MWh
	Plant restoration time with spares	1	Day
	Plant restoration time with no spares	7	Days
Financial	Emergency replacement cost with spares	0.01	$million
	Emergency replacement cost with no spares	0.1	$million

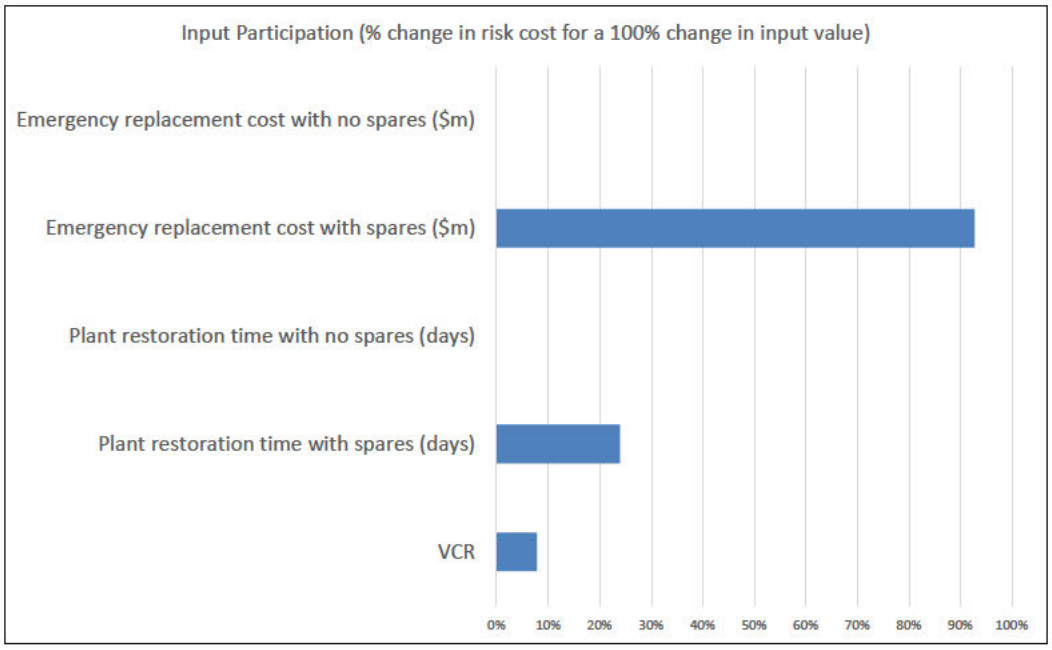


Figure 6 - Participation factors, secondary systems model – pre secondary systems obsolescence

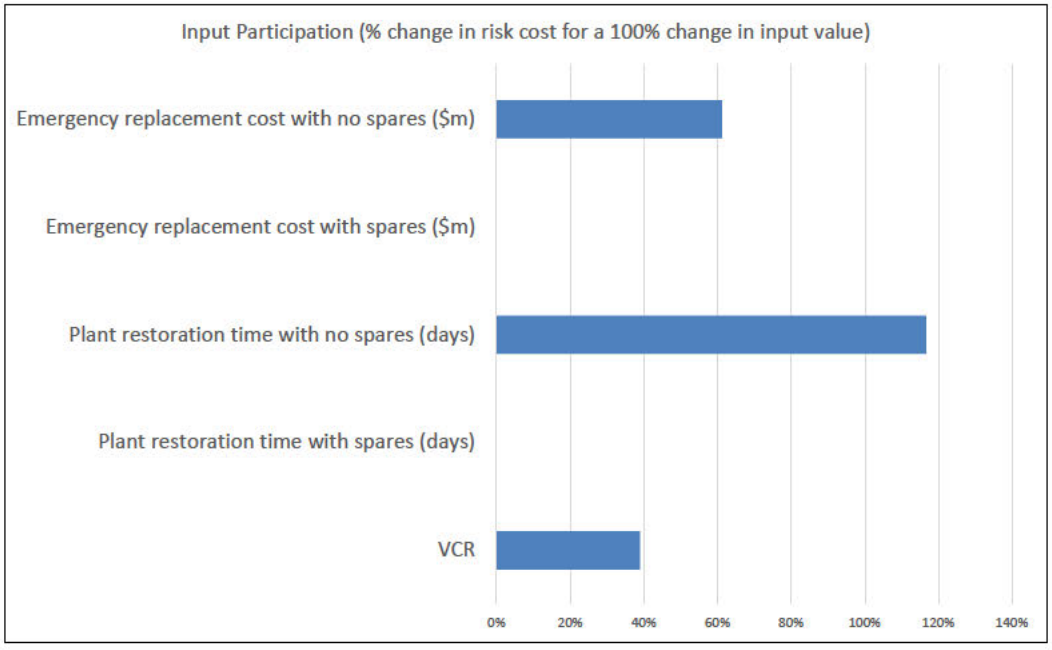


Figure 7 - Participation factors, secondary systems model – post secondary systems obsolescence

Project Scope Report

CP.02756

Molendinar Secondary Systems Replacement

Concept – Version 1

Document Control

Change Record

Issue Date	Responsible Person	Objective Document Name	Background
20/07/20	[redacted]	Project Scope Report CP.02756 Molendinar Secondary Systems Replacement (Stage 1)	Preliminary scope

Related Documents

Issue Date	Responsible Person	Objective Document Name
20/05/2020	[redacted]	H031 Molendinar Secondary Systems Condition Assessment Report - 08 May 2020 (A3359019)

Project Contacts

Project Sponsor	[redacted]	[redacted]
Connection & Development Manager	<name>	Ext.
Strategist – HV/Digital Asset Strategies	<name>	Ext.
Grid Planner – Main/Regional Grid	<name>	Ext.
Manager Projects	<name>	Ext.
Project Manager	<name>	Ext.
Design Coordinator	<name>	Ext.

Project Details

1. Project Need & Objective

Molendinar Substation, located approximately 75km south-east of Brisbane, is one of two major injection points into the Gold Coast area. Established in 2003, it 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 overhead 110kV network supplies Robina and Nerang substations.

A condition assessment of the Molendinar substation secondary systems recommends replacement of the secondary systems by 2026/27.

The objective of this project is to replace the secondary systems at Molendinar Substation by October 2026.

2. Project Drawing

Figure 1 – Operational Diagram

Figure 2 – Aerial View

3. Project Scope

3.1. 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 5 Special Considerations*.

Briefly, the project consists of the replacement of the secondary systems equipment at Molendinar Substation.

3.1.1. Transmission Line Works

Not applicable

3.1.2. H031 Molendinar Substation Works

Design, procure, construct and commission replacement of the complete secondary systems. Within the scope of work:

- Establish new secondary systems panels and associated common control, protection and monitoring equipment within the existing control buildings. In the event that new buildings are required then the scope of works shall consider:
    - Establish new cable termination racks such that cables terminated directly between the existing secondary systems panels and marshalling kiosks can be relocated from the existing control buildings to new cable termination rack without need to re-run cables to the yard marshalling kiosks.
    - Construct cable trenches to the new cable termination racks and run cables from the new cable termination rack to the new control buildings as appropriate;

- Effect the staged cutover, testing and commissioning of the existing secondary systems panels and associated equipment to the new control system, in accordance with current Powerlink design standards, including;

  Existing Building +6: -
    - 1 Bus Zone CBF
    - 275kV Feeder 8824 Greenbank
    - Feeder 916 Surfers Paradise
    - 1 Transf HV including transformer PLC
    - 1-3 Bus Section
    - 1-2 Bus Section
    - 10 Transf HV
    - 4 Cap
    - Revenue Metering – T1 110kV, F916, T10 33kV
    - 110kV Multiplex communications
    - Station SCADA (NSC & LCF), Aux Control, Timing, OpsWAN & Common RTU
    - 125VDC (X & Y), batteries, monitors and chargers
    - DC Distribution Board

Existing Building +7: -

- 2 Bus Zone CBF
- Feeder 917 Southport
- Feeder 7193 Cades County
- Feeder 798 Nerang
- 11 Transf HV
- 2 Transf LV
- High Speed Power Monitoring and PQM
- Aux Control, Timing, OpsWAN & Common RTU
- 110kV Multiplex communications
- Revenue Metering to Feeders 917, 7193, 798 & Egx T6
- Revenue Metering to 11 Trf 33kV and 2 Trf 110kV
- Stub CB 4462 Bay =D33 2Bus to Egx Trf T6
- 275kV Feeder 8825 Greenbank
- 2 Transf HV including transformer PLC
- 125VDC (X & Y), batteries, monitors and chargers
- DC Distribution Board

Existing Building +8: -

- 3 Bus Zone CBF
- Feeder 7297 Cades County
- Feeder 907 Southport
- Feeder 7229 Robina
- 12 Transf HV
- Aux Control, Timing, OpsWAN & Common RTU
- 110kV Multiplex communications
- Revenue Metering to Feeders 907, 7297, 7229 & Egx T4
- Stub CB 4442 Bay =D34 1Bus to Egx Trf T4
- 3 Cap
- 125VDC (X & Y), batteries, monitors and chargers
- DC Distribution Board

- Decommission Bay =D08 Bus Coupler Panel (Building +6)
- Decommission 5 Cap Bay =D19
- Decommission and recover all redundant equipment, and update drawing records, SAP records, config files, etc. accordingly.

In the event that new control buildings are required, the scope of work shall include consideration of the following:

- All fibre termination panels shall be located in one of the new buildings as appropriate
- Fire panels, fire protection equipment as well as substation security related equipment shall be located in one of the new buildings or Amenities building as appropriate.
- Decommission and remove the old control buildings +6, +7 & +8.

3.1.3. S003 Greenbank Substation Works

- Modify protection, control, automation and communications systems for feeders 8824 and 8825.

3.1.4. Remote End Energex Substation Works

Coordinate modification of protection, control, automation and communications systems at the following Energex substations.

- T075 Nerang
- T081 Cades County
- SSSPO – Energex Southport Substation
- SSSPD – Energex Surfers Paradise Substation
- H031 Molendinar Energex 33kV and 11kV Substation

3.1.5. Telecoms Works

Modify telecoms to suit the requirements of the new protection/control equipment as necessary.

3.1.6. Easement/Land Acquisition & Permits Works

Not applicable

3.2. Key Scope Assumptions

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

- The new panels shall in accordance with the current secondary systems standard;
- Existing control cables are assumed to have sufficient remaining life so as not to require replacement.

In the event new control buildings are required then:

- the location of new control buildings shall consider minimizing cable requirements and modification;

4. Project Timing

4.1. Project Approval Date

The anticipated date by which the project will be approved is 30 June 2023.

4.2. Site Access Date

Molendinar Substation is an existing Powerlink asset, site access is already available.

4.3. 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 31 October 2026.

5. Special Considerations

The following issues are important to consider during the implementation of this project:

- any existing assets to be removed and disposed of as part of this scope must be identified within the estimate together with the forecast asset residual value at time of disposal;
- plant and equipment identified as suitable to be recovered for use as spares or returned to stores should be packaged and transported to an appropriate storage location, with a suitable allowance for the cost included in the estimate;
- as some of the outages may be difficult to get, the estimate should include some discussion on the delivery method to achieve a successful cutover of the secondary systems; and
- a high level project implementation plan including staging and outage plans should be considered as part of the estimate.

6. 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 Strategy and Business Development.

The Business Development Team will provide the primary customer interface with Energex. The Project Sponsor should be kept informed of any discussions with the customer.

7. Asset Ownership

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

The asset boundaries with Energex will be at the:

- LV terminals of the 10, 11, and 12 110/33kV Transformers;
- Landing Beam of all Energex 110kV feeders and 11kV connections.

8. 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.

9. Options

Not applicable

10. Division of Responsibilities

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

11. Related Projects

Project No.	Project Description	Planned Comm Date	Comment
Pre-requisite Projects			
Co-requisite Projects			
Other Related Projects			
CP.02415	Greenbank - Mudgeeraba 275kV TL Refit	2029	
CP.02725	H004 Mudgeeraba 110kV secondary system replacement	2026	
CP.0xxxx	H004 Mudgeeraba Primary Plant Replacement	2026	
CP.0xxxx	Greenbank Secondary Systems Replacement	2028	
CP.0xxxx	Mudgeeraba to STR-1731 (NSW Boarder Terranora) Line Refit (1009)	2029	

Concept Estimate for CP.02756 - Molendinar Secondary Systems Replacement

Record ID	A3374424	
Policy stream	Asset Management	
Authored by	Project Manager	[redacted]
Reviewed by	Project Manager	[redacted]
Reviewed by	Team Leader Projects	[redacted]
Approved by	Manager Projects	[redacted]

Table of Contents

1. Executive Summary

A condition assessment of the Molendinar substation secondary systems has recommended replacement of the secondary systems by 2026, Therefore the objective of this project is to replace the secondary systems at Molendinar Substation by October 2026.

H031 Molendinar substation 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.

Scope

Establish new secondary systems panels and associated common control, protection and monitoring equipment in two (2) new buildings replacing buildings +6 , +7 and +8. These require;

- Establishing new cable termination racks such that cables terminated directly between the existing secondary systems panels and marshalling kiosks can be relocated from the existing control buildings to new cable termination rack without need to re-run cables to the yard marshalling kiosks.
- Constructing cable trenches to the new cable termination racks and run cables from the new cable termination rack to the new control buildings as appropriate;
- Remove Cap Bank 5.

1.1 Project Estimate

Estimate Components		Base $	Escalated $
Estimate Class	5		
Estimate Accuracy	+100% / - 50%		
Base Estimate		**22,483,814**	**26,907,148**
Mitigated Risk	[redacted]	[redacted]	[redacted]
Contingency Allowance	[redacted]	[redacted]	[redacted]
TOTAL		[redacted]	[redacted]

1.2 Project Financial Year Cash Flows

	June 2020 Base $	Escalated $
To June 2024	5,839,593	6,577,465
To June 2025	5,743,856	6,745,381
To June 2026	5,743,856	7,021,941
To June 2027	5,156,508	6,562,361
Total	**22,483,814**	**26,907,148**

2. Project and Site Specific Information

2.1 Project Dependencies & Interactions

No other options other than replacing the existing 3 buildings with 2 new buildings was considered due to limitations of spare space in existing buildings for panel by panel replacement.

Project No.	Project Description	Planned Comm Date	Comment
Dependencies			
Nil			
Interactions			
Nil			
Other Related Projects			
CP.02415	Greenbank - Mudgeeraba 275kV TL Refit	2029	
CP.02725	H004 Mudgeeraba 110kV secondary system replacement	2026	
CP.0xxxx	H004 Mudgeeraba Primary Plant Replacement	2026	
CP.0xxxx	Greenbank Secondary Systems Replacement	2028	
CP.0xxxx	Mudgeeraba to STR-1731 (NSW Boarder Terranora) Line Refit (1009)	2029	

2.2 Site Specific Issues

H031 Molendinar substation is supplied from Greenbank Substation by a 275kV double circuit transmission line into two 375MVA 275/110kV transformers. The 110kV supplies Energex substations and close co-operation from Energex is vital for the successful outcome of this project as outages will be paramount.

Utilizing the existing cables may result in creating some challenges when re-routing to new building cable termination racks.

3. Secondary Systems Replacement into 2 New Buildings

3.1 Definition

3.1.1 Scope

Establish new secondary systems panels and associated common control, protection and monitoring equipment in two (2) new buildings replacing buildings +6 , +7 and +8. These require;

- Establishing new cable termination racks such that cables terminated directly between the existing secondary systems panels and marshalling kiosks can be relocated from the existing control buildings to new cable termination rack without need to re-run cables to the yard marshalling kiosks.
- Constructing cable trenches to the new cable termination racks and run cables from the new cable termination rack to the new control buildings as appropriate;
- Remove Cap Bank 5.
- Remove existing buildings +6, +7 & +8.

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
    - SSSPO – Energex Southport Substation
    - SSSPD – Energex Surfers Paradise Substation
    - H031 Molendinar Energex 33kV and 11kV Substation

3.1.1.1 Substations Works

Summary of replaced panels

- 3x BZ & CB Fail panel
- 2x 110kV Bus coupler panels
- 5 x 275kV Transformer HV panels for 1T,2T , 10T, 11T , 12T
- 2x Transformer LV panels for 1T and 2T
- 2x CAP bank panel for 3CAP and 4CAP
- 2x 275kV FDR panel for Fdr 8824, Fdr 8825
- 7x 110kV FDR panels for FDR798, FDR7229, FDR7193, FDR7297, FDR917, FDR907, FDR916
- 2x Stub CB Management for CB4462 and CB4442
- 4x REV Meter panel
- 2x HSM & PQM panels
- 2X NET panels
- 2x SIP & MPLS panels (preferably to be installed in existing COMMs BLDG)
- 2x Control Building infrastructure
- ASSUMPTION: 35 panels in total installed in 2 new Control Buildings

Other works: -

- Decommission Bay =D08 Bus Coupler Panel (Building +6)
- Decommission 5 Cap Bay =D19

3.1.1.2 Transmission Line Works

Not applicable

3.1.1.3 Telecommunication Works

Modify telecoms to suit the requirements of the new protection/control equipment as necessary.

3.1.1.4 Easement/Land Acquisition & Permit Works

Not applicable

3.1.2 Major Scope Assumptions

The following key assumptions were made for this Project Estimate.

- The work includes replacement of the 275 /110kV secondary systems at H031 Molendinar complete with 2 new demountable control buildings. Construct and commission three new cable termination rack such that cables terminated directly between the existing secondary systems panels and marshalling kiosks can be relocated from the existing control buildings to new cable termination rack without need to re-run cables to the yard marshalling kiosks.
- It is assumed that the existing cables will be reusable and they will be pulled to the terminal racks outside the buildings
- It is assumed that no Restricted Access Zone will be deployed on this site during construction.
- It is assumed that outages will be available as being request.

3.1.3 Scope Exclusions

- No major modification to the earth grid is included in this estimate.
- No major earthworks are included in this estimate.
- Rock is excluded from the base estimate (an item is included in the risk)
- This estimate does not include any costs for repairing or modification to the primary plants.
- The estimate excludes upgrades for the following: modification and upgrading the internal roads, lights, fences, gates and extension to platform
- No asbestos removal is included in the scope of this project.
- No modification on the existing transmission lines are considered in this estimate.

3.2 Project Execution

3.2.1 Project Schedule

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

Task	Target Completion
Project Approval, PAN Issued	August 2022
Design Commencement	August 2022
Design Complete	February 2023
Procurement Orders	March 2023
Procurement Deliveries	August 2023
Contract Award	July 2023
Site Access Date	July 2023
Staged Bay Construction	February 2024
Staged Bay Commissioning	November 2026
Final Decommissioning	February 2027
Project Completion	February 2027

3.2.2 Network Impacts

Works are scheduled to avoid any major outage during the summer season. It is assumed that outages will be available in non-summer periods.

3.3 Project Estimate

Estimate Components		Base $	Escalated $
Estimate Class	5		
Estimate Accuracy	+100% / - 50%		
Base Estimate		**22,483,814**	**26,907,148**
Mitigated Risk	[redacted]	[redacted]	[redacted]
Contingency Allowance	[redacted]	[redacted]	[redacted]
TOTAL		[redacted]	[redacted]

3.4 Project Financial Year Cash Flows

	June 2020 Base $	Escalated $
To June 2024	5,839,593	6,577,465
To June 2025	5,743,856	6,745,381
To June 2026	5,743,856	7,021,941
To June 2027	5,156,508	6,562,361
Total	**22,483,814**	**26,907,148**

3.5 Project Asset Classification

Asset Class	Asset Life	Base $	Percentage
Secondary systems	15 years	16,652,367	74%
Communications	15 years	1,489,409	7%
Primary plant	40 years	4,342,038	19%
Transmission lines	50 years		
TOTAL		**22,483,814**	

4. References

Document name	Version	Date
Project Scope Report	1.0	20/07/2020