January 2026

Powerlink 2027-32 Revenue Proposal

Project Pack

CP.02760 Middle Ridge Secondary Systems Replacement

Project Status: Unapproved

Network Requirement

The Middle Ridge 330/275/110kV Substation, located south of Toowoomba, was established in 1965 and is an essential bulk supply point for local and South East Queensland including Toowoomba and the Darling Downs area. It is also a major transmission node between South West and South East Queensland. The substation consists of a 330kV, 275kV and 110kV yard, with two 330/275kV transformers, three 275/110kV transformers, 330kV capacitor banks and 110kV capacitor banks.

Ageing secondary systems, which are no longer supported by the manufacturer are increasingly at risk of failing to comply with Schedule 5.1.9(c) of the National Electricity Rules, AEMO's Power System Security Guidelines and the reliability standard included in Powerlink's Transmission Authority.

A condition assessment of the Middle Ridge Substation secondary systems identifies various secondary systems components that require replacement [1].

Powerlink's 2025 Central scenario forecast confirms there is an enduring need to maintain electricity supply into the Toowoomba and Darling Downs area. The removal or reconfiguration of the Middle Ridge Substation due to secondary system failure or obsolescence would violate Powerlink's N-1-50MW/600MWh Transmission Authority reliability standard and significantly impact the power transfer capability into the South East Queensland Area [2].

Recommended Option

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

The current recommended option is for full replacement of all 330kV, 275kV and 110kV secondary systems within existing control buildings by 2032 [3].

Options considered but not proposed include:

- Replacement of some secondary systems and decommission some functionality – this will increase the value of network losses by more than the cost of the avoided secondary systems replacement and so will be a higher overall cost.

Figure 1 shows the current recommended option reduces the forecast risk monetisation profile of the Middle Ridge Substation secondary systems from around $3.6 million per annum in 2033 to less than $0.05 million from 2034 [5].

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

Cost and Timing

The estimated cost to replace secondary systems at Middle Ridge substation is $62.5m ($2025/26) [4].

Target Commissioning Date: July 2032

Document in CP.02760 Project Pack

Public Documents

1. H014 Middle Ridge Secondary Systems Condition Assessment Report
2. CP.02760 Middle Ridge Secondary Systems Replacement – Planning Statement
3. CP.02760 Middle Ridge Secondary Systems Replacement – Project Scope Report
4. CP.02760 Middle Ridge Secondary Systems Replacement – Concept Estimate
5. CP.02760 Middle Ridge Secondary Systems Replacement – Risk Cost Summary

H014 Middle Ridge 330/275/110kV

Secondary Systems Condition Assessment Report

Document Details			
Version Number	2.0	**Principal Author**	[redacted]
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Date	Version	Nature of Change	Author	Authorisation
15/06/2018	1.0	New document	[redacted]	[redacted]
28/03/2019	2.0	Update health index	[redacted]	[redacted]

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1. Introduction

This report is pertinent to H014 Middle Ridge substation 330/275/110kV secondary systems and associated site infrastructure. The report is provided to assist with determining the future strategy and scope for refurbishment and replacement works of Middle Ridge 330/275kV/110kV secondary systems.

The assessment has been formulated with the assistance of data extracted from SAP, SPF, Forced Outage Database (FOD), discussion with maintenance staff and a site inspection. Photographs of items are included in the text and all photographs taken during the site visit have been retained for future reference.

H014 Middle Ridge substation is a 330/275/110kV transmission substation located at the southern Queensland transmission network and is a key switch point to Southern Queensland.

The 330/275/110kV yard is a major node in the wider interconnected network supplying power to Southern Queensland. Majority of secondary systems were commissioned from 2002 to 2007 while secondary systems in 2011 for 330kV 3 & 4 Cap.

[redacted]

H014 Middle Ridge operating diagram

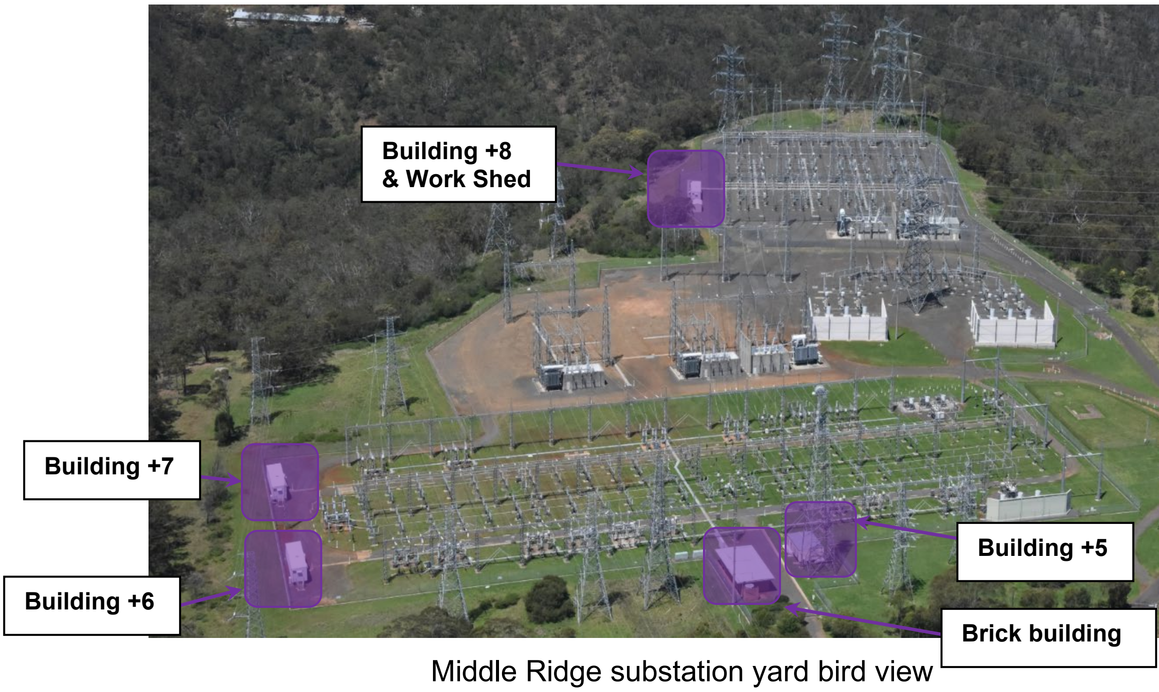
2. Site infrastructure

Middle Ridge substation consists of one yard of 330kV, 275kV and 110kV operating voltage enclosed by the one perimeter fence. The substation was built in 1965. Extensions with load growth have resulted in a mixture of secondary systems from 2002 through to 2011.

H014 Middle Ridge Substation is an essential transmission yard, with secondary systems for:-

- 2 x 330kV feeder bays
- 2 x 330kV Capacitor banks
- 275kV 1 and 2 Bus
- 275kV 1, 2, 3 and 4 coupler
- 5 x 275kV Transformer bays
- 3 x 275kV Feeders
- 3 x 110kV bus zones
- 3 x 110kV bus couplers
- 3 x 110kV Transformer bays
- 13 x 110kV feeder bays
- 2 x 110kV relocatable Capacitor banks

2 x 330kV feeder bays are energised through R004 Millmerran. 10 x 110kV feeder bays are connected to Ergon supplies such as Torrington, Yarranlea, Warwick, Toowoomba South and Kearneys Spring.



Middle Ridge substation yard bird view

The existing Middle Ridge substation site is located at Toowoomba area. Emergency and routine maintenance of the secondary systems is conducted by Powerlink staff at Virginia. The secondary system is housed in a Switchyard Services Building (SSB) and demountable buildings adjacent to the switchyard as shown above.

3. Secondary System Assessment Methodology

Secondary systems including protection and control equipment are required to operate the transmission network and prevent any damages to primary systems when adverse events occur. Under the National Electricity Rules, Transmission Network Service Providers are required to provide sufficient secondary systems to ensure the transmission system is protected. A health index of secondary system asset plays an essential role for secondary system reliability, availability and security.

An asset health index rating method has been developed to describe secondary system asset conditions considering:-

- Secondary system equipment functional failure rate
- Operating environment of the secondary system equipment
- Secondary system equipment physical age

Secondary system asset health Index is modelled in the range from a score zero (0) to ten (10), where zero represents new assets and then indicates the asset requires immediate action to address its increasing risk of equipment failure.

The impacts of equipment obsolescence on availability is also considered when determining the recommended replacement actions.

4. Condition Assessment

4.1 Buildings

The condition assessment of buildings is a separate document and carried out by Substation Strategies. The following details are for information only.

There are multiple buildings at H014 Middle Ridge, including:-

- Brick building
- COMMS building +5
- 110kV control building +6 and +7
- 330/330kV control building +8
- Work shed

The brick building was built in 1965. It is the main entry of the substation and contains intruder and fire protection system.

Brick building

Telecommunication building +5 was built in 2012. It is air-conditioned and contains telecommunication equipment including MPLS and MUX equipment.

COMMS building +5

Demountable building +6 and +7 were built in 2005. These building were air-conditioned and house all 110kV secondary systems and associated communication equipment. There are 6 x spare panel spaces in building +6 and 10 spares panel spaces in building +7 which can be used for future secondary system replacement or refurbishment.

Demountable control building +6 and +7

Demountable control building +8 was established in 2005. It is air-conditioned and accommodates all 330/275kV secondary systems. There are 4 x spare panel spaces in +8 which can be used for future secondary system replacement or refurbishment.

Demountable control building +8

4.2 Trench, marshalling cubicles and control cables

Trenches are part of primary assets. Conditions of cable trenches are not included in this report.

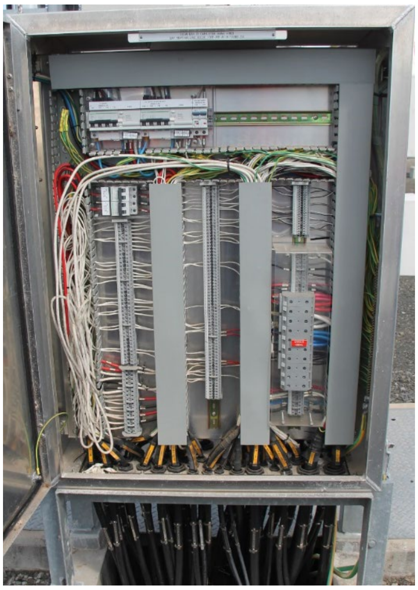

Substation trenches

4.2.1 330/275kV yard

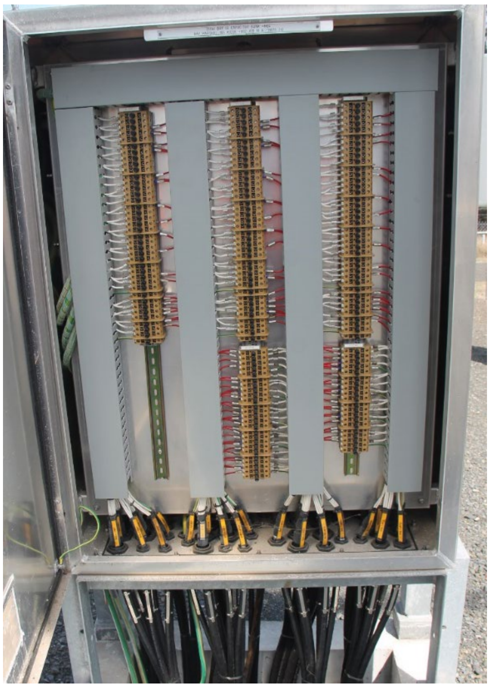
VT boxes for Feeder 9907 and 9908 were installed in 2005 and 2007 respectively. These boxes are in fair condition. There are no condition-driven replacement required until 2040 and 2042 respectively.

Bay marshalling kiosks for 330kV Capacitor bank 3 and 4 were installed in 2011. They are in fair condition. However, the physical disconnect terminals for CT circuits need to be replaced to mitigate CT open circuit risks with major secondary system replacement according to SU0031 New Physical Disconnect Terminals for CT Circuits.

There are no condition driven replacement required for associated control cables until 2046.

=B01 330kV Capacitor 3 bay marshalling kiosk

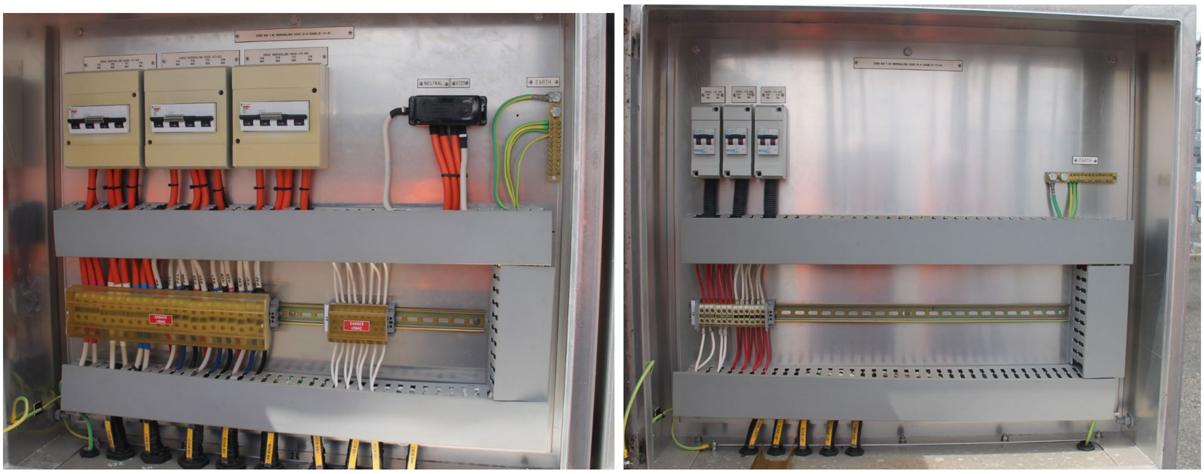
=B02 330kV Capacitor 4 bay marshalling kiosk

Bay marshalling kiosks, VT boxes and control cables for 275kV bus zones were installed in 2005. They are in fair conditions. There are no condition-driven replacement required for VT boxes and control cables until 2040. However, the physical disconnect terminals for CT circuits for bay marshalling kiosks need to be replaced to mitigate CT open circuit risks with major secondary system replacement according to SU0031 New Physical Disconnect Terminals for CT Circuits.

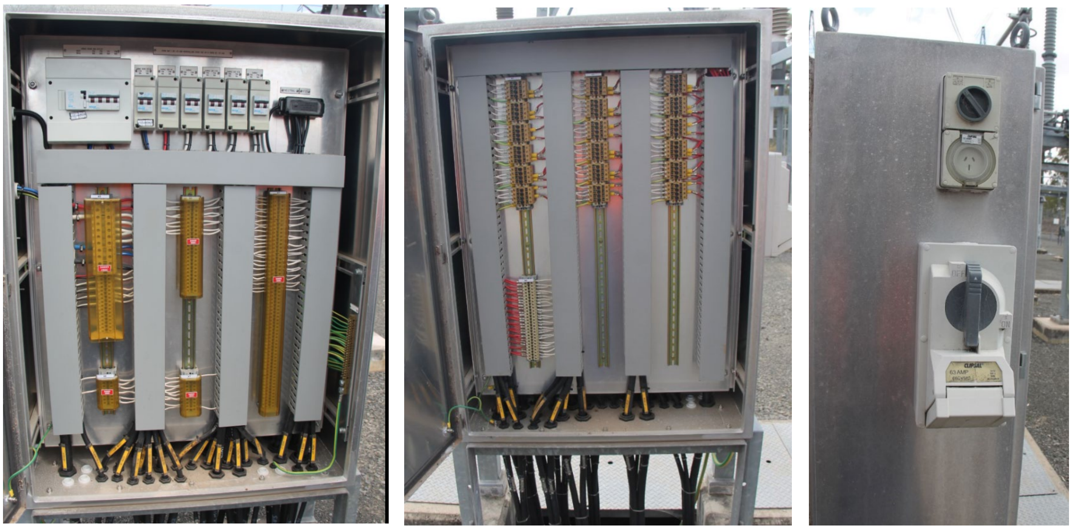
275kV 1 Bus marshalling kiosk and VT box

275kV 2 Bus marshalling kiosk and VT box

Bay marshalling kiosks, VT boxes, control cables and AC/DC marshalling for =C1 and =C2 were installed in 2005. There are no condition-driven replacement required until 2040. The physical disconnect terminals for CT circuits for all bay marshalling kiosks need to be replaced to mitigate CT open circuit risks with major secondary system replacement according to SU0031 New Physical Disconnect Terminals for CT Circuits.



=C1 275kV AC and DC marshalling kiosk



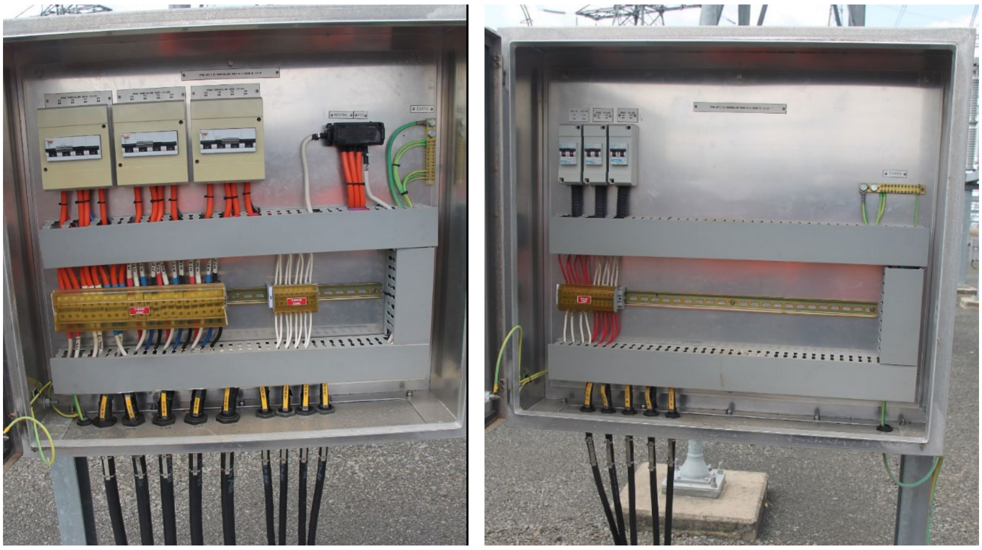
=C1 275kV coupler 501 marshalling kiosk

=C1 275kV Transformer 2 stub CVT box +C1-A23

=C1 275kV 2 Transformer CB marshalling kiosk

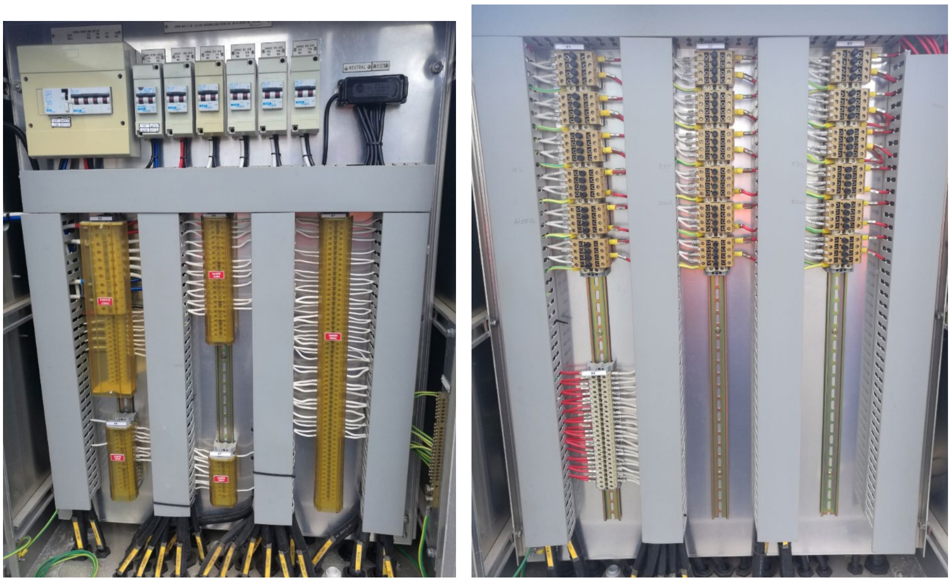
=C1.1 275kV Transformer 3 CB marshalling kiosk

=C1.1 275kV Transformer 3 Stub CVT BOX +C1-A13



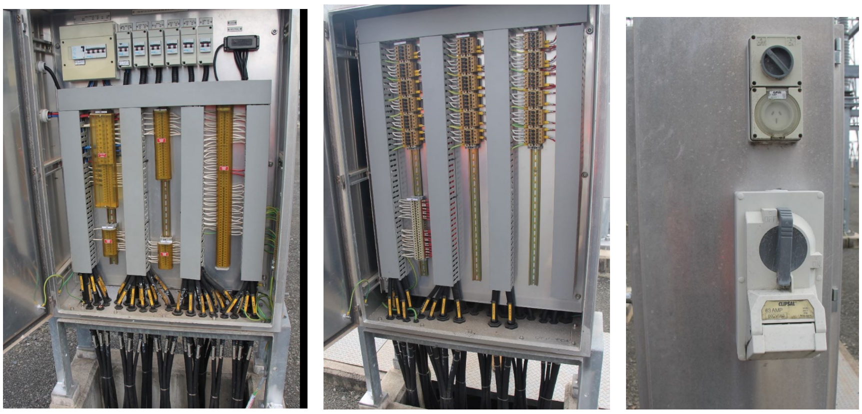
=C2 275kV Bay 2 AC and DC marshalling kiosk

=C2 275kV Coupler 502 marshalling kiosk

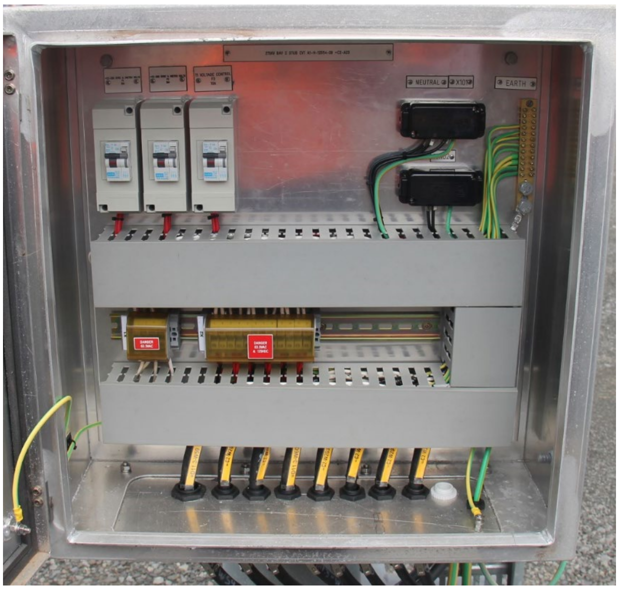


=C2.1 275kV Feeder 831 CB marshalling kiosk

=C2.1 275kV Feeder 831 CVT Box +C2-A13



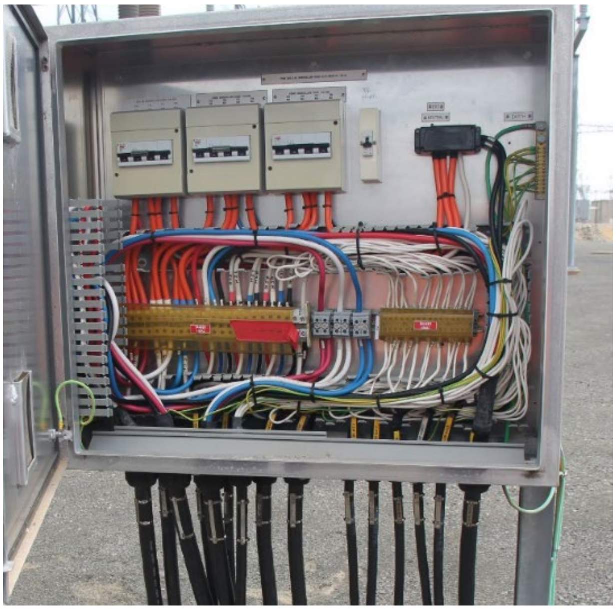
=C2 275kV Transformer 1 CB marshalling kiosk (+C2-A20)



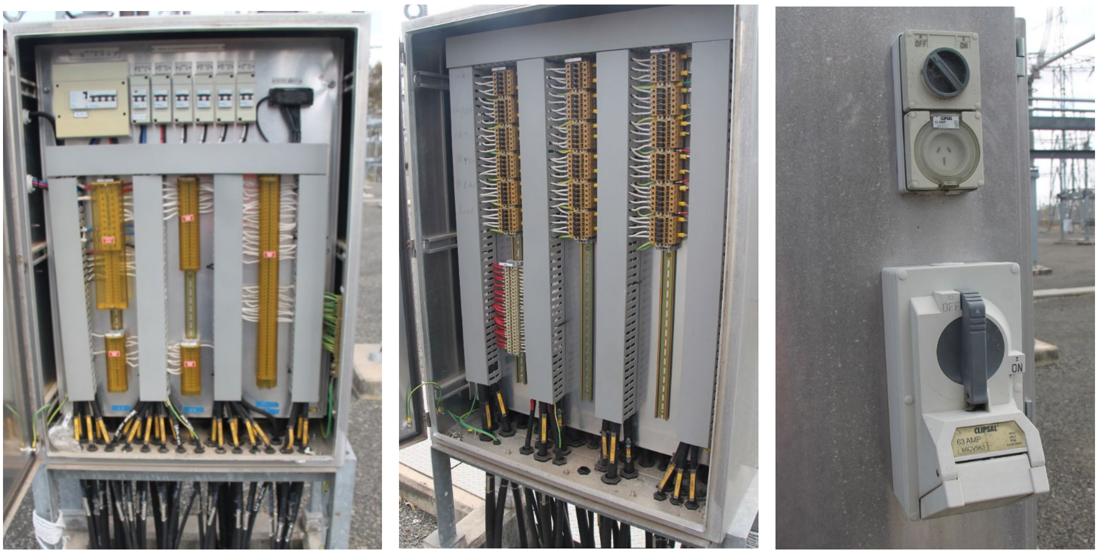
=C2 1 Transformer 275kV VT box

AC supply termination cubicle

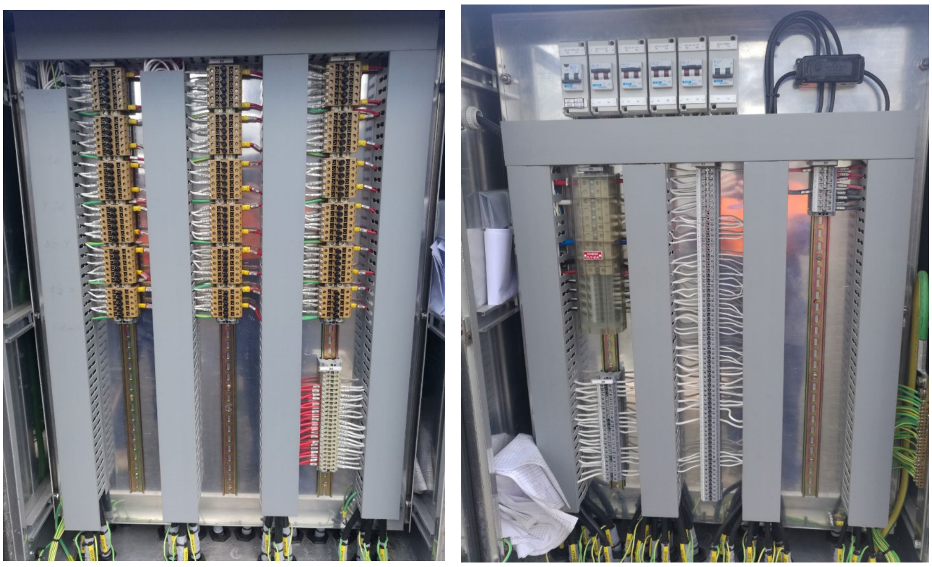
Bay marshalling kiosks and associated control cables for =C3 including AC/DC marshalling kiosk were installed in 2005. They are in fair condition. There are no condition driven replacement required for AC/DC marshalling kiosks, VT boxes and associated control cables until 2040. However, the physical disconnect terminals for CT circuits for bay marshalling kiosks need to be replaced to mitigate CT open circuit risks with major secondary system replacement according to SU0031 New Physical Disconnect Terminals for CT Circuits .



=C3 275kV AC and DC marshalling kiosk

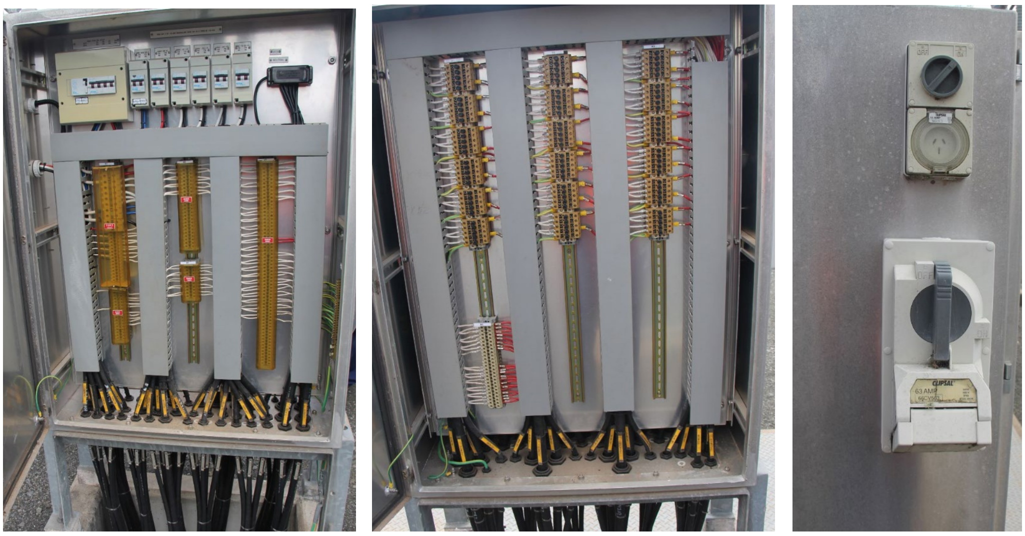


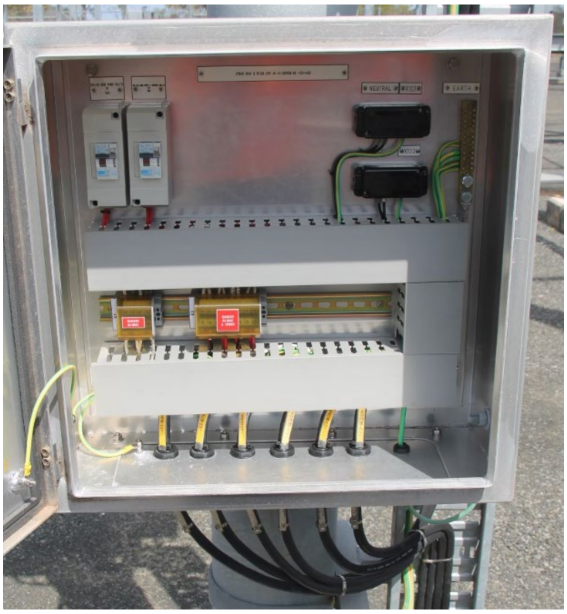
=C3 275kV coupler 503 CB marshalling kiosk



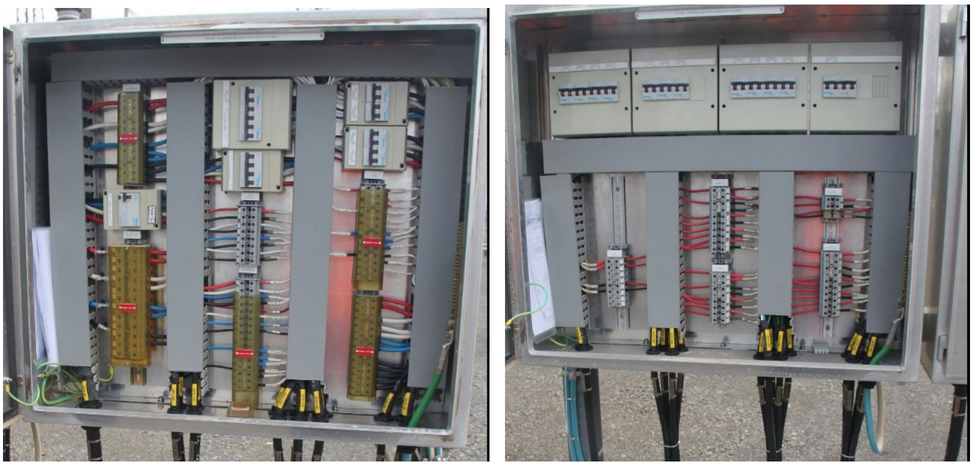
=C3.1 Feeder 8848 CB marshalling kiosk

=C3.1 Feeder 8848 CVT box (=C03-A13)


=C3 4 Transformer 275kV CB marshalling kiosk


=C3 4 Transformer 275kV VT box

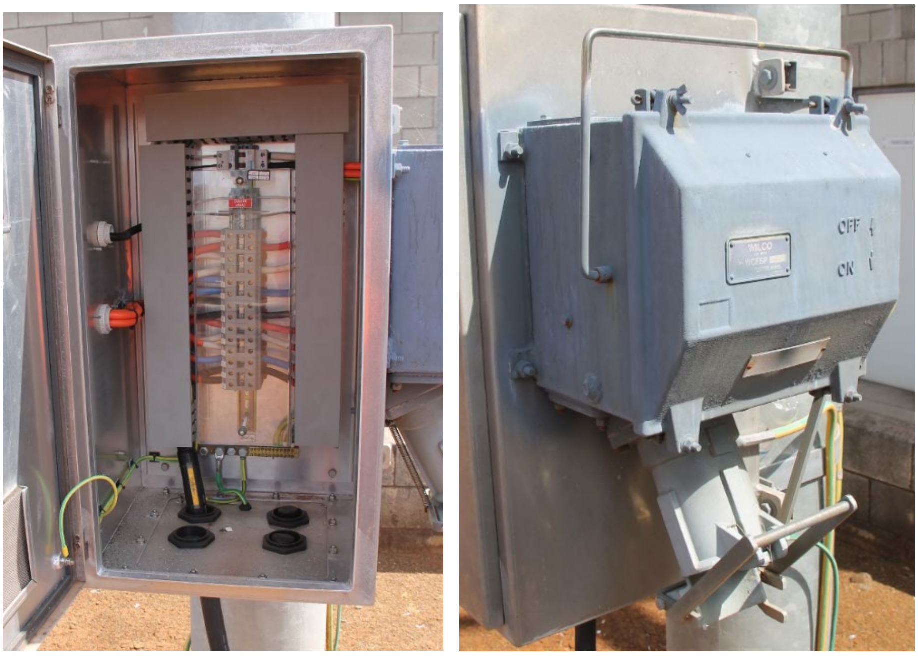
Marshalling kiosks and associated cables for =C4 were installed in 2007. They are in good condition. There are no condition driven replacement required for AC/DC marshalling kiosks and associated control cables until 2042. However, the physical disconnect terminals for CT circuits for bay marshalling kiosks need to be replaced to mitigate CT open circuit risks with major secondary system replacement according to SU0031 New Physical Disconnect Terminals for CT Circuits.


=C4 275kV AC and DC marshalling kiosk


=C04.1 Feeder 8849 marshalling kiosk and CVT box


=C4 275kV 5 transformer CB marshalling kiosk and VT box

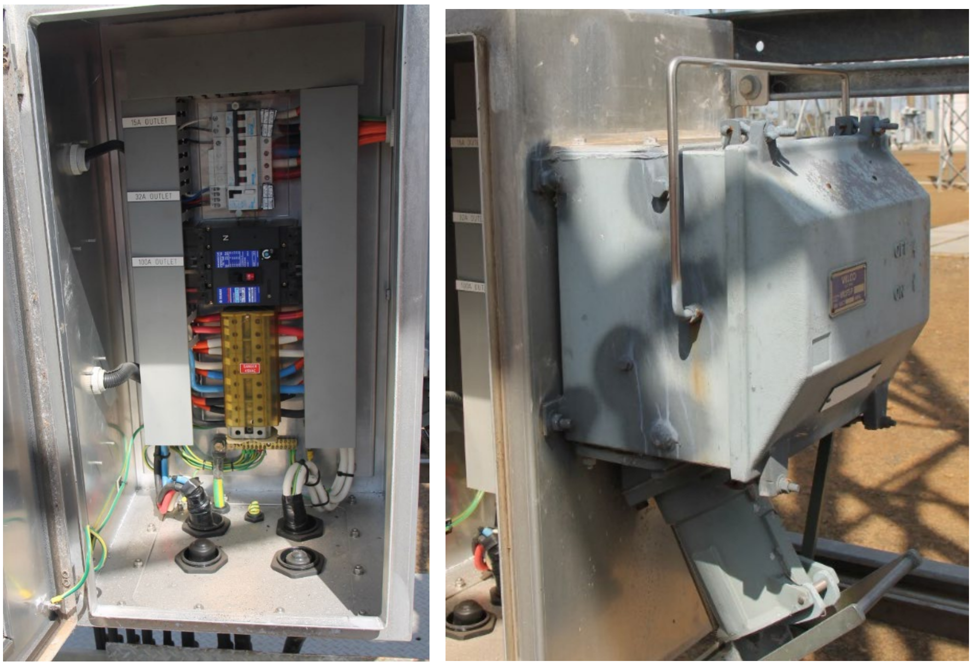
Transformer 1 and 4 power outlet box were installed in 2005 and are in fair condition. There are no condition driven replacement required until 2040.



Transformer 1 power outlet box

Transformer 4 power outlet box

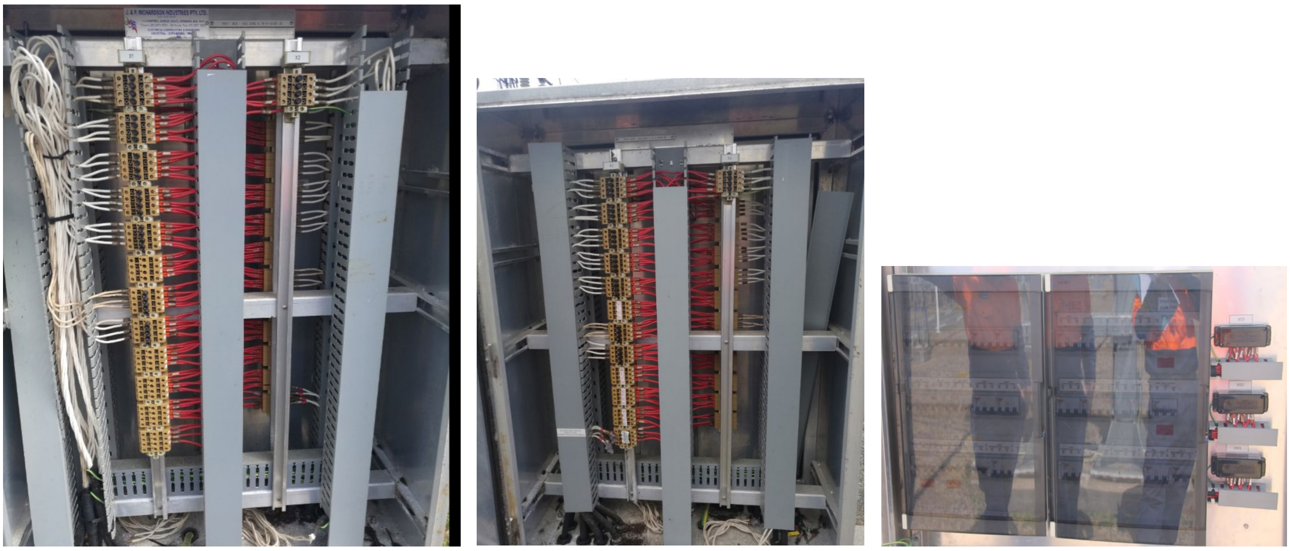
Transformer 2 and 3 power outlet box were installed in 2005 and are in fair condition. There are no condition driven replacement required until 2040.



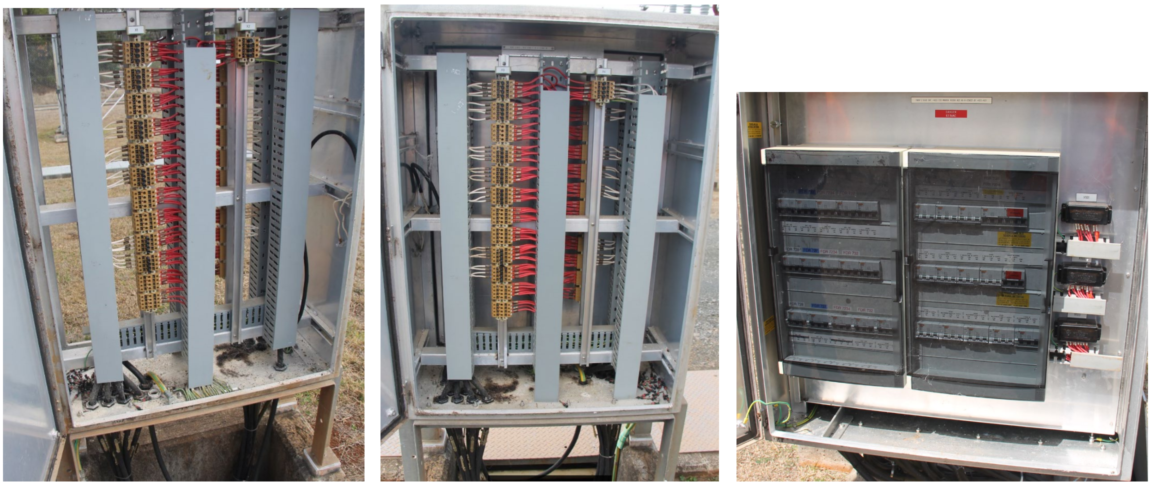
Transformer 2 and 3 power outlet box

4.2.2 110kV yard

Bay marshalling kiosks, VT box and associated control cables for 110kV 1, 2, and 3 bus were installed in 2005. They are in fair condition. There are no condition driven replacement required for VT boxes and associated control cables until 2040. However, the physical disconnect terminals for CT circuits for bay marshalling kiosks need to be replaced to mitigate CT open circuit risks with major secondary system replacement according to SU0031 New Physical Disconnect Terminals for CT Circuits.



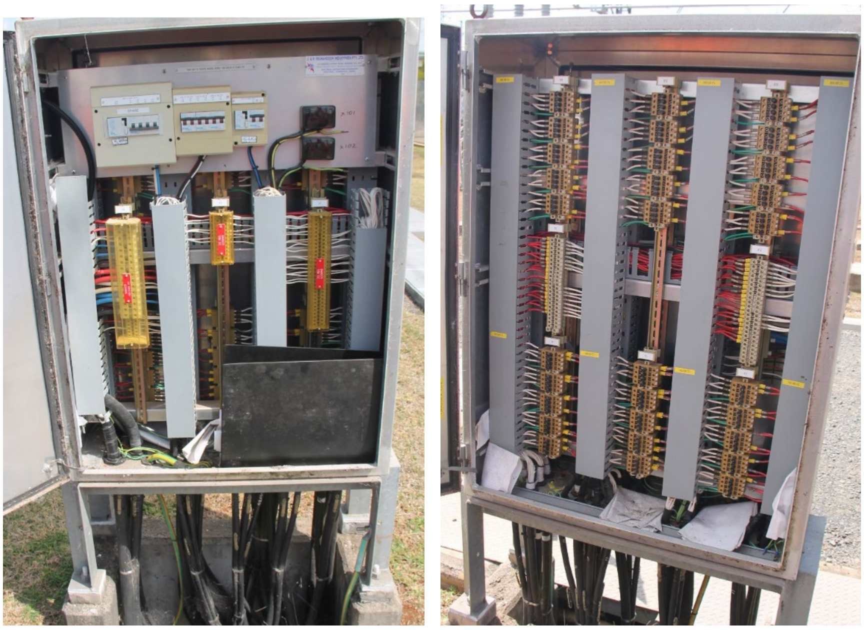
110kV 1 Bus – bus zone marshalling kiosk and VT box



110kV 2 Bus – Bus zone marshalling kiosk and VT box

110kV 3 Bus zone marshalling kiosk and VT box

110kV bus coupler 1-2, 2-3 and 1-3 were installed (including 415/240V AC supply marshalling kiosk) in 2005 and are in fair condition. There are no condition driven replacement required for AC supply kiosk and associated control cables until 2040. However, the physical disconnect terminals for CT circuits for bay marshalling kiosks need to be replaced to mitigate CT open circuit risks with major secondary system replacement according to SU0031 New Physical Disconnect Terminals for CT Circuits.



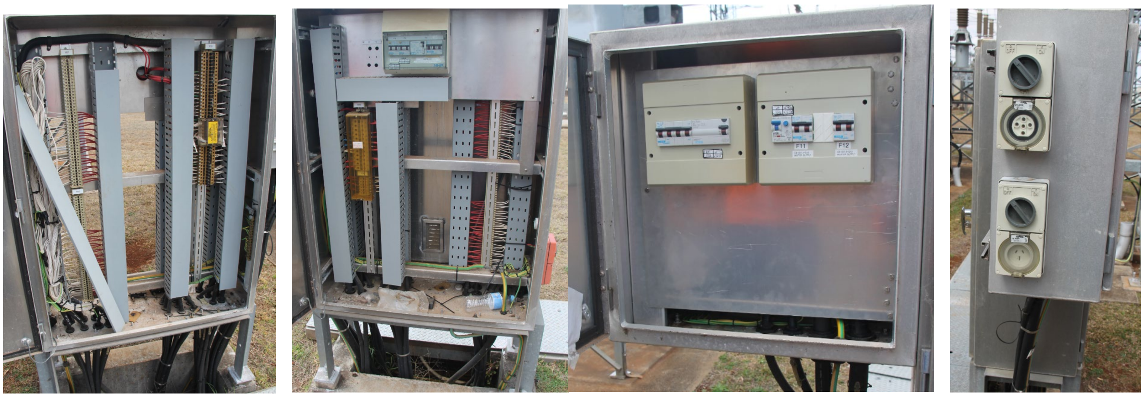
=D9 110kV 1-2 Bus coupler marshalling kiosk

=D0.0 Bus 2-3 coupler marshalling kiosk

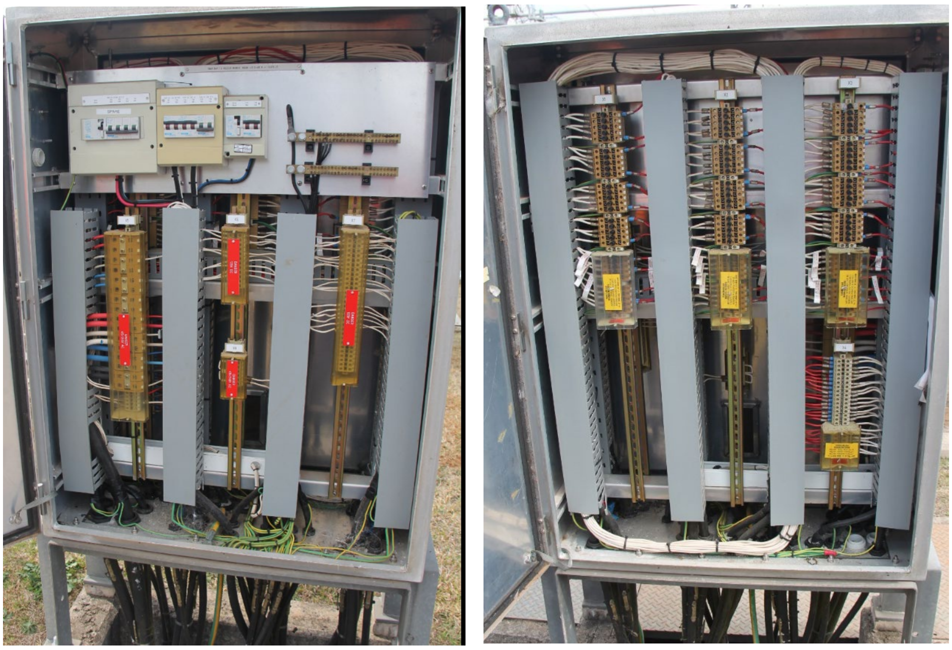
=D16 1-3 bus coupler marshalling kiosk

415/240V AC supply marshalling kiosk

Marshalling kiosks and associated control cables for =D1 Feeder 728 and 730 were installed between 2003 and 2004. They are in fair condition. As such there are no condition driven replacements required for control cables until 2038-2039. However, the physical disconnect terminals for CT circuits for bay marshalling kiosks need to be replaced to mitigate CT open circuit risks with major secondary system replacement according to SU0031 New Physical Disconnect Terminals for CT Circuits.

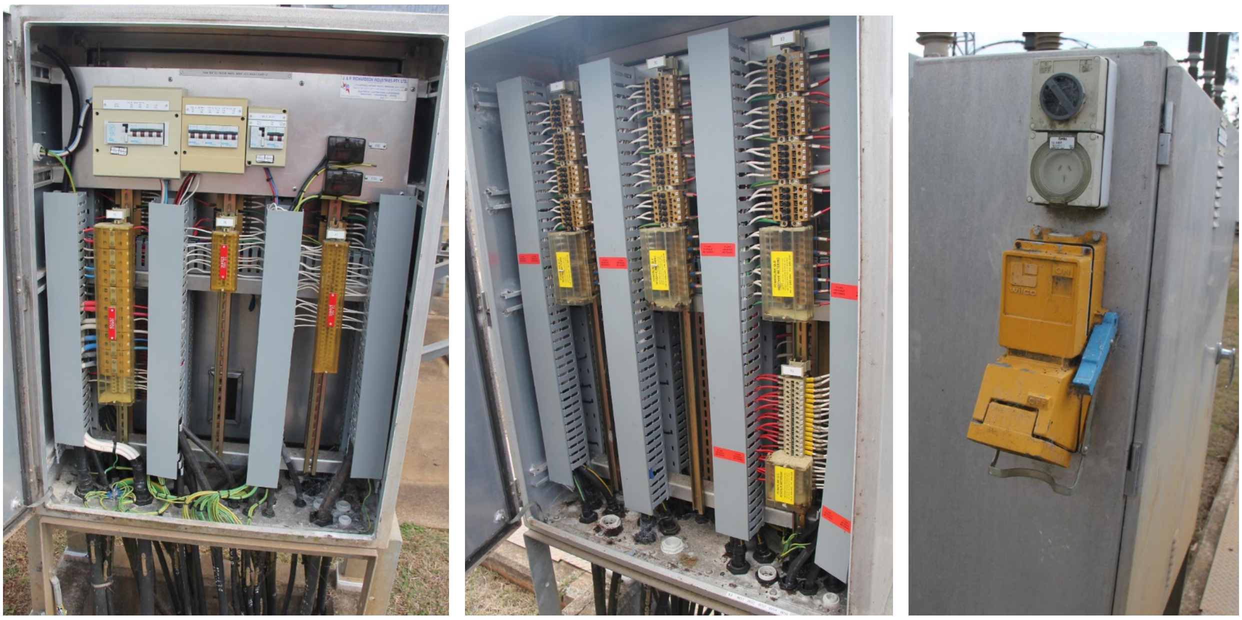


=D1.2 Feeder 728 marshalling kiosk

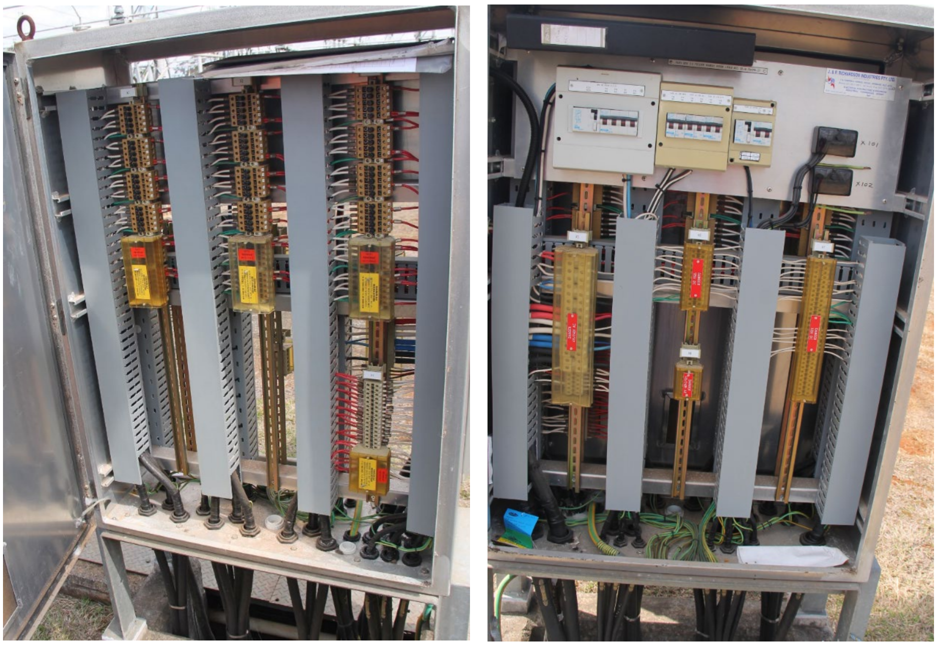


=D1.3 Feeder 730 marshalling kiosk

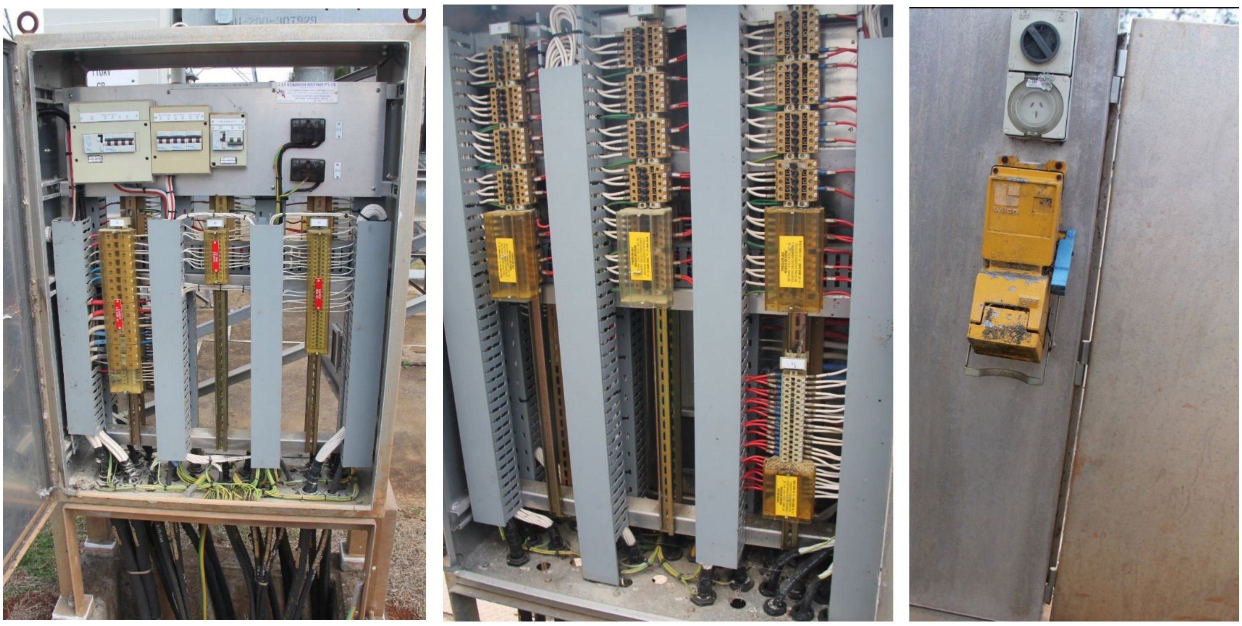
Marshalling kiosks and associated control cables for Feeder 7233, 727, 7234 and 732 were installed between 2004 and 2005. The kiosk structure appears sound with wirings intact. There are no condition-driven replacement required for control cables until 2039-2044. However, the physical disconnect terminals for CT circuits for bay marshalling kiosks need to be replaced to mitigate CT open circuit risks with major secondary system replacement according to SU0031 New Physical Disconnect Terminals for CT Circuits.



=D2.3 Feeder 7233 marshalling kiosk



=D3.2 Feeder 727 marshalling kiosk



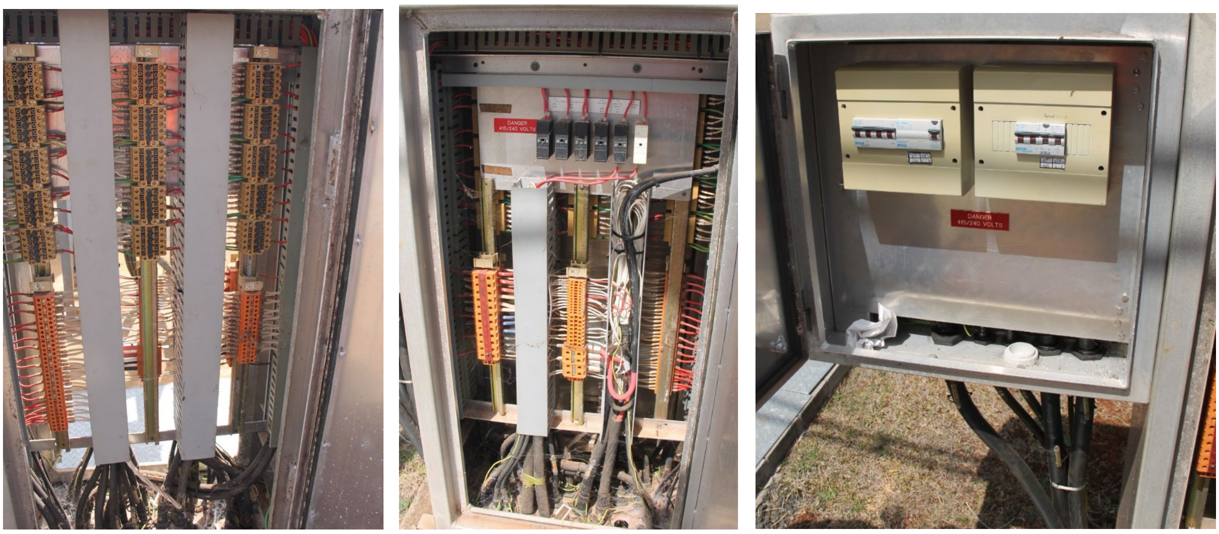
=D4.2 Feeder 7234 marshalling kiosk

=D5.2 Feeder 732 marshalling kiosk

Marshalling kiosk and associated control cables for Feeder 731 were installed in 1999. There are no condition driven replacement required for control cables until 2034-2039. . However, the physical disconnect terminals for CT circuits for all bay marshalling kiosks need to be replaced to mitigate CT open circuit risks with major secondary system replacement according to SU0031 New Physical Disconnect Terminals for CT Circuits.

=D6 Feeder 731 marshalling kiosk

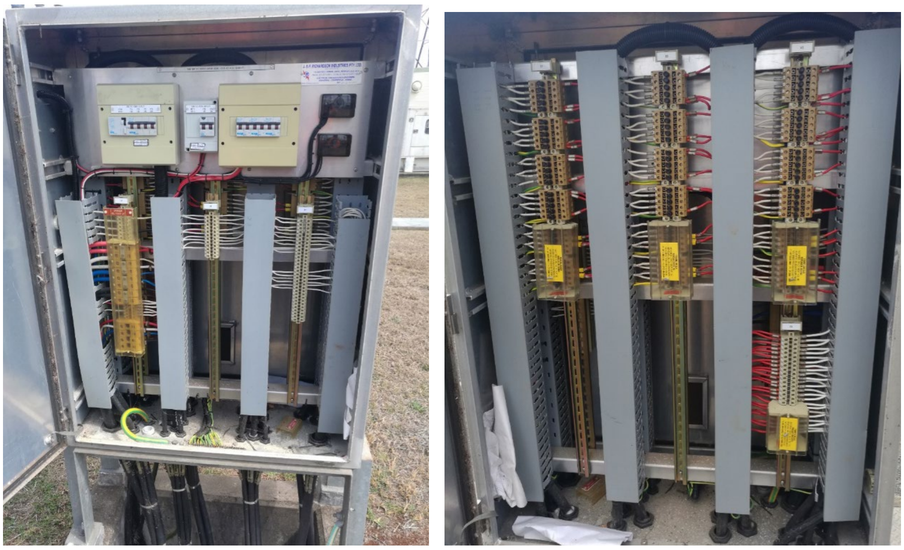
Marshalling kiosks and associated control cables for 2 and 3 transformer 110kV side were installed in 1987. Orange coloured Utilux terminals in the marshalling kiosk are showing signs of embrittlement. Fuses are utilised within these marshalling kiosks. These fuses do not provide safety and monitoring features and make the event investigation more difficult. Maintenance on these fuses is expensive. These fuses should be replaced with MCBs to improve the performance of circuitries according to current design standard. Bay marshalling kiosks and associated cables need to be replaced with major secondary system or primary plant replacement between 2022 and 2027.



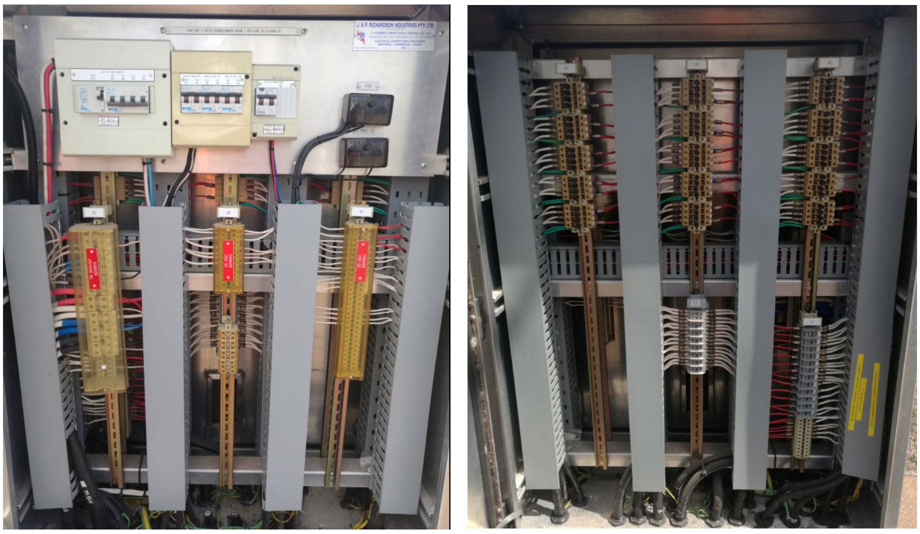
=D8 110kV Transformer 3 marshalling kiosk

=D10.1 Transformer 2 marshalling kiosk

Marshalling kiosks and associated control cables for Feeder 733, 110kV 1 Transformer, Feeder 736, Feeder 7348, spare 5 bay and Feeder 735 were installed between 2004 and 2005 (Except Feeder 7348 in 2011). These are in fair condition and there are no condition driven replacement required for control cables until 2039-2044. However, the physical disconnect terminals for CT circuits for bay marshalling kiosks need to be replaced to mitigate CT open circuit risks with major secondary system replacement according to SU0031 New Physical Disconnect Terminals for CT Circuits.

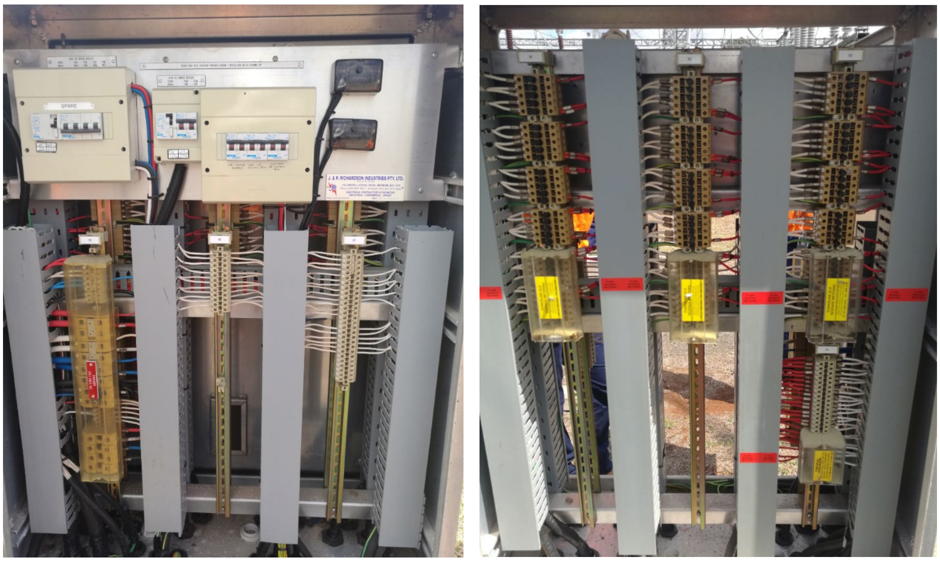


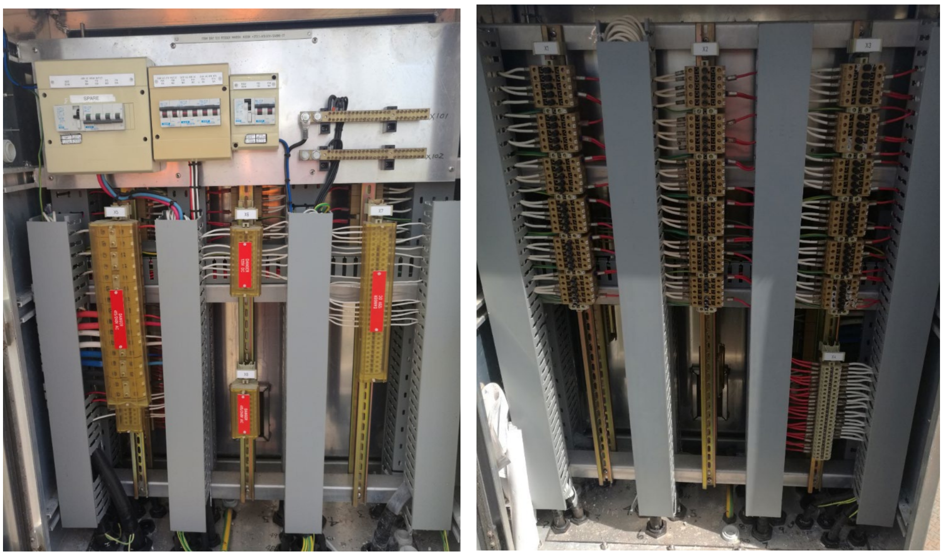
=D11.1 Feeder 733 marshalling kiosk

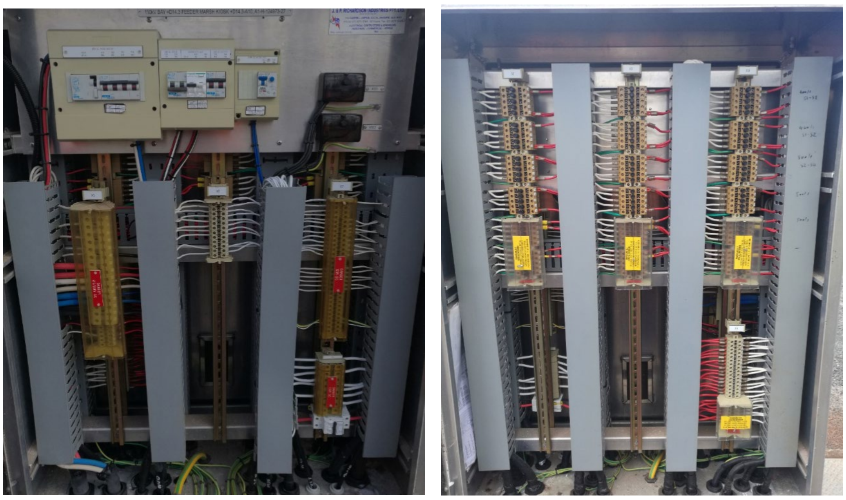


=D11.3 Transformer 1 marshalling kiosk

=D12.1 Feeder 736 marshalling kiosk


=D12.3 Feeder 7348 marshalling kiosk


=D13.1 Spare 5 bay marshalling kiosk


=D14.3 Feeder 735 marshalling kiosk

4.3 Control and protection bays

4.3.1 Protection and control panels

Secondary systems at Middle Ridge are housed in a type of swing frame panel. There are safety in design concerns on the type of swing frame panel, such as isolation issues and potential termination falling loose risks. Updates on the panel are required to be conducted with major secondary system replacement according to SU0020 Updates to SDM8 Panels to Mitigate Safety in Design Concerns (Obj ID: A2753457).

4.3.2 330kV feeder bay secondary systems

Equipment details of 330kV feeder bay secondary systems are listed in a table below:-

330kV Feeder Bays	Relay & control	Model	Startup Date	Still Manufactured?	Manufacture Support?	PLQ Spares	Health Index
Feeder 9907	X	[redacted]	2007	No	Yes	Yes	5.90
		[redacted]	2007	Yes	Yes	Yes	5.90
		[redacted]	2007	Yes	Yes	Yes	5.90
	Y	[redacted]	2007	Yes	Yes	Yes	5.90
		[redacted]	2007	No	Yes	Yes	5.90
	Control	[redacted]	2007	No	No	Yes	5.90
Feeder 9908	X	[redacted]	2004	No	Yes	Yes	7.20
		[redacted]	2005	No	Yes	Yes	7.00
		[redacted]	2005	No	Yes	Yes	7.00
		[redacted]	2005	Yes	Yes	Yes	7.00
	Y	[redacted]	2005	Yes	Yes	Yes	7.00
		[redacted]	2005	No	Yes	Yes	7.00
	Control	[redacted]	2005	No	No	Yes	7.00

*__PLQ Spares__: Limited – Spares will be depleted within 5 years
Yes – The estimated time of depletion is more than 5 years

330kV feeders 9907 and 9908 are protected by digital current differential relays [redacted] and distance protection relays [redacted]. The health index indicates that majority of secondary systems for Feeder 9907 and 9908 will reach the end of technical life and should be replaced by 2027 and 2025 respectively.

330kV =B02 Feeder 9907 and =B01 Feeder 9908 protection and control panel

4.3.3 330kV Capacitor Bays

Secondary systems for 330kV Capacitor bank bays are detailed in a table below.

330kV Cap	Relay & control	Model	Startup Date	Still Manufactured?	Manufacture Support?	PLQ Spares	Health Index
3 CAP	X	[redacted]	2011	Yes	Yes	Yes	3.80
			2011	Yes	Yes	Yes	3.80
			2011	Yes	Yes	Yes	4.00
	Y		2011	Yes	Yes	Yes	3.80
			2011	Yes	Yes	Yes	3.80
	POW		2011	Yes	Yes	Yes	7.30
	Local RTU		2011	No	No	Yes	4.16
4 CAP	X		2011	Yes	Yes	Yes	3.70
			2011	Yes	Yes	Yes	3.70
			2011	Yes	Yes	Yes	4.00
	Y		2011	Yes	Yes	Yes	3.70
			2011	Yes	Yes	Yes	3.70
	POW		2011	Yes	Yes	Yes	7.30
	Local RTU		2011	No	No	Yes	4.16

*PLQ Spares: Limited – Spares will be depleted within 5 years
Yes – The estimated time of depletion is more than 5 years

High Impedance [redacted] and Balance protection [redacted] are used to protect 3 and 4 capacitor banks. These relays were installed in 2011 and have been providing reliable services. The health index shows that there are no condition driven replacement required until 2031-2032.

[redacted] RTUs are utilized for the function of control. These [redacted] RTUs have become obsolete. Powerlink had the last buy of [redacted] in 2014 and has relied on these spares to maintian their operation.

330kV 3 & 4 CAP protection and control panel

4.3.4 275kV bus zone and coupler bay

Secondary systems for 275kV bus zones and coupler bays are shown in table below:-

Bus	Relay & control	Model	Startup Date	Still Manufactured?	Manufacture Support?	PLQ Spares	HI Health Index
1 Bus	X	[redacted]	2005	Yes	Yes	Yes	7.00
		[redacted]	2005	Yes	Yes	Yes	7.00
		[redacted]	2005	Yes	Yes	Yes	7.00
		[redacted]	2005	Yes	Yes	Yes	7.00
	Y	[redacted]	2005	Yes	Yes	Yes	7.00
		[redacted]	2005	Yes	Yes	Yes	7.00
		[redacted]	2005	Yes	Yes	Yes	7.00
	Local control	[redacted]	2005	No	No	Yes	7.00
2 Bus	X	[redacted]	2005	Yes	Yes	Yes	7.00
		[redacted]	2005	Yes	Yes	Yes	7.00
		[redacted]	2005	Yes	Yes	Yes	7.00
	Y	[redacted]	2005	Yes	Yes	Yes	7.00

Bus	Relay & control	Model	Startup Date	Still Manufactured?	Manufacture Support?	PLQ Spares	HI Health Index
		[redacted]	2005	Yes	Yes	Yes	7.00
		[redacted]	2005	Yes	Yes	Yes	7.00
	Local control	[redacted]	2005	No	No	Yes	7.00
Coupler 501	X	[redacted]	2005	Yes	Yes	Yes	7.00
	Y	[redacted]	2005	Yes	Yes	Yes	7.00
	Local control	[redacted]	2005	No	No	Yes	7.00
Coupler 502	X	[redacted]	2005	Yes	Yes	Yes	7.00
	Y	[redacted]	2005	Yes	Yes	Yes	7.00
	Local control	[redacted]	2005	No	No	Yes	7.00
Coupler 503	X	[redacted]	2005	Yes	Yes	Yes	7.00
	Y	[redacted]	2005	Yes	Yes	Yes	7.00
	Local control	[redacted]	2005	No	No	Yes	7.00
Coupler 504	X	[redacted]	2007	Yes	Yes	Yes	5.90
	Y	[redacted]	2007	Yes	Yes	Yes	5.90
	Local control	[redacted]	2007	No	No	Yes	5.90

*__PLQ Spares__: Limited – Spares will be depleted within 5 years
Yes – The estimated time of depletion is more than 5 years

275kV Bus zone protections were commissioned in 2005. Associated health index indicate that secondary systems for 1 & 2 275kV bus zones will reach the end of technical asset life and need to be replaced between 2025 and 2026.

275kV 1 & 2 Bus zone and CB fail panels

Secondary systems for coupler 501, 502 and 503 and 504 were installed in 2005. Health index calculated based on the reliability analysis shows that all these secondary systems need to be replaced between 2025 and 2026.

275kV bus coupler 501, 502 and 503 protection and control panel

Secondary systems for coupler 504 were installed in 2007. Health index calculated based on the reliability analysis shows that all these secondary systems need to be replaced between 2027 and 2028.

275kV bus coupler 504 protection and control panel

4.3.5 330/275kV transformer bays

As both Feeder 9907 and 9908 are transformer ended feeder without 330kV CB for 4T and 5T, all secondary systems for 4T and 5T have been implemented and allocated at 275kV side.

Equipment for 330/275kV transformer bays is detailed below.

Transformer	Relay & control		Model	Startup Date	Still Manufactured?	Manufacture Support?	PLQ Spares	Health Index
4T	275kV	X	[redacted]	2005	Yes	Yes	Yes	7.00
			[redacted]	2005	No	Yes	Yes	7.00
			[redacted]	2005	No	Yes	Yes	7.00
		Y	[redacted]	2005	Yes	Yes	Yes	7.00
		Local RTU	[redacted]	2005	No	No	Yes	7.00
5T	275kV	X	[redacted]	2007	Yes	Yes	Yes	5.90
			[redacted]	2007	No	Yes	Yes	5.90
			[redacted]	2007	No	Yes	Yes	5.90
		Y	[redacted]	2007	Yes	Yes	Yes	5.90
		Local RTU	[redacted]	2008	No	No	Yes	5.20

***PLQ Spares**: Limited – Spares will be depleted within 5 years
Yes – The estimated time of depletion is more than 5 years

Secondary systems for 4T and 5T were installed in 2005 and 2007/2008 respectively. The health index indicates these relays will reach the end of technical life and need to be replaced by 2025 and 2027 respectively.

4 and 5 Transformer 275kV protection and control panel

4.3.6 275kV feeder bays

Protection and control equipment for 275kV feeder bays are detailed in the following table.

275kV Feeder	Relay & control	Model	Startup Date	Still Manufactured?	Manufacture Support?	PLQ Spares	Health Index
831	X	[redacted]	2005	Yes	Yes	Yes	7.00
		[redacted]	2009	No	Yes	Yes	4.90
		[redacted]	2005	Yes	Yes	Yes	7.00
		[redacted]	2005	Yes	Yes	Yes	6.90
	Y	[redacted]	2005	Yes	Yes	Yes	7.00
		[redacted]	2009	No	Yes	Yes	4.90
	Prot Signalling	[redacted]	2005	Yes	Yes	Yes	6.90
		[redacted]	2005	No	Yes	Yes	6.90
	Local RTU	[redacted]	2005	No	No	Yes	7.00
8848	X	[redacted]	2005	No	Yes	Yes	6.90
	Y	[redacted]	2007	Yes	Yes	Yes	5.90
		[redacted]	2007	No	Yes	Yes	5.90
	Prot Signalling	[redacted]	2007	Yes	Yes	Yes	5.90
		[redacted]	2007	No	Yes	Yes	5.90
	Local RTU	[redacted]	2007	No	No	Yes	5.90

275kV Feeder	Relay & control	Model	Startup Date	Still Manufactured?	Manufacture Support?	PLQ Spares	Health Index
8849	X	[redacted]	2018	No	Yes	Yes	4.10
			2015	No	Yes	Yes	2.40
	Y		2012	Yes	Yes	Yes	4.40
			2007	No	Yes	Yes	5.90
	Prot Signalling		2007	Yes	Yes	Yes	5.90
			2007	No	Yes	Yes	5.90
	Local RTU		2007	No	No	Yes	5.90

*PLQ Spares: Limited – Spares will be depleted within 5 years
Yes – The estimated time of depletion is more than 5 years

275kV feeders 831 is protected by duplicate distance protection [redacted] and [redacted] with associated protection signalling devices. Majority of them were installed in 2005 (except [redacted] and [redacted] in 2009 which have become obsolete). The health index indicates that majority of equipment will reach the end of technical life and need to be replaced by 2025.

Feeder 831 protection and control panel

Current differential and distance protection schemes with associated protection signalling equipment are utilized to protection Feeder 8848. Majority of secondary systems for Feeder 8848 were installed in 2007. The health index indicates that these secondary systems will reach the end of useful asset life and need to be replaced by 2027.

Feeder 8848 protection and control panel

Feeder 8849 is protected by current differential and distance protection schemes with associated protection signalling devices. Associated protection relays were replaced between 2012 and 2018 while the bay control RTU and protection signalling equipment were replaced in 2007. The health index shows that there are no condition driven replacement required for protection relays until 2029 while the bay controller [redacted] and associated protection signalling need to be replaced by 2027.

Feeder 8849 protection and control panel

4.3.7 275/110kV transformer bays

Secondary systems for 275/110kV transformer bays are detailed in a table below.

Transformer		Relay & control	Model	Startup Date	Still Manufactured ?	Manufacture Support?	PLQ Spares	Health Index
1 Transformer	275kV	X Protection	[redacted]	2005	Yes	Yes	Yes	7.00
			[redacted]	2005	No	Yes	Yes	7.00
			[redacted]	2005	No	Yes	Yes	7.00
		Y Protection	[redacted]	2005	Yes	Yes	Yes	7.00
		Bay Controller	[redacted]	2005	No	No	Yes	7.00
	110kV	CB Fail X	[redacted]	2005	Yes	Yes	Yes	7.00
		CB Fail Y	[redacted]	2005	Yes	Yes	Yes	7.00
		Bay control	[redacted]	2005	No	No	Yes	7.00
2 Transformer	275kV	X Protection	[redacted]	2005	No	Yes	Yes	7.00
			[redacted]	2005	No	Yes	Yes	7.00
		Y Protection	[redacted]	2005	Yes	Yes	Yes	7.00
		Bay Controller	[redacted]	2005	No	No	Yes	7.00
	110kV	CB Fail X	[redacted]	2005	Yes	Yes	Yes	6.90
		CB Fail Y	[redacted]	2005	Yes	Yes	Yes	6.90
		Bay control	[redacted]	2005	No	No	Yes	6.90
3 Transformer	275kV	X Protection	[redacted]	2005	No	Yes	Yes	7.00
			[redacted]	2005	No	Yes	Yes	7.00
		Y Protection	[redacted]	2005	Yes	Yes	Yes	7.00
		Bay Controller	[redacted]	2005	No	No	Yes	7.00
	110kV	CB Fail X	[redacted]	2005	Yes	Yes	Yes	6.90
		CB Fail Y	[redacted]	2005	Yes	Yes	Yes	6.90
		Bay control	[redacted]	2005	No	No	Yes	6.90

***PLQ Spares**: Limited – Spares will be depleted within 5 years
Yes – The estimated time of depletion is more than 5 years

High impedance REF relay MFAC14, biased current differential relay T60 and SEL-387-5 are utilized to protection transformer 1, 2 and 3. These secondary systems were installed in 2005 and have provided reliable services. Associated health index indicates that all secondary systems for 1T, 2T and 3T will reach the end of technical asset life and need to be replaced by 2025.

1T protection and control panel

2T protection and control panel


3T protection and control panel

4.3.8 110kV Bus zones and coupler bays

Secondary systems for 110kV bus zones and coupler bays are listed in a table below.

110kV Bus	Relay & control	Model	Startup Date	Still Manufactured?	Manufacture Support?	PLQ Spares	Health Index
1 Bus	X	[redacted]	2005	Yes	Yes	Yes	7.00
		[redacted]	2005	Yes	Yes	Yes	7.00
		[redacted]	2005	Yes	Yes	Yes	7.00
		[redacted]	2005	Yes	Yes	Yes	7.00
	Y	[redacted]	2005	Yes	Yes	Yes	7.00
		[redacted]	2005	Yes	Yes	Yes	7.00
		[redacted]	2005	Yes	Yes	Yes	7.00
		[redacted]	2005	Yes	Yes	Yes	7.00
	Local Control	[redacted]	2005	No	No	Yes	7.00
2 Bus	X	[redacted]	2005	Yes	Yes	Yes	7.00
		[redacted]	2005	Yes	Yes	Yes	7.00
		[redacted]	2005	Yes	Yes	Yes	7.00
		[redacted]	2005	Yes	Yes	Yes	7.00
	Y	[redacted]	2005	Yes	Yes	Yes	7.00
		[redacted]	2005	Yes	Yes	Yes	7.00
		[redacted]	2005	Yes	Yes	Yes	7.00
		[redacted]	2005	Yes	Yes	Yes	7.00

110kV Bus	Relay & control	Model	Startup Date	Still Manufactured?	Manufacture Support?	PLQ Spares	Health Index
	Local Control	[redacted]	2005	No	No	Yes	7.00
3 & 4 Bus	X	[redacted]	2005	Yes	Yes	Yes	7.00
		[redacted]	2005	Yes	Yes	Yes	7.00
		[redacted]	2005	Yes	Yes	Yes	7.00
		[redacted]	2005	Yes	Yes	Yes	7.00
	Y	[redacted]	2005	Yes	Yes	Yes	7.00
		[redacted]	2005	Yes	Yes	Yes	7.00
		[redacted]	2005	Yes	Yes	Yes	7.00
		[redacted]	2005	Yes	Yes	Yes	7.00
	Local Control	[redacted]	2005	No	No	Yes	7.00
Coupler 401	CB Fail X	[redacted]	2005	Yes	Yes	Yes	6.80
	CB Fail Y	[redacted]	2005	Yes	Yes	Yes	6.80
	Local Control	[redacted]	2005	No	No	Yes	6.80
Coupler 402	CB Fail X	[redacted]	2005	Yes	Yes	Yes	7.10
	CB Fail Y	[redacted]	2005	Yes	Yes	Yes	7.10
	Local Control	[redacted]	2005	No	Yes	Yes	7.10
Coupler 411	CB Fail X	[redacted]	2005	Yes	Yes	Yes	6.80
	CB Fail Y	[redacted]	2005	Yes	Yes	Yes	6.80
	Local Control	[redacted]	2005	No	No	Yes	6.80

*__PLQ Spares__: Limited – Spares will be depleted within 5 years
Yes – The estimated time of depletion is more than 5 years

Duplicate high impedance differential relays [redacted] are used to protect 110kV bus zones 1, 2 and 3 & 4. These relays were installed in 2005 and have provided reliable services. Health index shows that all secondary systems for 110kV bus zones will reach the end of technical asset life and need to be replaced by 2025.

110kV Bus zone protection and control panels

[redacted] and [redacted] are utilized for 110kV coupler CB management. These protection and control devices were installed in 2005. Health index shows that all secondary systems for 110kV bus couplers will reach the end of technical asset life and need to be replaced by 2025.

110kV bus coupler 401, 402 and 411 protection and control panel

4.3.9 110kV feeder bays

Secondary systems for 110kV feeder bays are detailed in a table below.

Feeder	Relay & control	Model	Startup Date	Still Manufactured?	Manufacture Support?	PLQ Spares	Health Index
711	X	[redacted]	2005	No	Yes	Yes	6.80
	Y	[redacted]	2005	Yes	Yes	Yes	6.80
		[redacted]	2005	No	Yes	Yes	6.80
	Local RTU	[redacted]	2005	No	No	Yes	6.80
7233	X	[redacted]	2003	Yes	Yes	Yes	7.70
	Y	[redacted]	2003	No	Yes	Yes	7.70
	PROT SIG	[redacted]	2006	No	No	No	6.50
	Local RTU	[redacted]	2009	No	No	Yes	5.10
7234	X	[redacted]	2009	Yes	Yes	Yes	4.90
	Y	[redacted]	2003	No	Yes	Yes	7.70
	Local RTU	[redacted]	2008	No	No	Yes	5.30
727	X	[redacted]	2005	No	Yes	Yes	6.80
	Y	[redacted]	2005	Yes	Yes	Yes	6.80
	Local RTU	[redacted]	2005	No	No	Yes	6.80
728	X	[redacted]	2015	No	Yes	Yes	4.70
	Y	[redacted]	2015	Yes	Yes	Yes	4.50
	PROT SIG	[redacted]	2002	No	Yes	Yes	8.70
	Local RTU	[redacted]	2007	No	No	Yes	5.80
730	X	[redacted]	2015	No	Yes	Yes	4.70
	Y	[redacted]	2015	Yes	Yes	Yes	4.50
	PROT SIG	[redacted]	2002	No	Yes	Yes	8.40
	Local RTU	[redacted]	2007	No	No	Yes	5.80
731	X	[redacted]	2005	No	Yes	Yes	7.00
	Y	[redacted]	2003	Yes	Yes	Yes	7.00
	PROT SIG	[redacted]	2009	Yes	Yes	Yes	5.50
	Local RTU	[redacted]	2009	No	No	Yes	5.10
732	X	[redacted]	2006	No	Yes	Yes	6.30
	Y	[redacted]	2003	Yes	Yes	Yes	7.70
	PROT SIG	[redacted]	2009	Yes	Yes	Yes	5.90
	Local RTU	[redacted]	2009	No	No	Yes	5.10
733	X	[redacted]	2005	No	Yes	Yes	6.00
	Y	[redacted]	2005	Yes	Yes	Yes	6.00
	Local RTU	[redacted]	2005	No	No	Yes	6.00
734	X	[redacted]	2007	No	Yes	Yes	5.70
	Y	[redacted]	2007	Yes	Yes	Yes	5.70
	Local RTU	[redacted]	2007	No	No	Yes	5.70
7348	X	[redacted]	2011	No	Yes	Yes	5.20
		[redacted]	2011	No	Yes	Yes	3.90
	Y	[redacted]	2005	Yes	Yes	Yes	6.70
	Local RTU	[redacted]	2005	No	No	Yes	6.70

Feeder	Relay & control	Model	Startup Date	Still Manufactured?	Manufacture Support?	PLQ Spares	Health Index
735	X	[redacted]	2005	No	Yes	Yes	6.70
	Y	[redacted]	2005	Yes	Yes	Yes	6.70
	PROT SIG	[redacted]	2005	No	Yes	Yes	6.70
	Local RTU	[redacted]	2005	No	No	Yes	6.70
736	X	[redacted]	2007	No	Yes	Yes	5.80
	Y	[redacted]	2007	Yes	Yes	Yes	5.70
	PROT SIG	[redacted]	2002	No	Yes	Yes	8.20
	Local RTU	[redacted]	2007	No	No	Yes	5.70

*__PLQ Spares__: Limited – Spares will be depleted within 5 years
Yes – The estimated time of depletion is more than 5 years

All protection and control panels for 110kV feeders were installed under CP.01068 Middle Ridge 110kV substation refurbishment between 2003 and 2005. This type of original SDM7 swing frame panel has isolation issues and potential termination falling loose risks. They need to be updated to mitigate associated safety risks with major secondary system replacement.

Associated secondary systems were commissioned in different stages and some protection relays were replaced due to change of protection schemes in different opex projects:-

- Secondary systems for Feeder 728, 730, 734 and 736 were re-commissioned under OR.00945 in 2007
- Secondary systems for Feeder 7233, 7234, 731 and 732 re-commissioned under OR.01133 in 2008
- Protection relays for feeder 728 and 730 were replaced within the existing panel under OR.01708 in 2015.

Secondary systems for Feeder 734 and 736 were commissioned in 2007. Associated health index shows that these secondary systems will reach the end of useful asset life and need to be replaced by 2027.

=D7.3 Feeder 734 protection and control panel

=D12.1 Feeder 736 protection and control panel

Majority of secondary systems for Feeders 7233 and 7234 were installed between 2003 and 2005. They are facilitated within swing frame panels and have been providing reliable operations. Health index shows that these secondary systems will reach the end of technical asset life and need to be replaced by 2023-2025.

=D2.3 Feeder 7233 protection and control panel

=D4.2 Feeder 7234 protection and control panel

Secondary systems for Feeder 711, 727, 733, 735 were installed in 2005. Health index indicate that these secondary systems will reach the end of technical asset life and need to be replaced by 2025.

=D13.1 Feeder 711 (Spare 5) protection and control panel

=D3.2 Feeder 727 protection and control panel

=D11.1 Feeder 733 protection and control panel

=D14.3 Feeder 735 protection and control panel

Secondary systems for Feeder 731 and 732 were commissioned in 2008 while the panel were installed between 2003 and 2005. Considering the condition of panel and heal index of secondary systems across the whole bay, secondary systems need to be replaced by 2025.

=D6.3 Feeder 731 protection and control panel

=D5.2 Feeder 732 protection and control panel

X protection relay was replaced for Feeder 7348 under CP.01751 Middle Ridge - Murphys Creek 110kV Feeder in 2011 within the existing panel. Considering the overall condition of the bay, secondary systems need to be replaced by 2025.

=D12.3 Feeder 7348 protection and control panel

Both X and Y protection relays for Feeder 728 and 730 were replaced in 2015. Relay [redacted] become obsolete and Powerlink is relying on available spares to maintain the performance. These relays need to be replaced between 2028 and 2029.

=D1.2 Feeder 728 protection and control panel

=D1.3 Feeder 730 protection and control panel

Under Frequency Load Shedding (UFLS))has been implemented for feeder 728, 730, 733, 734, 735, 736, 731, 732, 727, 7348, 7233 and 7234 within associated feeder protection relay [redacted] and [redacted] When the relay is replaced, the requirement for the UFLS function needs to be consulted with Network Operations.

4.3.10 110kV Capacitor bank

Secondary systems for 110kV capacitor bank are detailed in a table below:

Capacitor	Relay & control	Model	Startup Date	Still Manufactured?	Manufacture Support?	PLQ Spares	Health Index
1 CAP	X	[redacted]	2002	Yes	Yes	Yes	8.30
		[redacted]	2002	Yes	Yes	Yes	8.30
		[redacted]	2002	No	No	Yes	8.30
	Y	[redacted]	2002	Yes	Yes	Yes	8.30
		[redacted]	2002	Yes	Yes	Yes	8.30
	Point On Wave	[redacted]	2002	Yes	Yes	Yes	8.30
	Local RTU	[redacted]	2002	No	No	Yes	8.30
2 CAP	X	[redacted]	2002	Yes	Yes	Yes	8.30
		[redacted]	2002	Yes	Yes	Yes	8.30
		[redacted]	2002	No	No	Yes	8.30
	Y	[redacted]	2002	Yes	Yes	Yes	8.30
		[redacted]	2002	Yes	Yes	Yes	8.30

Capacitor	Relay & control	Model	Startup Date	Still Manufactured?	Manufacture Support?	PLQ Spares	Health Index
	Point On Wave	[redacted]	2002	Yes	Yes	Yes	8.50
	Local RTU	[redacted]	2002	No	No	Yes	8.30

***PLQ Spares**: Limited – Spares will be depleted within 5 years
Yes – The estimated time of depletion is more than 5 years

Secondary systems for 110kV 1 & 2 Capacitor bank were installed in 2002. They are located within air-conditioned control cubicles in the switching yard. They are hard to maintain the operational standard due to harsh operating working environment with high failures of aid conditioning. These relocatable Capacitor's Protection and Control device should be relocated inside the control building. Health index indicates they will reach the end of technical asset life and need to be replaced between 2022 and 2023. Replacements need to be lined up with major secondary system replacement.

1 and 2 CAP protection and control panel

4.3.11 Power System Control and Monitoring

Power system control and monitoring equipment is detailed in a table below:

Power System monitoring	Model	Startup Date	Still Manufactured?	Manufacture Support?	PLQ Spares	Health Index
HSM	[redacted]	2017	Yes	Yes	Yes	0.92
PQM	[redacted]	2012	Yes	Yes	Yes	3.40
Travelling Wave Fault Locator	[redacted]	2010	Yes	Yes	Yes	4.40

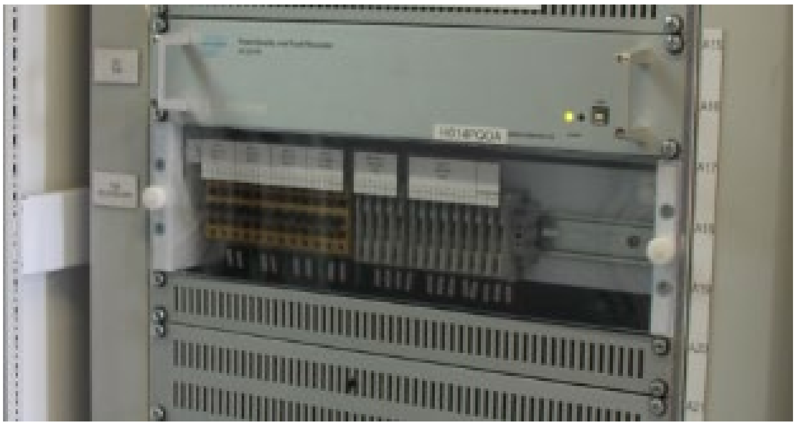
A) High Speed Monitoring (HSM)

High Speed Monitoring (HSM) was implemented to provide synchronized information for AEMO and Powerlink to manage and investigate power system incidents. Dedicated GPS clock has been installed for HSM to provide high accurate synchronized information. These 18 channel Qualitrol [redacted] was commissioned in 2017 and are in good condition. There is no condition driven replacement required until 2037.

High Speed Monitoring device

B) Power Quality Monitoring (PQM)

1 x [redacted] device has been installed to monitoring the power quality of 110kV network at H014 Middle Ridge. This device was installed at 2012 and are in good condition. There is no condition driven replacement required until 2032.



Power Quality Monitoring Panel

C) Travelling wave fault locator

Travelling fault locator TWS has been installed to accurately locate a fault. The device was installed in 2010. The device has experienced triggering issues due to the network arrangement due to attenuated travelling wave signal for the transformer ended feeder. Powerlink is trialling [redacted] provide accurate fault locating information based on travelling wave for Feeder 9907 and 9908. Once testing successfully, the TWS will be replaced with [redacted] unit under major secondary system replacement.



Qualitrol TWS unit

D) GIC (Geomagnetically Induced Current) Monitoring System

Geomagnetically Induced Current (GIC) monitoring system was implemented based on DC transducer for Auto Transformer 5 neutral to monitor the GIC level in 2012. To further understand the GIC level on 330kV side, optical CT was installed to monitor GIC on 5 Transformer 330kV side in 2014. They are in good condition. There are no condition driven replacements required until 2032 and 2034.


GIC transformer neutral monitoring system

Transformer HV GIC monitoring system

4.4 Metering

Secondary systems for metering at H014 Middle Ridge are listed in a table below:

Metering	Revenue and Check Meter	Model	Startup Date	Still Manufactured?	Manufacture Support?	PLQ Spares	Health Index
Feeder 7234	Revenue	[redacted]	2009	No	Yes	Yes	5.10
	Check	[redacted]	2008	No	Yes	Yes	5.30
Feeder 728	Revenue	[redacted]	2009	No	Yes	Yes	5.10
	Check	[redacted]	2009	No	Yes	Yes	5.10
Feeder 733	Revenue	[redacted]	2009	No	Yes	Yes	5.10
	Check	[redacted]	2009	No	Yes	Yes	5.10
Feeder 736	Revenue	[redacted]	2009	No	Yes	Yes	5.10
	Check	[redacted]	2009	No	Yes	Yes	5.10
Feeder 727	Revenue	[redacted]	2004	No	Yes	Yes	7.40
	Check	[redacted]	2004	No	Yes	Yes	7.40
Feeder 7233	Revenue	[redacted]	2009	No	Yes	Yes	5.10
	Check	[redacted]	2009	No	Yes	Yes	5.10
Feeder 730	Revenue	[redacted]	2009	No	Yes	Yes	5.10
	Check	[redacted]	2009	No	Yes	Yes	5.10
Feeder 734	Revenue	[redacted]	2009	No	Yes	Yes	5.10
	Check	[redacted]	2009	No	Yes	Yes	5.10
Feeder 735	Revenue	[redacted]	2009	No	Yes	Yes	5.10
	Check	[redacted]	2009	No	Yes	Yes	5.10
Feeder 7348	Revenue	[redacted]	2009	No	Yes	Yes	4.70
	Check	[redacted]	2011	No	Yes	Yes	4.10

EDMI energy metering devices are utilized to meter Middle Ridge-Postmans Ridge feeder 727 and installed in 2004. Health index indicates these metering equipment will reach the end of technical asset life and need to be replaced with major associated major secondary system replacement between 2004 and 2005.

Feeder 727 metering panel (+6A8)

Revenue and check meter equipment for Feeder 7234, 728, 733, 736, 7233, 730, 734, 735 and 7348 were replaced in about 2009. Health index shows that these devices will reach the end of technical asset life and need to be replaced with associated major secondary system replacement between 2028 and 2029.

Metering panel (+6A9, +7A8 and 7A9)

Metering data is currently interrogated via dial-up PSTN netowrk. The National Broadband Netowrk (NBN) is rolling out across Queensland and the change in the Telstra's core network to an IP based network. The change in technology has meant that serial communication lines via the public PSTN have become less reliable and problematic. As such, Powerlink has developed a solution to migrate PSTN metering to IP based metering. All meters with dial-up connection need to be migrated to IP based meter with major secondary system replacement.

4.5 Non-bays

Secondary systems for Non-bays at H014 Middle Ridge are detailed in a table below:

NBay	Relay & control	Model	Startup Date	Still Manufactured?	Manufacture Support?	PLQ Spares	Health Index
Local control	LCF RTU (110kV)	[redacted]	2005	No	No	Yes	7.00
	LCF RTU (330/275kV)	[redacted]	2005	No	No	Yes	7.00
	HMI	[redacted]	2009	No	No	Limited	10.00
SCADA	NSC1 (110kV)	[redacted]	2005	No	No	Yes	7.00
	NSC2 (110kV)	[redacted]	2005	No	No	Yes	7.00
	NSC1 (330/275kV)	[redacted]	2004	No	No	Yes	7.50
	NSC2 (330/275kV)	[redacted]	2004	No	No	Yes	7.50
Central Control	Comms RTU (+5)	[redacted]	2002	No	No	Yes	8.30
	Common RTU (+6)	[redacted]	2005	No	No	Yes	7.00
	Common RTU (+7)	[redacted]	2005	No	No	Yes	7.00
	Common RTU (+8)	[redacted]	2005	No	No	Yes	7.00
Master OpsWAN (+5)	Router	[redacted]	2010	Yes	Yes	Yes	8.90
	Ethernet switch	[redacted]	2006	Yes	Yes	Yes	10.00
	Port Server	[redacted]	2006	Yes	Yes	Yes	10.00
	Server	[redacted]	2002	Yes	Yes	Yes	10.00
OpsWAN Station (+6)	Ethernet switch	[redacted]	2005	Yes	Yes	Yes	10.00
	Port Server	[redacted]	2005	Yes	Yes	Yes	10.00
OpsWAN Station (+7)	Ethernet switch	[redacted]	2005	Yes	Yes	Yes	10.00
	Port Server	[redacted]	2005	Yes	Yes	Yes	10.00
OpsWAN Station (+8)	Ethernet switch	[redacted]	2005	Yes	Yes	Yes	10.00
	Port Server	[redacted]	2005	Yes	Yes	Yes	10.00

NBay	Relay & control	Model	Startup Date	Still Manufactured?	Manufacture Support?	PLQ Spares	Health Index
OpsWAN Camera	Camera 1	[redacted]	2002	Yes	Yes	Yes	10.00
	Camera 2	[redacted]	2002	Yes	Yes	Yes	10.00
	Camera 3	[redacted]	2005	Yes	Yes	Yes	10.00
	Camera 4	[redacted]	2005	Yes	Yes	Y es	10.00
Timing (+6)		[redacted]	2005	Yes	Yes	Yes	7.00
Timing (+7)		[redacted]	2011	Yes	Yes	Yes	4.50
Timing (+8)		[redacted]	2005	Yes	Yes	Yes	7.00

4.5.1 SCADA, Control and OpsWAN

There are 2 x OptoNet rings, one for 330/275kV and another for 110kV bays.

[redacted]

[redacted]

[redacted]

Dedicated SCADA paths have been implemented for 330/275kV and 110kV secondary systems. The SCADA system in Ring 1 (330/275kV) and Ring 2 (110kV) has independent [redacted] and [redacted] RTU to implement 2 x dual SCADA paths based on DNP3 serial. The SCADA serial protocol is being phased out because of expensive serial infrastructures and low fault tolerance. They need to be migrated to DNP over IP. Health index indicates that SCADA RTUs will reach the end of technical asset life and need to be replaced between 2024 and 2025.

Local control LCF RTUs were installed in 2005. They will reach the end of technical asset life and need to be replaced by 2025. [redacted] is used for the local control. There are only limited spares available. The HMI functionality of [redacted] needs to be replaced with major secondary system replacement.

LCF and SCADA RTUs (330/275kV and 110kV)

[redacted]

Majority of OpsWAN equipment were installed between 2005 and 2006. These devices need to be replaced with major secondary system replacement to maintain the operational standards.

Comms and common RTUs were installed between 2002 and 2005. These devices become obsolete and Powerlink is currently relying on spares to maintain its operation. Health index shows that these devices will reach the end of useful asset life and need to be replaced by 2025.

OpsWAN network and Comms and Common RTUs

Timing clock was installed for Building +6 and +8 in 2005. It needs to be replaced by 2025 to maintain the reliability. Timing clock Building +7 was replace in 2011 and there is no condition-driven replacement required until 2031.

4.5.2 Auxiliary supply

The 415VAC auxiliary supplies are derived from two 11kV/415V 300kVA station transformers. Standby AC supply is from an on-site 150kVA diesel generator. Suitable monitoring and changeover arrangement are available for the site. The arrangement is considered acceptable for the situation.

415VAC station transformer


AC changeover board

The AC distribution boards in Building +6, +7 and 8 were commissioned in 2002 and are in fair condition. There are no condition driven replacement required until 2037-2042.

AC distribution board within building +6, +7 and +8

The dual 125VDC battery banks were replaced in 2018 and are in good condition. Associated DC rectifiers were installed in 2009 and need to be replaced by 2029.

125VDC Batteries and charger in Building +6, +7 and +8

Dual 48VDC battery and associated chargers were replaced in 2008. Battery banks will reach the end of technical asset life and need to be replaced by 2023 while chargers to be replaced in 2028.

4.6 Telecommunication

Communication systems at H014 Middle Ridge consist of fibre optic technology. Majority of PDH MUX equipment were installed between 2005 and 2007. SDH equipment were was replaced in 2012. MPLS networks were established in 2014. They have been providing reliable services for protection and control systems. Associated communication cards for SDH network are still supportable and repairable. However, [redacted] no longer supports the PDH equipment. There are some cards available from [redacted] but not all cards are 100% compatible. Failure of any of the PDH equipment could result extended outage depending on which cards fail. Failure of the PDH equipment could result in the failed [redacted] PDH equipment being replaced with an [redacted] equivalent installation.

MUX equipment

Site Infrastructure & MPLS panel

5. Summary of H14 Middle Ridge Asset Health

The asset health of major equipment of H014 Middle Ridge secondary system assets is determined by an assessment of the equipment aging profile, reliability, conditions (including the condition of panel wirings, control cables and marshalling cubicles) and obsolescence. Asset health index of equipment at H014 Middle Ridge are summarized in the table below:-

		Protection and control equipment condition and replacement recommendation							Marshalling kiosk/Cable condition and replacement recommendation			
Bay	**Functional Loc.**	**Description**	**Model number**	**Start-up date**	**Manufacturer**	**Life Span**	**HI**	**Recommendation Replacement by**	**Item**	**Startup Date**	**HI**	**To be replaced by**
=KD1 110kV 1 Bus	H014-SSS-1BU4-BAYCONT	REMOTE TERMINAL UNIT FOXBORO C50	[redacted]	24/04/2005	FOXBORO	20 Years	7.00	2025	110kV 1 Bus marshalling kiosk	7/08/2005	3.56	2040-2045
	H014-SSS-1BU4-XPROT	RELAY DIFF ALSTOM MFAC34 RANGE 25-325VAC	[redacted]	24/04/2005	ALSTOM	20 Years	7.00		110kV 1 Bus VT box	7/08/2005	3.56	2040-2045
	H014-SSS-1BU4-XPROT	RELAY TRIPPING SUPPLY FAIL ALSTOM MVAX12	[redacted]	24/04/2005	ALSTOM	20 Years	7.00					
	H014-SSS-1BU4-XPROT	RELAY TRIPPING LOW BURDEN ALSTOM MVAJ13	[redacted]	24/04/2005	ALSTOM	20 Years	7.00					
	H014-SSS-1BU4-XPROT	RELAY TRIPPING LOW BURDEN ALSTOM MVAJ13	[redacted]	24/04/2005	ALSTOM	20 Years	7.00					
	H014-SSS-1BU4-XPROT	RELAY CB FAIL BUS TRIP RACK	[redacted]	24/04/2005	RMS	20 Years	7.00					
	H014-SSS-1BU4-XPROT	RELAY CB FAIL BUS TRIP RACK	[redacted]	24/04/2005	RMS	20 Years	7.00					
	H014-SSS-1BU4-YPROT	RELAY DIFF ALSTOM MFAC34 RANGE 25-325VAC	[redacted]	24/04/2005	ALSTOM	20 Years	7.00					
	H014-SSS-1BU4-YPROT	RELAY TRIPPING SUPPLY FAIL ALSTOM MVAX12	[redacted]	24/04/2005	ALSTOM	20 Years	7.00					
	H014-SSS-1BU4-YPROT	RELAY TRIPPING LOW BURDEN ALSTOM MVAJ13	[redacted]	24/04/2005	ALSTOM	20 Years	7.00					
	H014-SSS-1BU4-YPROT	RELAY TRIPPING LOW BURDEN ALSTOM MVAJ13	[redacted]	24/04/2005	ALSTOM	20 Years	7.00					
	H014-SSS-1BU4-YPROT	RELAY CB FAIL BUS TRIP RACK	[redacted]	24/04/2005	RMS	20 Years	7.00					
	H014-SSS-1BU4-YPROT	RELAY CB FAIL BUS TRIP RACK	[redacted]	24/04/2005	RMS	20 Years	7.00					
=KC1 275kV 1 Bus	H014-SSS-1BU5-BAYCONT	REMOTE TERMINAL UNIT FOXBORO C50	[redacted]	24/04/2005	FOXBORO	20 Years	7.00	2025-2026	1 Bus marshalling kiosk	24/04/2005	3.64	2040-2045
	H014-SSS-1BU5-XPROT	RELAY DIFF ALSTOM MFAC34 RANGE 25-325VAC	[redacted]	24/04/2005	ALSTOM	20 Years	7.00		1 BUS VT box	24/04/2005	3.64	2040-2045
	H014-SSS-1BU5-XPROT	RELAY TRIPPING SUPPLY FAIL ALSTOM MVAX12	[redacted]	24/04/2005	ALSTOM	20 Years	7.00					
	H014-SSS-1BU5-XPROT	RELAY CB FAIL BUS TRIP RACK	[redacted]	24/04/2005	RMS	20 Years	7.00					
	H014-SSS-1BU5-XPROT	RELAY TRIPPING LOW BURDEN ALSTOM MVAJ13	[redacted]	20/05/2005	AREVA	20 Years	6.90					
	H014-SSS-1BU5-YPROT	RELAY TRIPPING LOW BURDEN ALSTOM MVAJ13	[redacted]	24/04/2005	ALSTOM	20 Years	7.00					
	H014-SSS-1BU5-YPROT	RELAY DIFF ALSTOM MFAC34 RANGE 25-325VAC	[redacted]	24/04/2005	ALSTOM	20 Years	7.00					
	H014-SSS-1BU5-YPROT	RELAY TRIPPING SUPPLY FAIL ALSTOM MVAX12	[redacted]	24/04/2005	ALSTOM	20 Years	7.00					
	H014-SSS-1BU5-YPROT	RELAY CB FAIL BUS TRIP RACK	[redacted]	24/04/2005	RMS	20 Years	7.00					
=KD2 110kV 2 Bus	H014-SSS-2BU4-BAYCONT	REMOTE TERMINAL UNIT FOXBORO C50	[redacted]	24/04/2005	FOXBORO	20 Years	7.00	2025	110kV 2 Bus marshalling kiosk	7/08/2005	3.56	2040-2045
	H014-SSS-2BU4-XPROT	RELAY DIFF ALSTOM MFAC34 RANGE 25-325VAC	[redacted]	24/04/2005	ALSTOM	20 Years	7.00		110kV 2 Bus VT box	7/08/2005	3.56	2040-2045
	H014-SSS-2BU4-XPROT	RELAY TRIPPING SUPPLY FAIL ALSTOM MVAX12	[redacted]	24/04/2005	ALSTOM	20 Years	7.00					
	H014-SSS-2BU4-XPROT	RELAY TRIPPING LOW BURDEN ALSTOM MVAJ13	[redacted]	24/04/2005	ALSTOM	20 Years	7.00					
	H014-SSS-2BU4-XPROT	RELAY TRIPPING LOW BURDEN ALSTOM MVAJ13	[redacted]	24/04/2005	ALSTOM	20 Years	7.00					
	H014-SSS-2BU4-XPROT	RELAY CB FAIL BUS TRIP RACK	[redacted]	24/04/2005	RMS	20 Years	7.00					
	H014-SSS-2BU4-XPROT	RELAY CB FAIL BUS TRIP RACK	[redacted]	24/04/2005	RMS	20 Years	7.00					
	H014-SSS-2BU4-YPROT	RELAY DIFF ALSTOM MFAC34 RANGE 25-325VAC	[redacted]	24/04/2005	ALSTOM	20 Years	7.00					
	H014-SSS-2BU4-YPROT	RELAY TRIPPING LOW BURDEN ALSTOM MVAJ13	[redacted]	24/04/2005	ALSTOM	20 Years	7.00					
	H014-SSS-2BU4-YPROT	RELAY TRIPPING LOW BURDEN ALSTOM MVAJ13	[redacted]	24/04/2005	ALSTOM	20 Years	7.00					
	H014-SSS-2BU4-YPROT	RELAY TRIPPING SUPPLY FAIL ALSTOM MVAX12	[redacted]	24/04/2005	ALSTOM	20 Years	7.00					
	H014-SSS-2BU4-YPROT	CB FAIL BUS TRIP RACK	[redacted]	24/04/2005	RMS	20 Years	7.00					
	H014-SSS-2BU4-YPROT	RELAY CB FAIL BUS TRIP RACK	[redacted]	24/04/2005	RMS	20 Years	7.00					
=KC2 275kV 2 Bus	H014-SSS-2BU5-BAYCONT	REMOTE TERMINAL UNIT FOXBORO C50	[redacted]	24/04/2005	FOXBORO	20 Years	7.00	2025-2026	2 Bus marshalling kiosk	8/02/2005	3.70	2040-2045
	H014-SSS-2BU5-XPROT	RELAY TRIPPING LOW BURDEN ALSTOM MVAJ13	[redacted]	24/04/2005	ALSTOM	20 Years	7.00		2 BUS VT box	8/02/2005	3.70	2040-2045
	H014-SSS-2BU5-XPROT	RELAY DIFF ALSTOM MFAC34 RANGE 25-325VAC	[redacted]	24/04/2005	ALSTOM	20 Years	7.00					
	H014-SSS-2BU5-XPROT	RELAY TRIPPING SUPPLY FAIL ALSTOM MVAX12	[redacted]	24/04/2005	ALSTOM	20 Years	7.00					
	H014-SSS-2BU5-XPROT	RELAY CB FAIL BUS TRIP RACK	[redacted]	24/04/2005	RMS	20 Years	7.00					
	H014-SSS-2BU5-YPROT	RELAY TRIPPING LOW BURDEN ALSTOM MVAJ13	[redacted]	24/04/2005	ALSTOM	20 Years	7.00					
	H014-SSS-2BU5-YPROT	RELAY DIFF ALSTOM MFAC34 RANGE 25-325VAC	[redacted]	24/04/2005	ALSTOM	20 Years	7.00					
	H014-SSS-2BU5-YPROT	RELAY TRIPPING SUPPLY FAIL ALSTOM MVAX12	[redacted]	24/04/2005	ALSTOM	20 Years	7.00					
	H014-SSS-2BU5-YPROT	RELAY CB FAIL BUS TRIP RACK	[redacted]	24/04/2005	RMS	20 Years	7.00					
=KD3 110kV 3 Bus	H014-SSS-3BU4-BAYCONT	REMOTE TERMINAL UNIT FOXBORO C50	[redacted]	24/04/2005	FOXBORO	20 Years	7.00	2025	110kV 3 Bus marshalling kiosk	7/08/2005	3.56	2040-2045
	H014-SSS-3BU4-XPROT	RELAY DIFF ALSTOM MFAC34 RANGE 25-325VAC	[redacted]	24/04/2005	ALSTOM	20 Years	7.00		110kV 3 Bus VT box	7/08/2005	3.56	2040-2045
	H014-SSS-3BU4-XPROT	RELAY TRIPPING LOW BURDEN ALSTOM MVAJ13	[redacted]	24/04/2005	ALSTOM	20 Years	7.00		Control cables	7/08/2005	3.56	2040-2045
	H014-SSS-3BU4-XPROT	RELAY TRIPPING LOW BURDEN ALSTOM MVAJ13	[redacted]	24/04/2005	ALSTOM	20 Years	7.00					
	H014-SSS-3BU4-XPROT	RELAY TRIPPING SUPPLY FAIL ALSTOM MVAX12	[redacted]	24/04/2005	ALSTOM	20 Years	7.00					
	H014-SSS-3BU4-XPROT	RELAY CB FAIL BUS TRIP RACK	[redacted]	24/04/2005	RMS	20 Years	7.00					
	H014-SSS-3BU4-XPROT	RELAY CB FAIL BUS TRIP RACK	[redacted]	24/04/2005	RMS	20 Years	7.00					
	H014-SSS-3BU4-YPROT	RELAY DIFF ALSTOM MFAC34 RANGE 25-325VAC	[redacted]	24/04/2005	ALSTOM	20 Years	7.00					
	H014-SSS-3BU4-YPROT	RELAY TRIPPING SUPPLY FAIL ALSTOM MVAX12	[redacted]	24/04/2005	ALSTOM	20 Years	7.00					
	H014-SSS-3BU4-YPROT	RELAY TRIPPING LOW BURDEN ALSTOM MVAJ13	[redacted]	24/04/2005	ALSTOM	20 Years	7.00					
	H014-SSS-3BU4-YPROT	RELAY TRIPPING LOW BURDEN ALSTOM MVAJ13	[redacted]	24/04/2005	ALSTOM	20 Years	7.00					
	H014-SSS-3BU4-YPROT	RELAY CB FAIL BUS TRIP RACK	[redacted]	24/04/2005	RMS	20 Years	7.00					
	H014-SSS-3BU4-YPROT	RELAY CB FAIL BUS TRIP RACK	[redacted]	24/04/2005	RMS	20 Years	7.00					
=D00 110kV 2-3 Bus coupler	H014-SSS-401--BAYCONT	REMOTE TERMINAL UNIT FOXBORO C50	[redacted]	13/08/2005	FOXBORO	20 Years	6.80	2025	110kV 2-3 bus coupler marshalling kiosk	10/02/2005	3.70	2040-2045
	H014-SSS-401--XPROT	RELAY CBMAN GE C60 (WITH W6T MODULE)	[redacted]	13/08/2005	GE	20 Years	6.80		Control cables	10/02/2005	3.70	2040-2045
	H014-SSS-401--YPROT	RELAY CBMAN SEL-351-1 (1A)	[redacted]	13/08/2005	SCHWEITZER	20 Years	6.80					
=D16 110kV 1-3 Bus	H014-SSS-402--XPROT	RELAY CBMAN GE C60 (WITH W6T MODULE)	[redacted] T	24/12/2004	GE	20 Years	7.10	2025	110kV 1-3 bus coupler marshalling kiosk	10/02/2005	3.70	2040-2045
	H014-SSS-402--YPROT	RELAY CBMAN SEL-351-1 (1A)	[redacted]	24/12/2004	SCHWEITZER	20 Years	7.10		Control cables	10/02/2005	3.70	2040-2045
=D09 110kV 1-2 Bus	H014-SSS-411--BAYCONT	REMOTE TERMINAL UNIT FOXBORO C50	[redacted]	18/09/2005	FOXBORO	20 Years	6.80	2025	110kV 1-2 bus coupler marshalling kiosk	10/02/2005	3.70	2040-2045
	H014-SSS-411--XPROT	RELAY CBMAN GE C60 (WITH W6T MODULE)	[redacted]	18/09/2005	GE	20 Years	6.80		Control cables	10/02/2005	3.70	2040-2045
	H014-SSS-411--YPROT	RELAY CBMAN SEL-351-1 (1A)	[redacted]	18/09/2005	SCHWEITZER	20 Years	6.80					
=D11.3 1T 110kV	H014-SSS-441--BAYCONT	REMOTE TERMINAL UNIT FOXBORO C50	[redacted]	24/04/2005	FOXBORO	20 Years	7.00	2025	1 Transformer 110kV marshalling kiosk and control cables	24/04/2005	3.64	2040-2045
	H014-SSS-441--XPROT	RELAY CBMAN GE C60 (WITH W6T MODULE)	[redacted]	24/04/2005	GE	20 Years	7.00					

	H014-SSS-441--YPROT	RELAY CBMAN SEL-351-1 (1A)	[redacted]	24/04/2005	SCHWEITZER	20 Years	7.00					
=D10.1 2T 110kV	H014-SSS-442--BAYCONT	REMOTE TERMINAL UNIT FOXBORO C50	[redacted]	29/05/2005	FOXBORO	20 Years	6.90	2025	2 Transformer 110kV marshalling kiosk and control cables	31/07/1987	8.71	2022-2027
	H014-SSS-442--XPROT	RELAY CBMAN GE C60 (WITH W6T MODULE)	[redacted]	29/05/2005	GE	20 Years	6.90					
	H014-SSS-442--YPROT	RELAY CBMAN SEL-351-1 (1A)	[redacted]	29/05/2005	SCHWEITZER	20 Years	6.90					
=D08.2 3T 110kV	H014-SSS-443--BAYCONT	REMOTE TERMINAL UNIT FOXBORO C50	[redacted]	2/07/2005	FOXBORO	20 Years	6.90	2025	3 Transformer 110kV marshalling kiosk and control cables	31/07/1987	8.71	2022-2027
	H014-SSS-443--XPROT	RELAY CBMAN GE C60 (WITH W6T MODULE)	[redacted]	2/07/2005	GE	20 Years	6.90					
	H014-SSS-443--YPROT	RELAY CBMAN SEL-351-1 (1A)	[redacted]	2/07/2005	SCHWEITZER	20 Years	6.90					
=D15.1 110kV Cap 1	H014-SSS-481--BAYCONT	REMOTE TERMINAL UNIT FOXBORO C50	[redacted]	29/07/2002	FOXBORO	20 Years	8.30	2022-2023	110kV 1 Cap marshalling kiosk and control cables	28/02/2002	4.54	2037-2042
	H014-SSS-481--POWAVE	RELAY POINT ON WAVE ABB E213	[redacted]	28/03/2002	ABB	20 Years	8.50					
	H014-SSS-481--XPROT	RELAY CAP PROTN ABB SPAJ160C	[redacted]	29/07/2002	ABB	20 Years	8.30					
	H014-SSS-481--XPROT	RELAY O/C 5A SEL-501-2	[redacted]	29/07/2002	SCHWEITZER	20 Years	8.30					
	H014-SSS-481--XPROT	RELAY CB FAIL ABB RAICA	[redacted]	29/07/2002	ABB	20 Years	8.30					
	H014-SSS-481--YPROT	RELAY OVERCURRENT ABB SPAJ140C	[redacted]	29/07/2002	ABB	20 Years	8.30					
	H014-SSS-481--YPROT	RELAY OVERVOLTAGE ABB SPAU121C	[redacted]	29/07/2002	ABB	20 Years	8.30					
=D15.3 110kV Cap 2	H014-SSS-482--BAYCONT	REMOTE TERMINAL UNIT FOXBORO C50	[redacted]	29/07/2002	FOXBORO	20 Years	8.30	2022-2023	110kV 1 Cap marshalling kiosk and control cables	28/02/2002	4.54	2037-2042
	H014-SSS-482--POWAVE	RELAY POINT ON WAVE ABB E213	[redacted]	3/04/2002	ABB	20 Years	8.50					
	H014-SSS-482--XPROT	RELAY CAP PROTN ABB SPAJ160C	[redacted]	29/07/2002	ABB	20 Years	8.30					
	H014-SSS-482--XPROT	RELAY O/C 5A SEL-501-2	[redacted]	29/07/2002	SCHWEITZER	20 Years	8.30					
	H014-SSS-482--XPROT	RELAY CB FAIL ABB RAICA	[redacted]	29/07/2002	ABB	20 Years	8.30					
	H014-SSS-482--YPROT	RELAY OVERCURRENT E/F ABB SPAJ140C	[redacted]	29/07/2002	ABB	20 Years	8.30					
	H014-SSS-482--YPROT	RELAY OVERVOLTAGE ABB SPAU121C	[redacted]	29/07/2002	ABB	20 Years	8.30					
=C01 275kV bus coupler 501	H014-SSS-501--BAYCONT	REMOTE TERMINAL UNIT FOXBORO C50	[redacted]	24/04/2005	FOXBORO	20 Years	7.00	2025-2026	Coupler 501 marshalling kiosk	24/04/2005	3.64	2040-2045
	H014-SSS-501--XPROT	RELAY CBMAN GE C60 (WITH W6T MODULE)	[redacted]	24/04/2005	GE	20 Years	7.00					
	H014-SSS-501--YPROT	RELAY CBMAN SEL-352 (1A) (3U)	[redacted]	24/04/2005	SCHWEITZER	20 Years	7.00					
=C02 275kV bus coupler 502	H014-SSS-502--BAYCONT	REMOTE TERMINAL UNIT FOXBORO C50	[redacted]	24/04/2005	FOXBORO	20 Years	7.00	2025-2026	Coupler 502 marshalling kiosk	24/04/2005	3.64	2040-2045
	H014-SSS-502--XPROT	RELAY CBMAN GE C60 (WITH W6T MODULE)	[redacted]	24/04/2005	GE	20 Years	7.00					
	H014-SSS-502--YPROT	RELAY CBMAN SEL-352 (1A) (3U)	[redacted]	24/04/2005	SCHWEITZER	20 Years	7.00					
=C03 275kV bus coupler 503	H014-SSS-503--BAYCONT	REMOTE TERMINAL UNIT FOXBORO C50	[redacted]	24/04/2005	FOXBORO	20 Years	7.00	2025-2026	Coupler 503 marshalling kiosk	24/04/2005	3.64	2040-2045
	H014-SSS-503--XPROT	RELAY CBMAN GE C60 (WITH W6T MODULE)	[redacted]	24/04/2005	GE	20 Years	7.00					
	H014-SSS-503--YPROT	RELAY CBMAN SEL-352 (1A) (3U)	[redacted]	24/04/2005	SCHWEITZER	20 Years	7.00					
=C04 275kV bus coupler 504	H014-SSS-504--BAYCONT	REMOTE TERMINAL UNIT FOXBORO C50	[redacted]	18/07/2007	FOXBORO	20 Years	5.90	2027-2028	Coupler 504	18/07/2007	3.00	2042-2047
	H014-SSS-504--XPROT	RELAY CB MGMT GE C60 (VER 2.93 FIRMWARE)	[redacted]	18/07/2007	GE	20 Years	5.90					
	H014-SSS-504--YPROT	RELAY CB MGMT SEL 352 1A, 125Vdc, 4U	[redacted]	18/07/2007	SCHWEITZER	20 Years	5.90					
=C02.2 1T 275kV	H014-SSS-541--BAYCONT	REMOTE TERMINAL UNIT FOXBORO C50	[redacted]	24/04/2005	FOXBORO	20 Years	7.00	2025	Transformer 1 CB marshalling kiosk	24/04/2005	3.64	2040-2045
	H014-SSS-541--XPROT	RELAY DIFF 25-325V 1POLE ALSTOM MFAC14	[redacted]	24/04/2005	ALSTOM	20 Years	7.00		Transformer 1 VT box	24/04/2005	3.64	2040-2045
	H014-SSS-541--XPROT	RELAY TRANSF O/LOAD GE F35	[redacted]	24/04/2005	GE	20 Years	7.00					
	H014-SSS-541--XPROT	RELAY TRANSF DIFF GE T60	[redacted]	24/04/2005	GE	20 Years	7.00					
	H014-SSS-541--YPROT	RELAY BIASED DIFF SEL-387-5 (1A) (3U)	[redacted]	24/04/2005	SCHWEITZER	20 Years	7.00					
=C01.2 2T 275kV	H014-SSS-542--BAYCONT	REMOTE TERMINAL UNIT FOXBORO C50	[redacted]	24/04/2005	FOXBORO	20 Years	7.00		Transformer 2 CVT box	24/04/2005	3.64	2040-2045
	H014-SSS-542--XPROT	RELAY TRANSF O/LOAD GE F35	[redacted]	24/04/2005	GE	20 Years	7.00	2025	Transformer 2 CB marshalling kiosk	24/04/2005	3.64	2040-2045
	H014-SSS-542--XPROT	RELAY TRANSF DIFF GE T60	[redacted]	24/04/2005	GE	20 Years	7.00					
	H014-SSS-542--YPROT	RELAY BIASED DIFF SEL-387-5 (1A) (3U)	[redacted]	24/04/2005	SCHWEITZER	20 Years	7.00					
=C01.1 3T 275kV	H014-SSS-543--BAYCONT	REMOTE TERMINAL UNIT FOXBORO C50	[redacted]	24/04/2005	FOXBORO	20 Years	7.00	2025	Transformer 3 CB marshalling kiosk	24/04/2005	3.64	2040-2045
	H014-SSS-543--XPROT	RELAY TRANSF DIFF GE T60	[redacted]	24/04/2005	GE	20 Years	7.00		Transformer 3 VT box	24/04/2005	3.64	2040-2045
	H014-SSS-543--XPROT	RELAY TRANSF O/LOAD GE F35	[redacted]	24/04/2005	GE	20 Years	7.00		Control cables	24/04/2005	3.64	2040-2045
	H014-SSS-543--YPROT	RELAY BIASED DIFF SEL-387-5 (1A) (3U)	[redacted]	24/04/2005	SCHWEITZER	20 Years	7.00					
=C03.2 4T 330/275kV	H014-SSS-544--BAYCONT	REMOTE TERMINAL UNIT FOXBORO C50	[redacted]	24/04/2005	FOXBORO	20 Years	7.00	2025-2027	Transformer 4 marshalling kiosk	24/04/2005	3.64	2040-2045
	H014-SSS-544--XPROT	RELAY DIFF 25-325V 1POLE ALSTOM MFAC14	[redacted]	24/04/2005	ALSTOM	20 Years	7.00		Transformer 4 VT box	24/04/2005	3.64	2040-2045
	H014-SSS-544--XPROT	RELAY TRANSF O/LOAD GE F35	[redacted]	24/04/2005	GE	20 Years	7.00					
	H014-SSS-544--XPROT	RELAY TRANSF DIFF GE T60	[redacted]	24/04/2005	GE	20 Years	7.00					
	H014-SSS-544--YPROT	RELAY BIASED DIFF SEL-387-5 (1A) (3U)	[redacted]	24/04/2005	SCHWEITZER	20 Years	7.00					
=C04.2 5T 330/275kV	H014-SSS-545--BAYCONT	REMOTE TERMINAL UNIT FOXBORO C50	[redacted]	27/11/2008	FOXBORO	20 Years	5.20	2025-2027	Transformer 5 CB marshalling kiosk	18/07/2007	3.00	2042-2047
	H014-SSS-545--XPROT	RELAY DIFF 25-325V 1POLE AREVA MFAC14	[redacted]	18/07/2007	AREVA	20 Years	5.90		Control cables	18/07/2007	3.00	2042-2047
	H014-SSS-545--XPROT	RELAY TRANSF DIFF GE T60 (3.48)	[redacted]	18/07/2007	GE	20 Years	5.90					
	H014-SSS-545--XPROT	RELAY TRANSF O/LOAD GE F35 (2.93)	[redacted]	18/07/2007	GE	20 Years	5.90					
	H014-SSS-545--YPROT	RELAY BIASED DIFF SEL-387-5 (1A) (3U)	[redacted]	18/07/2007	SCHWEITZER	20 Years	5.90					
=B01 330kV 3 Cap	H014-SSS-683--POWAVE	RELAY POW SWITCHSYNC F236 - SPAR CB	[redacted]	19/08/2011	ABB	20 Years	7.30	2031-2032	330kV Capacitor 3 marshalling kiosk and control cables	19/08/2011	1.83	2046-2051
	H014-SSS-683--XPROT	RELAY CAP PROTN ABB SPAJ160C	[redacted]	19/08/2011	ABB	20 Years	3.80					
	H014-SSS-683--XPROT	RELAY CAP PROTN ABB SPAJ160C	[redacted]	19/08/2011	ABB	20 Years	3.80					
	H014-SSS-683--XPROT	RELAY CAP PROTN ABB SPAJ160C	[redacted]	19/08/2011	ABB	20 Years	3.80					
	H014-SSS-683--XPROT	RELAY DIFF ALSTOM MFAC34 RANGE 25-325VAC	[redacted]	19/08/2011	ALSTOM	20 Years	3.80					
	H014-SSS-683--XPROT	RELAY CB MGMT GE C60 (5.22) 100BASE FX	[redacted]	19/08/2011	GE	20 Years	4.00					
	H014-SSS-683--YPROT	RELAY CB MGMT SEL-451-5 1A, 125VDC	[redacted]	19/08/2011	SCHWEITZER	20 Years	3.80					
	H014-SSS-683--YPROT	RELAY CAP PROTN ABB SPAJ160C	[redacted]	19/08/2011	ABB	20 Years	3.80					

	H014-SSS-683--YPROT	RELAY CAP PROTN ABB SPAJ160C	[redacted]	19/08/2011	ABB	20 Years	3.80					
	H014-SSS-683--YPROT	RELAY CAP PROTN ABB SPAJ160C	[redacted]	19/08/2011	ABB	20 Years	3.80					
	H014-SSS-683-BAYCONT		[redacted]	19/08/2011		20 Years	4.16					
=B02 330kV 4 Cap	H014-SSS-684--POWAVE	RELAY POW SWITCHSYNC F236 - SPAR CB	[redacted]	25/11/2011	ABB	20 Years	7.30	2031-2032	330kV Capacitor 4 marshalling kiosk and control cables	19/08/2011	1.83	2046-2051
	H014-SSS-684--XPROT	RELAY CB MGMT GE C60 (5.22) 100BASE FX	[redacted]	25/11/2011	GE	20 Years	4.00					
	H014-SSS-684--XPROT	RELAY CAP PROTN ABB SPAJ160C	[redacted]	25/11/2011	ABB	20 Years	3.70					
	H014-SSS-684--XPROT	RELAY CAP PROTN ABB SPAJ160C	[redacted]	25/11/2011	ABB	20 Years	3.70					
	H014-SSS-684--XPROT	RELAY CAP PROTN ABB SPAJ160C	[redacted]	25/11/2011	ABB	20 Years	3.70					
	H014-SSS-684--XPROT	RELAY DIFF ALSTOM MFAC34 RANGE 25-325VAC	[redacted]	25/11/2011	ALSTOM	20 Years	3.70					
	H014-SSS-684--YPROT	RELAY CB MGMT SEL-451-5 1A, 125VDC	[redacted]	25/11/2011	SCHWEITZER	20 Years	3.70					
	H014-SSS-684--YPROT	RELAY CAP PROTN ABB SPAJ160C	[redacted]	25/11/2011	ABB	20 Years	3.70					
	H014-SSS-684--YPROT	RELAY CAP PROTN ABB SPAJ160C	[redacted]	25/11/2011	ABB	20 Years	3.70					
	H014-SSS-684--YPROT	RELAY CAP PROTN ABB SPAJ160C	[redacted]	25/11/2011	ABB	20 Years	3.70					
	H014-SSS-684-BAYCONT		[redacted]	19/08/2011		20 Years	4.16					
=D13.3 Spare 5	H014-SSS-711--BAYCONT	REMOTE TERMINAL UNIT FOXBORO C50	[redacted]	13/08/2005	FOXBORO	20 Years	6.80	2025	Spare 5 bay marshalling kiosk and control cables	21/05/2004	3.90	2039-2044
	H014-SSS-711--PSPIT	DEWAR DM1200 PROT SIG DIG 90-320V SUPPLY	[redacted]	13/08/2005	DEWAR	20 Years	6.80					
	H014-SSS-711--XPROT	RELAY CURRENT DIFF GE L90 (2T+N6U) V3.48	[redacted]	13/08/2005	GE	20 Years	6.80					
	H014-SSS-711--YPROT	RELAY DISTANCE SEL 311C 1A	[redacted]	13/08/2005	SCHWEITZER	20 Years	6.80					
=D02.3 Feeder 7233	H014-SSS-7233-BAYCONT	REMOTE TERMINAL UNIT FOXBORO C50	[redacted]	5/12/2009	FOXBORO	20 Years	5.10	2023-2025	Feeder 7233 marshalling kiosk and control cables	16/07/2004	3.86	2039-2044
	H014-SSS-7233-PSDITA	F7233 SIT A1 H014 TO T116 VF PROT SIG	[redacted]	31/03/2006	DEWAR	20 Years	6.50					
	H014-SSS-7233-PSDITB	F7233 SIT B1 H014 TO T116 VF PROT SIG	[redacted]	31/03/2006	DEWAR	20 Years	6.50					
	H014-SSS-7233-XPROT	RELAY DISTANCE SEL 311C 1A	[redacted]	2/12/2003	SCHWEITZER	20 Years	7.70					
	H014-SSS-7233-YPROT	RELAY CURRENT DIFF GE L90 (2 TERM+N6U)	[redacted]	11/11/2003	GE	20 Years	7.70					
=D04.2 Feeder 7234	H014-SSS-7234-BAYCONT	REMOTE TERMINAL UNIT FOXBORO C50	[redacted]	4/08/2008	FOXBORO	20 Years	5.30	2023-2025	Feeder 7234 marshalling kiosk and control cables	8/07/2004	3.87	2039-2044
	H014-SSS-7234-XPROT	RELAY DISTANCE SEL-311C (1A)	[redacted]	5/07/2009	SCHWEITZER	20 Years	4.90					
	H014-SSS-7234-YPROT	RELAY CURRENT DIFF GE L90 (2T+N6U) V3.48	[redacted]	6/11/2003	GE	20 Years	7.70					
=D03.2 Feeder 727	H014-SSS-727--BAYCONT	REMOTE TERMINAL UNIT FOXBORO C50	[redacted]	28/09/2005	FOXBORO	20 Years	6.80	2025	Feeder 727 marshalling kiosk and control cables	28/09/2005	3.52	2040-2045
	H014-SSS-727--XPROT	RELAY CURRENT DIFF GE L90 (2T+N6U) V3.48	[redacted]	28/09/2005	GE	20 Years	6.80					
	H014-SSS-727--YPROT	RELAY DISTANCE SEL 311C 1A	[redacted]	28/09/2005	SCHWEITZER	20 Years	6.80					
=D01.2 Feeder 728	H014-SSS-728--BAYCONT	REMOTE TERMINAL UNIT FOXBORO C50	[redacted]	9/09/2007	FOXBORO	20 Years	5.80	2028-2029	Feeder 728 marshalling kiosk	3/02/2003	4.27	2038-2043
	H014-SSS-728--PSDIT	F728 DIT H014 TO T043 VF PROT SIG	[redacted]	1/06/2002	DEWAR	20 Years	8.70					
	H014-SSS-728--XPROT	RELAY CURR DIFF DISTANCE MICOM P546	[redacted]	22/05/2015	SCHNEIDER	20 Years	4.70					
	H014-SSS-728--YPROT	RELAY DIFF 1A SCHWEITZER 311L-7 125VDC	[redacted]	22/05/2015	SCHWEITZER	20 Years	4.50					
=D01.3 Feeder 730	H014-SSS-730--BAYCONT	REMOTE TERMINAL UNIT FOXBORO C50	[redacted]	30/09/2007	FOXBORO	20 Years	5.80	2028-2029	Feeder 730 marshalling kiosk	23/06/2004	3.88	2039-2044
	H014-SSS-730--PSDIT	F730 DIT H014 TO T043 VF PROT SIG	[redacted]	1/06/2002	DEWAR	20 Years	8.40					
	H014-SSS-730--XPROT	RELAY CURR DIFF DISTANCE MICOM P546	[redacted]	22/05/2015	SCHNEIDER	20 Years	4.70					
	H014-SSS-730--YPROT	RELAY DIFF 1A SCHWEITZER 311L-7 125VDC	[redacted]	22/05/2015	SCHWEITZER	20 Years	4.50					
=D06.3 Feeder 731	H014-SSS-731--BAYCONT	REMOTE TERMINAL UNIT FOXBORO C50	[redacted]	21/11/2009	FOXBORO	20 Years	5.10	2025	Feeder 731 marshalling kiosk and control cables	1/03/1999	5.40	2034-2039
	H014-SSS-731--PSPIT	RFL 9745 PROT SIG DIG I/O 48-125V	[redacted]	21/11/2009	RFL ELECTRONICS	20 Years	5.50					
	H014-SSS-731--XPROT	RELAY DISTANCE MICOM P442 (WITH R/PORT)	[redacted]	24/04/2005	ALSTOM	20 Years	7.00					
	H014-SSS-731--YPROT	RELAY DISTANCE SEL 311C 1A	[redacted]	5/11/2003	SCHWEITZER	20 Years	7.00					
=D05.2 Feeder 732	H014-SSS-732--BAYCONT	REMOTE TERMINAL UNIT FOXBORO C50	[redacted]	5/12/2009	FOXBORO	20 Years	5.10	2025	Feeder 732 marshalling kiosk and control cables	4/04/2005	3.65	2040-2045
	H014-SSS-732--PSPIT	RFL 9745 PROT SIG DIG I/O 48-125V	[redacted]	7/08/2009	RFL ELECTRONICS	20 Years	5.90					
	H014-SSS-732--XPROT	RELAY DISTANCE MICOM P442 (WITH R/PORT)	[redacted]	18/09/2006	AREVA	20 Years	6.30					
	H014-SSS-732--YPROT	RELAY DISTANCE SEL 311C 1A	[redacted]	2/12/2003	SCHWEITZER	20 Years	7.70					
=D11.1 Feeder 733	H014-SSS-733--BAYCONT	REMOTE TERMINAL UNIT FOXBORO C50	[redacted]	8/10/2005	FOXBORO	20 Years	6.70	2025	Feeder 733 marshalling kiosk and control cables	24/04/2004	3.92	2039-2044
	H014-SSS-733--XPROT	RELAY CURRENT DIFF GE L90 (2T+N6U) V3.48	[redacted]	8/10/2005	GE	20 Years	6.70					
	H014-SSS-733--YPROT	RELAY DISTANCE SEL 311C 1A	[redacted]	8/10/2005	SCHWEITZER	20 Years	6.70					
=D07.3 Feeder 734	H014-SSS-734--BAYCONT	REMOTE TERMINAL UNIT FOXBORO C50	[redacted]	4/11/2007	FOXBORO	20 Years	5.70	2027	Feeder 734 marshalling kiosk and control cables	12/07/2004	3.86	2039-2044
	H014-SSS-734--XPROT	RELAY CURRENT DIFF GE L90 (2 TERM+N6U)	[redacted]	1/12/2007	GE	20 Years	5.70					
	H014-SSS-734--YPROT	RELAY DISTANCE SEL 311C 1A	[redacted]	1/12/2007	SCHWEITZER	20 Years	5.70					
=D12.3 Feeder 7348	H014-SSS-7348-BAYCONT	REMOTE TERMINAL UNIT FOXBORO C50	[redacted]	10/11/2005	FOXBORO	20 Years	6.70	2025	Feeder 7348 marshalling kiosk and control cables	4/03/2011	1.96	2046-2051
	H014-SSS-7348-XPROT	COMMS INTERFACE UNIT ALSTOM P591	[redacted]	9/06/2011	AREVA	20 Years	3.90					
	H014-SSS-7348-XPROT	RELAY CURR DIFF DISTANCE MICOM P546	[redacted]	4/03/2011	AREVA	20 Years	5.20					
	H014-SSS-7348-YPROT	RELAY DISTANCE SEL 311C 1A	[redacted]	10/11/2005	SCHWEITZER	20 Years	6.70					
=D14.3 Feeder 735	H014-SSS-735--BAYCONT	REMOTE TERMINAL UNIT FOXBORO C50	[redacted]	16/10/2005	FOXBORO	20 Years	6.70	2025	Feeder 735 marshalling kiosk and control cables	16/10/2005	3.50	2040-2045
	H014-SSS-735--PSARBLK	DEWAR DM1200 PROT SIG DIG 90-320V SUPPLY	[redacted]	16/10/2005	DEWAR	20 Years	6.70					
	H014-SSS-735--PSDIT	DEWAR DM1200 PROT SIG DIG 90-320V SUPPLY	[redacted]	16/10/2005	DEWAR	20 Years	6.70					
	H014-SSS-735--XPROT	RELAY DISTANCE MICOM P442 (WITH R/PORT)	[redacted]	16/10/2005	AREVA	20 Years	6.70					
	H014-SSS-735--YPROT	RELAY DISTANCE SEL 311C 1A	[redacted]	16/10/2005	SCHWEITZER	20 Years	6.70					
=D12.1 Feeder 736	H014-SSS-736--BAYCONT	REMOTE TERMINAL UNIT FOXBORO C50	[redacted]	4/11/2007	FOXBORO	20 Years	5.70	2027	Feeder 736 marshalling kiosk and control cables	29/08/2005	3.54	2040-2045
	H014-SSS-736--PSDIT	DEWAR DM1200 PROT SIG DIG 20-60V SUPPLY	[redacted]	12/10/2002	DEWAR	20 Years	8.20					
	H014-SSS-736--XPROT	RELAY DISTANCE MICOM P442 (WITH R/PORT)	[redacted]	1/12/2007	ALSTOM	20 Years	5.80					
	H014-SSS-736--YPROT	RELAY DISTANCE SEL 311C 1A	[redacted]	1/12/2007	SCHWEITZER	20 Years	5.70					
	H014-SSS-831--BAYCONT	REMOTE TERMINAL UNIT FOXBORO C50	[redacted]	24/04/2005	FOXBORO	20 Years	7.00	2025	Feeder 831 bay marshalling kiosk	24/04/2005	3.64	2040-2045

=C02.1 Feeder 831	H014-SSS-831--PSPIT	RFL 9745 PROT SIG DIG I/O 48-125V	[redacted]	24/04/2005	RFL ELECTRONICS	20 Years	7.00		Feeder 831 VT box	24/04/2005	3.64	2040-2045
	H014-SSS-831--PSPIT	RFL 9745 PROT SIG DIG I/O 48-125V	[redacted]	7/06/2005	RFL ELECTRONICS	20 Years	6.90					
	H014-SSS-831--PSPITY	DEWAR DM1200 PROT SIG DIG 90-320V SUPPLY	[redacted]	9/07/2009	DEWAR	20 Years	4.90					
	H014-SSS-831--PSSITA	RFL 9745 PROT SIG DIG I/O 48-125V	[redacted]	7/06/2005	RFL ELECTRONICS	20 Years	6.90					
	H014-SSS-831--PSSITB	DEWAR DM1200 PROT SIG DIG 90-320V SUPPLY	[redacted]	7/06/2005	DEWAR	20 Years	6.90					
	H014-SSS-831--XPROT	RELAY CBMAN GE C60 (WITH W6T MODULE)	[redacted]	24/04/2005	GE	20 Years	7.00					
	H014-SSS-831--XPROT	RELAY DISTANCE MICOM P442 (WITH R/PORT	[redacted]	26/06/2009	AREVA	20 Years	4.90					
	H014-SSS-831--YPROT	RELAY DISTANCE SEL-421 (1A) (5U)	[redacted]	24/04/2005	SCHWEITZER	20 Years	7.00					
=C3.1 Feeder 8848	H014-SSS-8848-BAYCONT	REMOTE TERMINAL UNIT FOXBORO C50	[redacted]	18/07/2007	FOXBORO	20 Years	5.90	2027	Feeder 8848 CB marshalling kiosk	18/07/2007	3.00	2042-2047
	H014-SSS-8848-PSBLKA	DEWAR DM1200 PROT SIG DIG 90-320V SUPPLY	[redacted]	18/07/2007	DEWAR	20 Years	5.90		Feeder 8848 VT box	18/07/2007	3.00	2042-2047
	H014-SSS-8848-PSBLKB	DEWAR DM1200 PROT SIG DIG 90-320V SUPPLY	[redacted]	18/07/2007	DEWAR	20 Years	5.90					
	H014-SSS-8848-PSSITA	DEWAR DM1200 PROT SIG DIG 90-320V SUPPLY	[redacted]	18/07/2007	DEWAR	20 Years	5.90					
	H014-SSS-8848-PSSITB	RFL 9745 PROT SIG DIG I/O 48-125V	[redacted]	18/07/2007	RFL ELECTRONICS	20 Years	5.90					
	H014-SSS-8848-XPROT	CURR DIFF RELAY MICOM P544 + 2ND PORT	[redacted]	21/06/2005	MICOM	20 Years	6.90					
	H014-SSS-8848-YPROT	RELAY DISTANCE SEL-421 (1A) (5U)	[redacted]	18/07/2007	SCHWEITZER	20 Years	5.90					
=C04.1 Feeder 8849	H014-SSS-8849-BAYCONT	REMOTE TERMINAL UNIT FOXBORO C50	[redacted]	18/07/2007	FOXBORO	20 Years	5.90	2027	Feeder 8849 marshalling kiosk	18/07/2007	3.00	2042-2047
	H014-SSS-8849-PSPITY	DEWAR DM1200 PROT SIG DIG 90-320V SUPPLY	[redacted]	18/07/2007	DEWAR	20 Years	5.90					
	H014-SSS-8849-PSSITA	DEWAR DM1200 PROT SIG DIG 90-320V SUPPLY	[redacted]	18/07/2007	DEWAR	20 Years	5.90					
	H014-SSS-8849-PSSITB	RFL 9745 PROT SIG DIG I/O 48-125V	[redacted]	18/07/2007	RFL ELECTRONICS	20 Years	5.90					
	H014-SSS-8849-XPROT	CURR DIFF RELAY MICOM P544 + 2ND PORT	[redacted]	4/09/2018	MICOM	20 years	4.10					
	H014-SSS-8849-XPROT	COMMS INTERFACE UNIT ALSTOM P591	[redacted]	27/04/2015	AREVA	20 Years	2.40					
	H014-SSS-8849-YPROT	RELAY DISTANCE SCHW'ZER 421-5 1A 24 LED	[redacted]	8/10/2012	SCHWEITZER	20 Years	4.40					
=B02 Feeder 9907	H014-SSS-9907-BAYCONT	REMOTE TERMINAL UNIT FOXBORO C50	[redacted]	18/07/2007	FOXBORO	20 Years	5.90	2027	Feeder 9907 VT box	18/07/2007	3.00	2042-2047
	H014-SSS-9907-PSPITY	DEWAR DM1200 PROT SIG DIG 90-320V SUPPLY	[redacted]	2/01/2007	DEWAR	20 Years	6.10					
	H014-SSS-9907-PSSITA1	DEWAR DM1200 PROT SIG DIG 90-320V SUPPLY	[redacted]		DEWAR	20 Years	4.50					
	H014-SSS-9907-PSSITA2	RFL 9745 PROT SIG DIG I/O 48-125V	[redacted]	18/07/2007	RFL ELECTRONICS	20 Years	5.90					
	H014-SSS-9907-PSSITB1	DEWAR DM1200 PROT SIG DIG 90-320V SUPPLY	[redacted]	18/07/2007	DEWAR	20 Years	5.90					
	H014-SSS-9907-PSSITB2	RFL 9745 PROT SIG DIG I/O 48-125V	[redacted]	18/07/2007	RFL ELECTRONICS	20 Years	5.90					
	H014-SSS-9907-XPROT	CURR DIFF RELAY MICOM P544 + 2ND PORT	[redacted]	18/07/2007	MICOM	20 Years	5.90					
	H014-SSS-9907-YPROT	RELAY DISTANCE SEL-421 (1A) (5U)	[redacted]	18/07/2007	SCHWEITZER	20 Years	5.90					
=B01 Feeder 9908	H014-SSS-9908-BAYCONT	REMOTE TERMINAL UNIT FOXBORO C50	[redacted]	24/04/2005	FOXBORO	20 Years	7.00	2025	Feeder 9908 VT box	24/04/2005	3.64	2040-2045
	H014-SSS-9908-PSPITY	DEWAR DM1200 PROT SIG DIG 90-320V SUPPLY	[redacted]	24/04/2005	DEWAR	20 Years	7.00					
	H014-SSS-9908-PSSITA1	DEWAR DM1200 PROT SIG DIG 90-320V SUPPLY	[redacted]	24/04/2005	DEWAR	20 Years	7.00					
	H014-SSS-9908-PSSITA2	RFL 9745 PROT SIG DIG I/O 48-125V	[redacted]		RFL ELECTRONICS	20 Years	7.00					
	H014-SSS-9908-PSSITB1	DEWAR DM1200 PROT SIG DIG 90-320V SUPPLY	[redacted]	24/04/2005	DEWAR	20 Years	7.00					
	H014-SSS-9908-PSSITB2	RFL 9745 PROT SIG DIG I/O 48-125V	[redacted]	24/04/2005	RFL ELECTRONICS	20 Years	5.90					
	H014-SSS-9908-XPROT	CURR DIFF RELAY MICOM P544 + 2ND PORT	[redacted]	10/11/2004	MICOM	20 Years	7.20					
	H014-SSS-9908-XPROT	COMMS INTERFACE UNIT ALSTOM P591	[redacted]	24/04/2005	ALSTOM	20 Years	7.00					
	H014-SSS-9908-YPROT	RELAY DISTANCE SEL-421 (1A) (5U)	[redacted]	24/04/2005	SCHWEITZER	20 Years	7.00					
Metering	H014-SSS-METR-REVMET1	METER KWH/KVARH EDMI (CHECK)	[redacted]	4/08/2008	EDMI	20 Years	5.30	2028-2029	N/A			
	H014-SSS-METR-REVMET1	METER KWH/KVARH EDMI (REVENUE)	[redacted]	2/01/2009	EDMI	20 Years	5.10					
	H014-SSS-METR-REVMET10	METER KWH/KVARH EDMI 2000-0400 CL 0.5	[redacted]	7/11/2009	EDMI	20 Years	4.70					
	H014-SSS-METR-REVMET10	METER KWH/KVARH EDMI 2000-0400 CL 0.5	[redacted]	4/03/2011	EDMI	20 Years	4.10					
	H014-SSS-METR-REVMET2	METER KWH/KVARH EDMI (REVENUE)	[redacted]	2/01/2009	EDMI	20 Years	5.10					
	H014-SSS-METR-REVMET2	METER KWH/KVARH EDMI (CHECK)	[redacted]	2/01/2009	EDMI	20 Years	5.10					
	H014-SSS-METR-REVMET3	METER KWH/KVARH EDMI (REVENUE)	[redacted]	2/01/2009	EDMI	20 Years	5.10					
	H014-SSS-METR-REVMET3	METER KWH/KVARH EDMI	[redacted]	2/01/2009	EDMI	20 Years	5.10					
	H014-SSS-METR-REVMET4	METER KWH/KVARH EDMI (REVENUE)	[redacted]	2/01/2009	EDMI	20 Years	5.10					
	H014-SSS-METR-REVMET4	METER KWH/KVARH EDMI (CHECK)	[redacted]	2/01/2009	EDMI	20 Years	5.10					
	H014-SSS-METR-REVMET5	METER KWH/KVARH EDMI (REVENUE)	[redacted]	1/07/2004	EDMI	20 Years	7.40	2024-2025				
	H014-SSS-METR-REVMET5	METER KWH/KVARH EDMI (CHECK)	[redacted]	1/07/2004	EDMI	20 Years	7.40					
	H014-SSS-METR-REVMET6	METER KWH/KVARH EDMI (REVENUE)	[redacted]	2/01/2009	EDMI	20 Years	5.10	2028-2029				
	H014-SSS-METR-REVMET6	METER KWH/KVARH EDMI	[redacted]	2/01/2009	EDMI	20 Years	5.10					
	H014-SSS-METR-REVMET7	METER KWH/KVARH EDMI (REVENUE)	[redacted]	2/01/2009	EDMI	20 Years	5.10					
	H014-SSS-METR-REVMET7	METER KWH/KVARH EDMI (CHECK)	[redacted]	2/01/2009	EDMI	20 Years	5.10					
	H014-SSS-METR-REVMET8	METER KWH/KVARH EDMI (REVENUE)	[redacted]	2/01/2009	EDMI	20 Years	5.10					
	H014-SSS-METR-REVMET8	METER KWH/KVARH EDMI	[redacted]	2/01/2009	EDMI	20 Years	5.10					
	H014-SSS-METR-REVMET9	METER KWH/KVARH EDMI (REVENUE)	[redacted]	2/01/2009	EDMI	20 Years	5.10					
	H014-SSS-METR-REVMET9	METER KWH/KVARH EDMI (CHECK)	[redacted]	2/01/2009	EDMI	20 Years	5.10					
Non Bay	H014-SSS-NBAY-LCF	LOCAL CONTROL FACILITY PC X TERMINAL	[redacted]	13/02/2009	WYSE	10 Years	10.00	2025	N/A			
	H014-SSS-NBAY-LCF6PCX	LOCAL CONTROL FACILITY PC X TERMINAL	[redacted]	28/11/2008	WYSE	10 Years	10.00					
	H014-SSS-NBAY-LCF7	LOCAL CONTROL FACILITY PC X TERMINAL	[redacted]	28/11/2008	WYSE	10 Years	10.00					
	H014-SSS-NBAY-LCF8110	LOCAL CONTROL FACILITY PC X TERMINAL	[redacted]	13/02/2009	WYSE	10 Years	10.00					
	H014-SSS-NBAY-LCF8275	LOCAL CONTROL FACILITY SUN BLADE	[redacted]	12/02/2009	SUN	10 Years	10.00					
	H014-SSS-NBAY-LCFINT	REMOTE TERMINAL UNIT FOXBORO C50	[redacted]	29/07/2002	FOXBORO	20 Years	8.30					

	H014-SSS-NBAY-LCFINT6	REMOTE TERMINAL UNIT FOXBORO C50	[redacted]	24/04/2005	FOXBORO	20 Years	7.00					
	H014-SSS-NBAY-LCFINT8	REMOTE TERMINAL UNIT FOXBORO C50		24/04/2005	FOXBORO	20 Years	7.00					
	H014-SSS-NBAY-NSCLINK1	REMOTE TERMINAL UNIT FOXBORO C50		29/07/2002	FOXBORO	20 Years	8.30					
	H014-SSS-NBAY-NSCLINK2	REMOTE TERMINAL UNIT FOXBORO C50		29/07/2002	FOXBORO	20 Years	8.30					
	H014-SSS-NBAY-NSCLNK16	REMOTE TERMINAL UNIT FOXBORO C50		24/04/2005	FOXBORO	20 Years	7.00					
	H014-SSS-NBAY-NSCLNK18	REMOTE TERMINAL UNIT FOXBORO C50		21/04/2004	FOXBORO	20 Years	7.50					
	H014-SSS-NBAY-NSCLNK26	REMOTE TERMINAL UNIT FOXBORO C50		24/04/2005	FOXBORO	20 Years	7.00					
	H014-SSS-NBAY-NSCLNK28	REMOTE TERMINAL UNIT FOXBORO C50		21/04/2004	FOXBORO	20 Years	7.50					
	H014-SSS-NBAY-OWCAM1	VIDEO CAMERA		15/08/2002	CANON	10 Years	10.00					
	H014-SSS-NBAY-OWCAM2	VIDEO CAMERA		15/08/2002	CANON	10 Years	10.00					
	H014-SSS-NBAY-OWCAM3	CANON ETHERNET CAMERA		24/04/2005	CANON	10 Years	10.00					
	H014-SSS-NBAY-OWCAM4	CANON ETHERNET CAMERA		24/04/2005	CANON	10 Years	10.00					
	H014-SSS-NBAY-OWNTWK	PORT SERVER		12/06/2001	STALLION	10 Years	10.00					
	H014-SSS-NBAY-OWNTWK	PORT SERVER		12/06/2001	STALLION	10 Years	10.00					
	H014-SSS-NBAY-OWNTWK1	PORT SERVER		22/09/2006	STALLION	10 Years	10.00					
	H014-SSS-NBAY-OWNTWK1	SWITCH ETHERNET		22/09/2006	3 COM	10 Years	10.00					
	H014-SSS-NBAY-OWNTWK2	SWITCH ETHERNET		22/09/2006	3 COM	10 Years	10.00	2025				
	H014-SSS-NBAY-OWNTWK2	PORT SERVER		22/09/2006	STALLION	10 Years	10.00					
	H014-SSS-NBAY-OWNTWK2	ROUTER CISCO 2811 48VDC - OPSWAN		27/04/2010	CISCO	10 Years	8.90					
	H014-SSS-NBAY-OWNTWK6	SWITCH		24/04/2005	3 COM	10 Years	10.00					
	H014-SSS-NBAY-OWNTWK6	PORT SERVER		24/04/2005	STALLION	10 Years	10.00					
	H014-SSS-NBAY-OWNTWK7	SWITCH		24/04/2005	3 COM	10 Years	10.00					
	H014-SSS-NBAY-OWNTWK7	PORT SERVER		24/04/2005	STALLION	10 Years	10.00					
	H014-SSS-NBAY-OWNTWK8	PORT SERVER		11/02/2005	STALLION	10 Years	10.00					
	H014-SSS-NBAY-OWNTWK8	SWITCH		11/02/2005	3 COM	10 Years	10.00					
	H014-SSS-NBAY-OWSERV	SERVER		15/08/2002	COMPAQ	10 Years	10.00					
	H014-SSS-NBAY-PSPM1	RECORDER QUALITROL IDM+		12/01/2017	QUALITROL	20 years	0.92	2037				
	H014-SSS-NBAY-PWRQUAL1	PQ ANALYSER UNIPOWER UP-2210 VT & REF IN		5/07/2012	UNIPOWER	20 Years	3.40	2032				
	H014-SSS-NBAY-RTUCOM	REMOTE TERMINAL UNIT FOXBORO C50		29/07/2002	FOXBORO	20 Years	8.30					
	H014-SSS-NBAY-RTUCOM	RTU FOXBORO C50 TRANSF COOL & AC SUPPLY		11/03/2003	FOXBORO	20 Years	8.30					
	H014-SSS-NBAY-RTUCOM6	REMOTE TERMINAL UNIT FOXBORO C50		24/04/2005	FOXBORO	20 Years	7.00	2025				
	H014-SSS-NBAY-RTUCOM7	REMOTE TERMINAL UNIT FOXBORO C50		24/04/2005	FOXBORO	20 Years	7.00					
	H014-SSS-NBAY-RTUCOM8	REMOTE TERMINAL UNIT FOXBORO C50		24/04/2005	FOXBORO	20 Years	7.00					
	H014-SSS-NBAY-TIMING6	GPS CLOCK - TEKRON TCG01		24/04/2005	TEKRON	20 Years	7.00	2025				
	H014-SSS-NBAY-TIMING7	GPS CLOCK TEKRON TCG01-D:1		22/03/2011	TEKRON	20 Years	4.50	2031				
	H014-SSS-NBAY-TIMING8	GPS CLOCK - TEKRON TCG01		24/04/2005	TEKRON	20 Years	7.00	2025				
	H014-SSS-NBAY-TWFL	FAULT LOCATOR HATHAWAY TWS 5 CIRCUIT		11/06/2010	HATHAWAY	20 Years	4.40	2025				
Note	The physical disconnect terminals for CT circuits for marshalling kiosks need to be replaced to mitigate CT open circuit risks with major secondary system replacement according to SU0031 New Physical Disconnect Terminals for CT Circuits. Option such as in-situ or new replacement for the marshalling kiosk depends on required duration of primary plant outage.											

6. Recommendations

Based on the condition assessment, the main recommendations for the replacement of secondary systems equipment at H014 Middle Ridge are:-

1. Replace all secondary systems for 110kV 1 and 2 Cap and relocate all secondary systems in the control building by 2023

2. Conduct following replacements by 2025:-
   - Replace the physical disconnect terminals of CT circuits on marshalling kiosks including
     - =KC1 and =KC2 - 275kV bus zones
     - Diameter =C1 – 275kV coupler 501, 2 Transformer and 3 Transformer
     - Diameter C2 – 275kV coupler 502, 1 Transformer and Feeder 831
     - Diameter =C3 - 275kV coupler 503, 4 Transformer (excluding Feeder 8848)
     - =KD1, =KD2 and =KD3 = 110kV bus zones
     - 110kV bus coupler 401, 402 and 403
     - 110kV 1 Transformer
     - 110kV Feeder 711 (Bay Spare 5), 7233, 7234, 727, 731, 732, 733, 735 (except Feeder 7348)
   - Replace marshalling cubicle for 2T and 3T 110kV and associated control cables
   - Replace all secondary systems for 330kV/275kV 4 Transformer and the protection and control panel
   - Replace all secondary systems for 330kV Feeder 9908 and the protection and control panel
   - Replace all secondary systems for 275kV 1 and 2 bus including associated protection and control panels
   - Replace all secondary systems for 275kV bus coupler 501, 502, 503 and associated protection and control panels
   - Replace all secondary systems for 1T, 2T and 3T 275kV and associated protection and control panels
   - Replace all secondary systems for 275kV Feeder 831 and the protection and control panel
   - Replace all secondary systems for 110kV 1, 2 and 3 bus including associated protection and control panels
   - Replace all secondary systems for 110kV bus coupler 401, 402 and 411 and associated protection and control panels
   - Replace all secondary systems for 1T, 2T and 3T 110kV and associated protection and control panels
   - Replace all secondary systems for 110kV Feeder 711 (Bay Spare 5), 7233, 7234, 727, 731, 732, 733, 735, 7348 and the protection and control panel
   - Replace all Comms and common RTU in building +5, +6, +7 and +8
   - Replace all SCADA RTU for 330/275KV and 110kV and upgrade the DNP serial to DNP over IP
   - Replace [redacted] Workstation
   - Replace all OpsWAN equipment (including all OpsWAN cameras) in the brick building, +5, +6, +7 and +8
   - Replace timing clock for Building +6 and +8
   - Replace energy metering equipment for Feeder 727 and migrate to IP based metering
   - Migrate the rest of meters to IP based meters
   - Replace the existing traveling wave based fault locator for feeder 9907 and 9908 with an approved new unit such as [redacted]

3. Carry out following replacements by 2027:-
   - Replace the physical disconnect terminals of CT circuits on marshalling kiosks including
     - Diameter =C4 – 275kV coupler 504, 5 Transformer and Feeder 8849
     - Bay =C3.1 – Feeder 8848
     - 110kV Feeder 728, 730, 734, 736
   - Replace all secondary systems for 330kV Feeder 9907 and the protection and control panel

- Replace all secondary systems for 330/275kV 5T and associated protection and control panels
- Replace all secondary systems for 275kV bus coupler 504 and the protection and control panels
- Replace all secondary systems for 275kV Feeder 8848, 8849 and the protection and control panel
- Replace all secondary systems for 110kV Feeder 728, 730, 734, 736 and the protection and control panel
- Replace metering equipment for Feeder 7234, 728, 733, 736, 7233, 730, 734, 735 and 7348
- Replace all 125VDC batter chargers in Building +6, +7 and +8
- Replace 48VDC battery banks

4. Carry out following replacements by 2032
   - Replace the physical disconnect terminals of CT circuits on marshalling kiosks including
     - 330kV 3 & 4 Cap
   - Replace all secondary systems for 330kV 3 & 4 Cap and associated protection and control panels
   - Replace timing clock for Building +7
   - Replace UP-2210 power quality monitoring
   - Replace GIC monitoring based on traditional DC transducers
5. Carry out following replacements by 2037
   - Replace High Speed Monitoring (HSM) IDM+
   - Replace GIC monitoring electronic devices based on flexible Optical CT

7. References

(1) National Electricity Rules (NER) Version 100, AEMC, 20/10/2017
(2) AM-POL-0463 Protection Design, Powerlink, 25/02/2014
(3) AM-POL-0970 Secondary Systems Design, Powerlink, 05/05/2009
(4) OSD - SCADA Requirements for Operational Purposes - Standard, Powerlink, 13/01/2016
(5) AM-POL-0169 Secondary Systems Maintenance Policy, Powerlink, 3/11/2008
(6) AM-POL-0053 AC and DC Supplies, Powerlink, 08/05/2014
(7) SU0031 New Physical Disconnect Terminal for CT Circuits, DTS, 22/11/2018
(8) SU0023 Clearance Requirements for Panels, Switchboard and Kiosks, ID&TS, 06/05/2016
(9) SU0020 Updates to SDM8 Panels to Mitigate Safety in Design Concerns (Obj. ID: A2753457), 09/2017
(10) SDM7 & SDM8 replacement investment strategy (A2975443), 30/04/2018

Planning Report	**7 January 2026**
Title	CP.02760 – H014 Middle Ridge Secondary Systems Replacement
Zone	South West
Need Driver	Emerging compliance risks arising from condition and obsolescence of Middle Ridge's ageing secondary systems.
Network Limitations and statutory requirements	Middle Ridge Substation is required to meet Powerlink Queensland's N-1-50MW/600MWh Transmission Authority reliability standards and maintain power transfer capability between the Bulli, South West and Moreton zones.
Pre-requisites	None

Executive Summary

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

Powerlink's 2025 Central scenario forecast confirms there is an enduring need to maintain electricity supply to the loads supplied from the Middle Ridge Substation. The removal or reconfiguration of the Middle Ridge 330/275/110kV Substation due to secondary system failure/obsolesce would violate Powerlink's N-1-50MW/600MWh Transmission Authority reliability standard and significantly impact the power transfer capability into South East Queensland.

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

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

Table of Contents

1. Introduction

The Middle Ridge 330/275/110kV Substation is located just south of Toowoomba and is a crucial transmission hub to connect the Bulli, South West and Moreton zones and to supply power to Toowoomba, Darling Downs, and nearby areas.

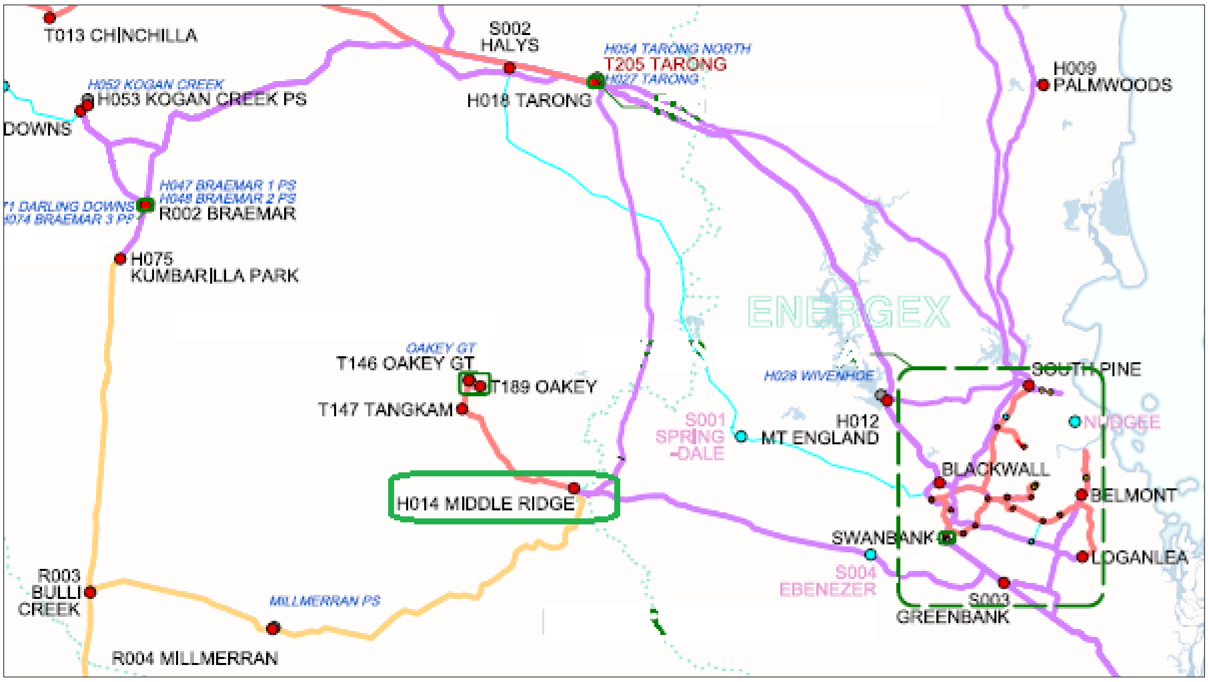


Figure 1. Middle Ridge Substation connects the Bulli, South West and Moreton zones

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

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

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

2. H014 Middle Ridge Substation configuration

As shown in Figure 2 the Middle Ridge Substation consists of:

1. Two 330kV transformer-ended feeders originating from Tummaville Substation.

2. The 275kV switchyard includes feeders that connect to Tarong and Greenbank substations, three 275/110kV transformers and two 330/275kV transformers.

3. The 110kV switchyard comprises 12 x 110kV connections that provide supply to the Toowoomba and Granite Belt areas, as well as connections extending to the west of Ipswich.

4. The associated 110kV network also connects synchronous generators such as the Oakey Power Station (288MW) and the embedded non-scheduled Daandine Power Station (30MW). Approximately 275MW of semi-scheduled embedded solar farms are also connect via the 110kV network (Oakey 1, Oakey 2, Yarranlea, Warwick, and Marybrorough).

[redacted]

Figure 2. Existing connection configuration of the Middle Ridge Substation and connecting network.

3. Middle Ridge Demand Forecast

The Middle Ridge Substation supplies Energy Queensland's (EQL) 110kV loads via three 275/110kV transformers.

Figure 3 shows that the maximum demand of the loads supplied from the Middle Ridge Substation. The peak load is not expected to change materially in coming years.

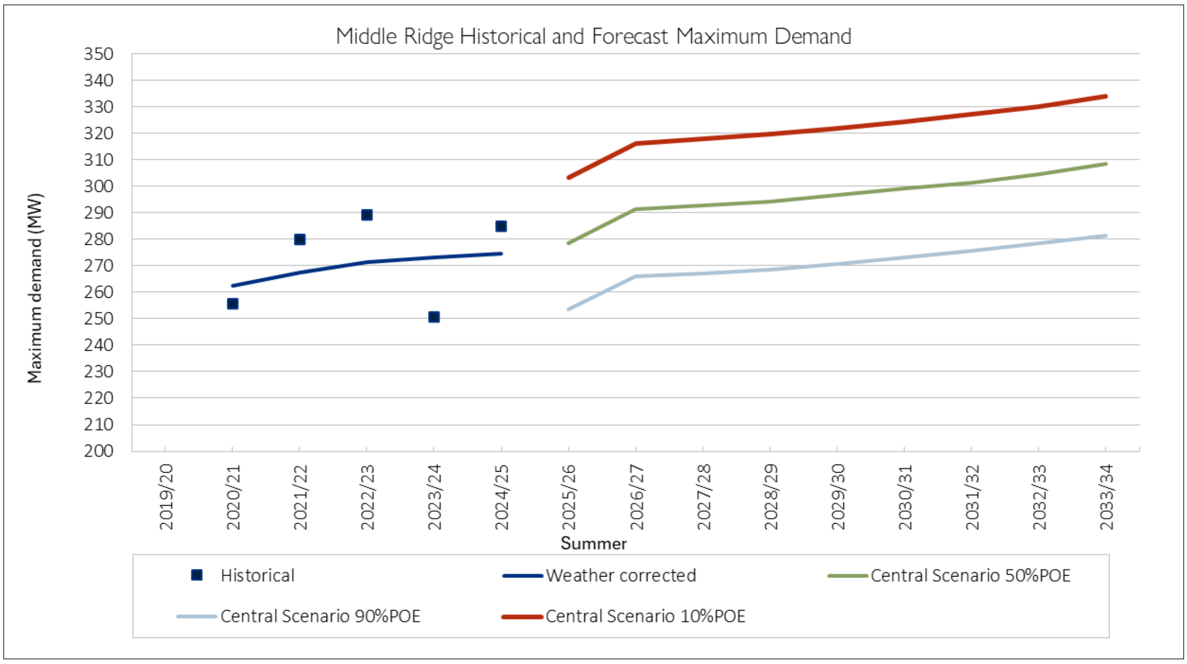


Figure 1. Historical and forecast demand for Middle Ridge 110kV

With consideration of rooftop PV within the EQL network supplied from Middle Ridge Substation, the maximum customer load is significantly higher. Figure 4 shows that rooftop PV meets up to approximately 150MW of underlying demand. The difference between underlying load and delivered load is on average 112MW during summer.

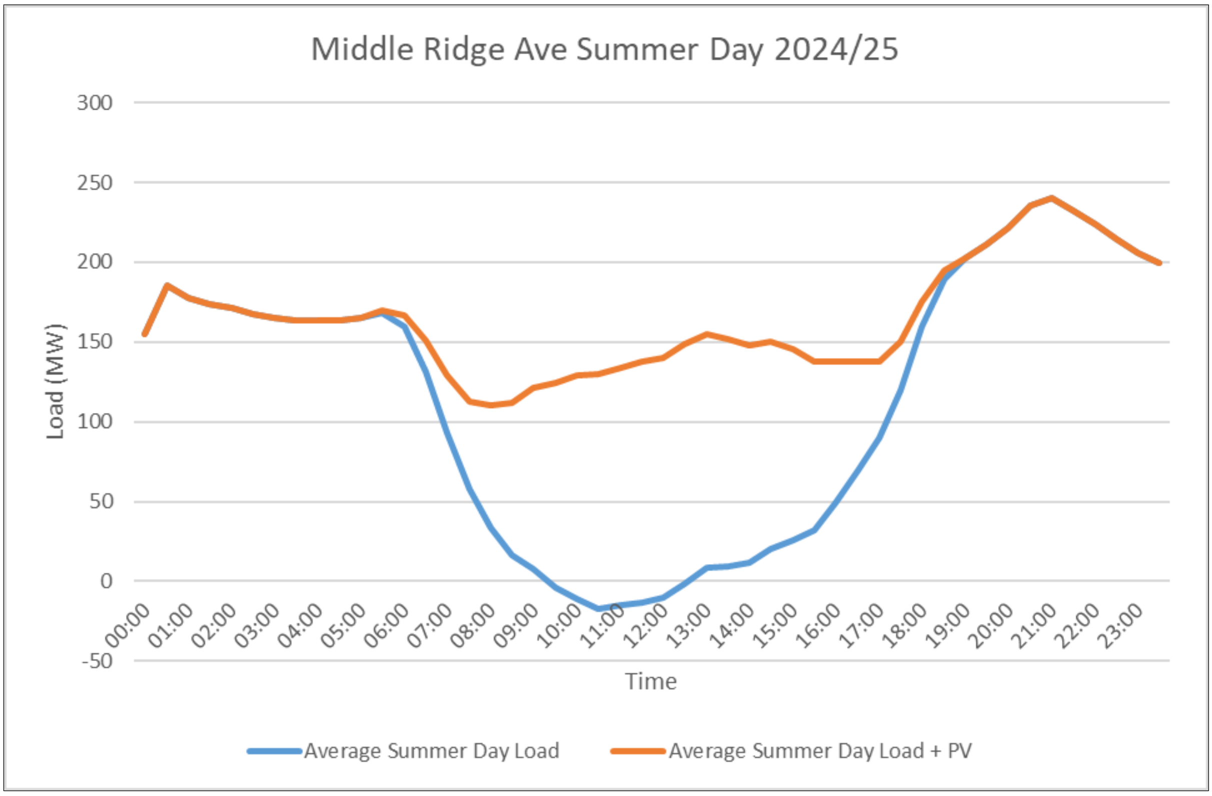


Figure 4. Average Rooftop PV during Summer 24/25

Figure 5, shows the historical load duration curve of the Middle Ridge 110kV.

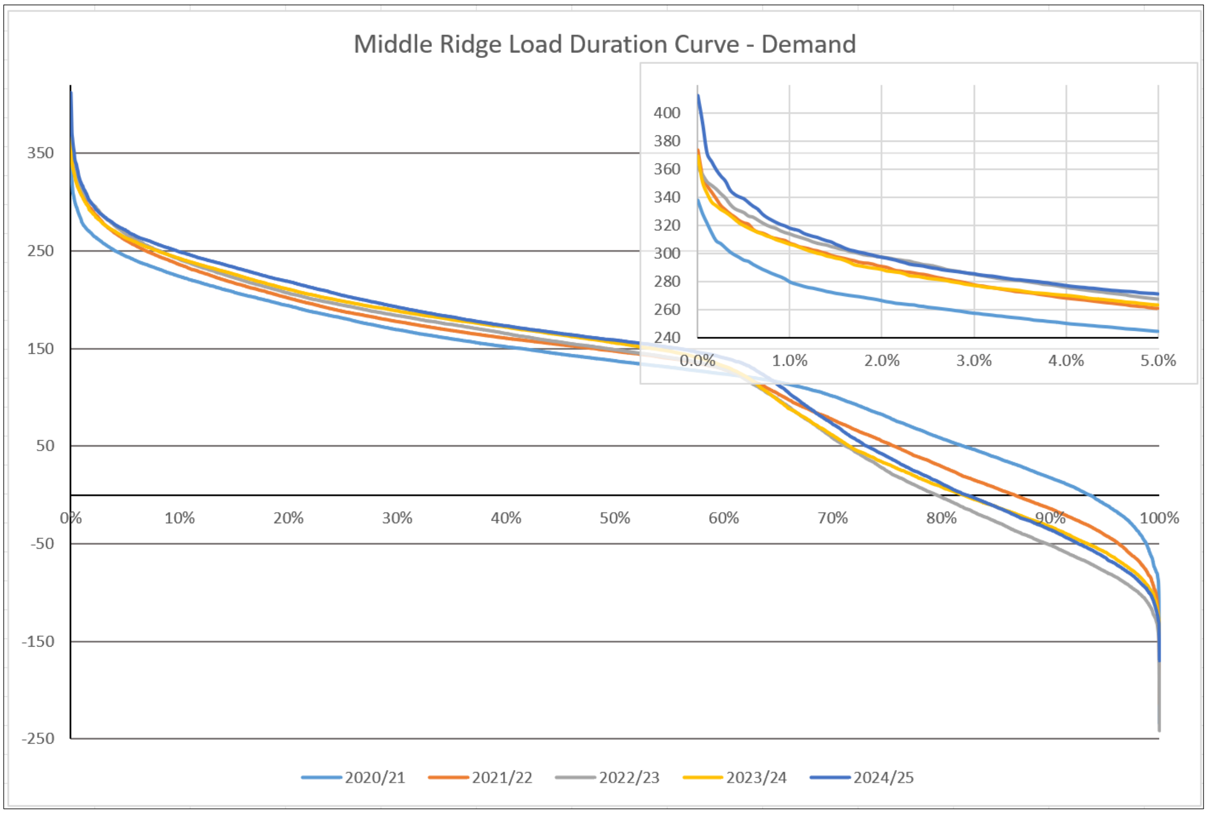


Figure 5. Load Duration Curve for Middle Ridge 110kV

There are no new large block loads committed in the Middle Ridge area for the Central scenario forecast.

4. Statement of Investment Need

The Middle Ridge Substation is a major bulk supply point for Energy Queensland loads in the South West zone. Therefore, addressing the risks arising from the condition of the secondary systems by removing the functionality of the Middle Ridge Substation would have a major impact on:

- the reliability of supply to the loads in the South West zone (including Tangkam, Postman Ridge, Torrington, Yarranlea, Warwick, Toowoomba, and Kearney Springs
- local generation connected via the 110kV network, and
- the power transfer capability between the Bulli, South West and Moreton zones[2].

[2] The through-flow between Tummaville and Greenbank substations could still be maintained, despite challenges related to energising a long 330/275kV line (approximately 200km) and ensuring adequate 330/275kV transformer protection. However, this approach would not allow for meeting the load supplied from Middle Ridge, as it would rely on a single 275kV line from Tarong.

Therefore, replacement of the secondary systems at Middle Ridge Substation is required to allow continued operation of the substation and avoid system failures that would result in loss of load exceeding Powerlink's N-1-50MW / 600MWh Transmission Authority reliability standard. There would also be impact to the capability to transfer power between Bulli, South West and Moreton zones.

5. Network Risk

Table 1 summarises the results of analysis to determine the load and energy at risk for loads connected to the Middle Ridge Substation at 110kV. The estimates take into account the expected level of rooftop PV connected to the Ergon Energy network supplied from Middle Ridge.

Table 1. Middle Ridge 110kV Load at Risk

Load at Risk	Contingency Event	Quantity	2034-35
Middle Ridge(1) (2)	275/110kV Transformer (1T and 2T) or (T2 and T1) 275/110kV Transformer (1T and 3T) or (T3 and T1)	Max (MW)	97
		Average (MW)	1.9
		24h Energy Max (MWh)	432
		24h Energy Average (MWh)	44
Middle Ridge(1) (2)	275/110kV Transformer (2T and 3T) or (3T and 2T)	Max (MW)	47
		Average (MW)	0.1
		24h Energy Max (MWh)	138
		24h Energy Average (MWh)	1.2
Tangkam	731 sec sys and outage of 732 caused by (732 trip or sec sys) 732 sec sys and outage of 731 caused by (731 trip or sec sys)	Max (MW)	94
		Average (MW)	33
		24h Energy Max (MWh)	1260
		24h Energy Average (MWh)	790
Torrington	7233 sec sys and outage of 7234 caused by (7234 trip or sec sys) 7234 sec sys and outage of 7233 caused by (7233 trip or sec sys)	Max (MW)	210
		Average (MW)	73
		24h Energy Max (MWh)	2850
		24h Energy Average (MWh)	1760
Yarranlea	733 sec sys and outage of 734 caused by (734 trip or sec sys) 734 sec sys and outage of 733 caused by (733 trip or sec sys)	Max (MW)	36
		Average (MW)	8.4
		24h Energy Max (MWh)	510
		24h Energy Average (MWh)	202
Toowoomba and Kearney Spring	730 sec sys and outage of 728 caused by (728 trip or sec sys)	Max (MW)	233
		Average (MW)	71
		24h Energy Max (MWh)	3360

	728 sec sys and outage of 730 caused by (730 trip or sec sys)	24h Energy Average (MWh)	1700
Warwick and Stanthorpe	735 sec sys and outage of 736 caused by (736 trip or sec sys) 736 sec sys and outage of 735 caused by (735 trip or sec sys)	Max (MW)	113
		Average (MW)	31
		24h Energy Max (MWh)	1335
		24h Energy Average (MWh)	730
Postman Ridge and Gatton	727 sec sys and outage of 7348 caused by (7348 trip or sec sys) 7348 sec sys and outage of 727 caused by (727 trip or sec sys)	Max (MW)	97
		Average (MW)	30
		24h Energy Max (MWh)	1310
		24h Energy Average (MWh)	735
Lockrose and Wulkuraka QR	727 sec sys and trip of 7259 7348 sec sys and trip of 7259 330/275kV 4T sec sys and trip of 7259 330/275kV 5T and trip of 7259	Max (MW)	168
		Average (MW)	46
		24h Energy Max (MWh)	1875
		24h Energy Average (MWh)	1105
Gatton BS	727 sec sys and trip of 726 7348 sec sys and trip of 726 330/275kV 4T and 726 330/275kV 5T and 726	Max (MW)	68
		Average (MW)	24
		24h Energy Max (MWh)	935
		24h Energy Average (MWh)	575

Notes:

(1) 1T may be taken out-of-service due to the failure of secondary systems associated with the following bays – 275kV 541, 110kV 441
2T may be taken out-of-service due to the failure of secondary systems associated with the following bays – 275kV 542, 110kV 442
3T may be taken out-of-service due to the failure of secondary systems associated with the following bays – 275kV 543, 110kV443

(2) A corresponding trip of one of the remaining two 275/110kV transformers can be caused by one of the following – Transformer trip, 110kV or 275kV associated secondary systems failure

Consideration has been given to the possible market impact if there is a secondary systems failure associated with either of the 330/275kV transformers at Middle Ridge. This is shown in Appendix A.

The estimated cost of the market impact is not material and recommended not to be included in the network risk cost assessment.

6. Non-Network Options

The Middle Ridge 330/275/110kV Substation is essential for ensuring reliable electricity supply to the Toowoomba and Darling Downs regions, as well as supporting necessary power transfers between South West and Moreton zones.

Consequently, no feasible non-network alternatives have been identified.

To reduce the scope of this project, any viable non-network solutions should be capable of supplying individual 110kV Middle Ridge loads as identified (refer to table 1).

Powerlink is not aware of any Demand Side solutions (DSM) in the area supplied by Middle Ridge Substation. However, Powerlink will consider any proposed solution that can contribute significantly to the requirements of ensuring that Powerlink continues to meet its required reliability of supply obligations as part of the formal RIT-T consultation process prior to project approval.

7. Network Options

7.1 Proposed Option to Address Identified Need

As validated in Table 1 there is an enduring need for all 110kV feeder connections and 275/110kV transformer connections to reliably supply the Ergon Energy loads. In addition, the 110kV network connects a number of generators as outlined in Section 2.

There are 2 x 50MVAr capacitor banks connected to the 110kV bus. Both capacitor banks are regularly switched the provide local voltage support during high load conditions and support reactive power losses during higher transfers between South West and Moreton zones.

The only opportunity to optimise the scope of the secondary systems project is in relation to the Tarong to Middle Ridge 275kV feeder (831). This 275kV line is not required for Powerlink to meets its reliability obligations. However, removal of this line does increase the network losses. A play-back of historical snapshots show that these losses may be valued at between $200k to $400k per annum. This is greater than the annualised cost of the secondary system component. There have also been enquiries to connect wind farms and a pumped hydro energy system (Big T PHES) to this feeder.

Therefore, to address the emerging age and obsolescence of the Middle Ridge Substation secondary systems it is recommended that all 330kV, 275kV, and 110kV secondary systems be replaced.

This ensures that Powerlink’s Transmission Authority reliability standard is maintained, while also preserving the power transfer capability between South West and Moreton zones.

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

7.2 Option Considered but Not Proposed

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

7.2.1 Do Nothing

"Do Nothing" would not be an acceptable option as the primary driver (secondary systems condition and obsolescence) and associated safety, reliability and compliance risks are not addressed.

Furthermore, the "Do Nothing" option would not be consistent with good industry practice and would result in Powerlink breaching their obligations with the requirements of the System Standards of the National Electricity Rules and its Transmission Authority.

8. Recommendation

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

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

Retaining the Middle Ridge Substation capacity and functionality will allow Powerlink to continue to meet its required reliability obligations (N-1-50MW/600MWh) and maintain the power transfer capability between Bulls, South West and Moreton zones.

9. References

1. H014 Middle Ridge Secondary Systems Condition Assessment Report – March 2019
2. 2025 Transmission Annual Planning Report (A6049612)
3. Asset Planning Criteria - Framework (ASM-FRA-A2352970)
4. Powerlink Queensland's Transmission Authority T01/98

10. Appendix A

Figure A.1 shows the forecast levels of power transfer across the Tarong grid section.

If either 4T or 5T is removed from service due to a secondary system failure, then AEMO will need to configure and operate the network to be secure for the next event. The critical contingency to be covered is an outage of the remaining parallel 330kV transformer ended line between Tummaville and Middle Ridge. This will require AEMO to open the 275kV line between Middle Ridge and Tarong (831) and open the 110kV Ergon Energy feeder between Lockrose and Gatton (7289).

The power transfer across the Tarong grid section would then have to be managed to land *satisfactory* with only the five 275kV circuits from Tarong in-service[3]. However, these five circuits (together with the two 275kV circuits between Woolooga and South Pine and local SEQ generation) would need to supply the Moreton and South West Queensland loads, as Middle Ridge is back fed from the Greenbank Substation.

The corresponding time-sequential data (of Figure A.1) has been analysed to determine the maximum and average generation to be constrained and the maximum and average energy per day of this constraint. This constraint energy has been costed at $xxx/MWh (refer to Table A.1)

Table A.2 considers the market impact following the outage of the parallel 330kV transformer ended feeder at Middle Ridge and the redispatch required by AEMO to again resecure the network. This would require the power transfers across the Tarong grid section to be further reduced (approximately 4000MW). There may be other limitations within SEQ (e.g. power transfers between Blackwall and South Pine and/or Tennyson and West End) that may require load reductions. This has been ignored in the analysis.

What has also been assumed in the analysis is that there is sufficient CQ-SQ power transfer headroom (and available generation in CQ and NQ) to meet the level of redispatch required to resecure the system. If this was not available, then further pre-contingent (i.e. after the outage of both 330kV lines into Middle Ridge) would be required.

[3] Voltage stability limits the maximum power transfer to 5000MW

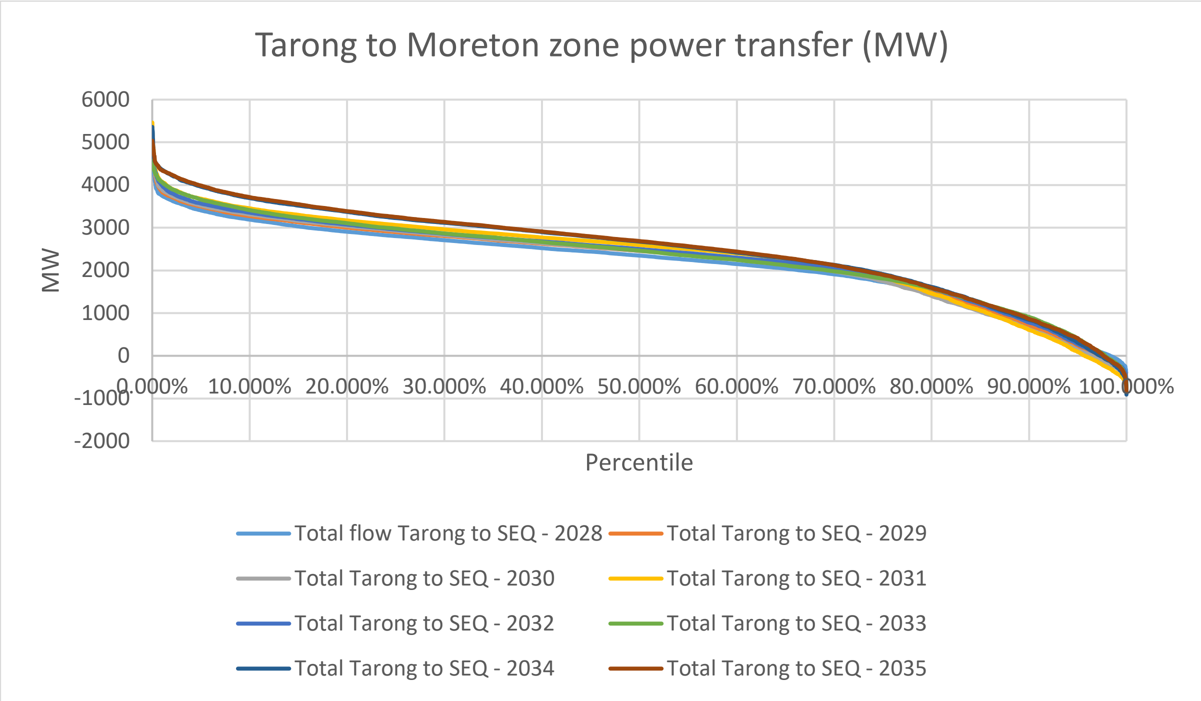


Figure A.1 Tarong to SEQ power transfer (MW) with both 330kV lines into Middle Ridge out-of-service

Table A.1 Market Impact of the initial failure of secondary systems

Contingency Event	**N-1**	
Secondary systems failure 330/275kV 4T	Max (MW)	465
	Average (MW)	0.12
	24h Energy Max (MWh)	925
	24h Energy Average (MWh)	3.0
	Differential cost of replacement energy ($/MWh)	
Secondary systems failure 330/275kV 5T	Max (MW)	465
	Average (MW)	0.12
	24h Energy Max (MWh)	925
	24h Energy Average (MWh)	3.0
	Differential cost of replacement energy ($/MWh)	

Table A.2. Market Impact of the initial failure of secondary systems followed by a second outage

Contingency Event	N-1 secure	
330/275kV 4T and 330/275kV 5T (9907)	Max (MW)	1465
	Average (MW)	4.0
	24h Energy Max (MWh)	6640
	24h Energy Average (MWh)	95
	Differential cost of replacement energy ($/MWh)	
330/275kV 5T and 330/275kV 4T (9908)	Max (MW)	1465
	Average (MW)	4.0
	24h Energy Max (MWh)	6640
	24h Energy Average (MWh)	95
	Differential cost of replacement energy ($/MWh)	

Project Scope Report

CP.02760

Middle Ridge Secondary Systems Replacement

Concept – Version 1

Document Control

Change Record

Issue Date	Revision	Prepared by	Reviewed by	Approved by	Background
4/06/2025	1	[redacted]	[redacted]	[redacted]	Preliminary scope

Related Documents

Issue Date	Responsible Person	Objective Document Name
29/3/2019	[redacted]	A3103391 PIF - H014 Middle Ridge Secondary System Replacement - Project initiation Form
28/03/2019	[redacted]	A3073040 H014 Middle Ridge Secondary Systems Condition Assessment Report March 2019
31/1/2024	[redacted]	A2753457 SU0020 Updates to SDM8 Panels to Mitigate Safety in Design Concerns
06/05/2016	[redacted]	A3003503 SU0031 New Physical Disconnect Terminals for CT Circuits.

Document Purpose

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

Project Contacts

Project Sponsor	[redacted]
Connection & Development Manager	[redacted]
Strategist – HV/Digital Asset Strategies	[redacted]
Planner – Main/Regional Grid	[redacted]
Manager Projects	TBC
Project Manager	TBC
Design Manager	TBC

Project Details

1. Project Need & Objective

H014 Middle Ridge substation is a 330/275/110kV transmission substation located at the southern Queensland transmission network and is a major node in the wider interconnected network supplying power to Southern Queensland. The substation consists of a 330kV, 275kV and 110kV yard, with two 330/275kV transformers, three 275/110kV transformers and 330kV capacitor banks.

A secondary systems condition assessment concluded that secondary systems for 330kV, 275kV and 110kV network will reach the end of its technical asset life from 2025 to 2032. As a result, it is recommended to replace these systems to mitigate risks including unavailability of spare parts, lack of technical support and declining condition of equipment causing decreased reliability.

The secondary systems at Middle Ridge are housed in SDM7/8 type swing frame panels. There are safety concerns with these types of panels, such as isolation issues and risks of terminations falling loose. Updates on the panels are required as part of a major secondary system replacement in accordance with SU0020 Updates to SDM8 Panels to Mitigate Safety in Design Concerns.

The secondary systems for 110kV 1 and 2 Capacitor bank were installed in 2002. They are located within air-conditioned control cubicles in the switching yard. Due to the harsh working environment, the cubicles have high rates of failures. These will be replaced into the control building as part of the secondary systems replacement.

The marshalling kiosks and associated control cables for 2 and 3 Transformer 110kV side were installed in 1987. The Utilux terminals in the marshalling kiosks are showing signs of embrittlement. The fuses utilised within these marshalling kiosks do not provide safety and monitoring features and make event investigations difficult. These bay marshalling kiosks and associated cables need to be replaced.

The objective of this project is to replace the secondary systems at H014 Middle Ridge by 31st October 2032.

2. Project Drawing

[redacted]

Figure 1: H014 Middle Ridge operating diagram

[redacted]

Figure 2: H014 Middle Ridge Site General Arrangement

3. Deliverables

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

1. A report (e.g. Concept Estimate Report) detailing the works to be delivered, high level staging, resource requirements and availability, and outage requirements and constraints;
2. A class 5 estimate (minimum);
3. Any existing assets to be removed and disposed of as part of this scope identified within the Proposal together with the forecast asset write off amounts at time of disposal; and
4. A basis of estimate document and risk table, detailing the key estimating assumptions and delivery risks.

4. Project Scope

4.1. Original Scope

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

Briefly, the project consists of the replacement of the 330kV, 275kV, and 110kV secondary systems at H014 Middle Ridge substation.

4.1.1. Transmission Line Works

Not applicable

4.1.2. H014 Middle Ridge Substation Works

Design, procure, construct and commission replacement of the 330kV, 275kV, and 110kV secondary systems. Within the scope of work:

- Replace all secondary systems and associated protection relays within the existing control buildings for the following bays:
  - 110kV 1, 2 and 3 Bus
  - 110kV Bus Coupler 401, 402 and 411
  - 110kV Feeders 7233, 7234, 727, 731, 732, 733, 735, 7348, 728, 730, 734, 736
  - 110kV Spare Bay 5
  - 110kV 1 and 2 Cap
  - 275kV 1 and 2 Bus
  - 275kV Bus Coupler 501, 502, 503 and 504
  - 275/110 kV Transformers 1T, 2T and 3T
  - 275kV Feeder 831, 8848, 8849
  - 330kV Feeder 9907 and 9908
  - 330kV/275kV transformers 4T and 5T
  - 330kV 3 and 4 Cap

- Install new WAMPAC panel to trip Ergon radial loads as part of the CQSQ WAMPAC scheme;

- Replace 110kV marshalling cubicles and associated control cables for 275/110kV transformers 2T and 3T;

- Replace the physical disconnect terminals of CT circuits on marshalling kiosks including:
  - 110kV Bus Coupler 401, 402 and 411
  - 110kV 1 Transformer
  - 110kV Feeder 7233, 7234, 727, 731, 732, 733, 735, 728, 730, 734, 736 (except Feeder 7348)
  - 110kV Spare Bay 5
  - =KC1 and =KC2 275kV Bus Zones
  - Diameter =C1 – 275kV coupler 501, 2 Transformer and 3 Transformer
  - Diameter =C2 – 275kV coupler 502, 1 Transformer and Feeder 831
  - Diameter =C3 - 275kV coupler 503, 4 Transformer and Feeder 8848
  - Diameter =C4 – 275kV coupler 504, 5 Transformer and Feeder 8849
  - =KD1, =KD2 and =KD3 110kV Bus Zones
  - 330kV 3 and 4 Cap

- Associated switchyard civil works including new cable trenches as appropriate;

- Replace all SCADA RTU for 330kV, 275KV and 110kV and upgrade the DNP serial to DNP over IP;

- Replace all Comms and common RTU in buildings +5, +6, +7 and +8;

- Replace timing clocks for Buildings +6, +7 and +8;
- Replace all OpsWAN equipment (including all OpsWAN cameras) in the brick building, +5, +6, +7 and +8;
- Replace 125VDC battery banks and chargers;
- Replace 48VDC battery banks;
- Replace [redacted]
- Replace metering equipment for Feeder 727, 7234, 728, 733, 736, 7233, 730, 734, 735 and 7348 and migrate to IP based metering;
- Replace the existing traveling wave based fault locator for feeder 9907 and 9908 with an approved new unit such as [redacted]
- Replace power quality monitoring and high speed monitoring equipment
- Replace GIC monitoring and integrate into new control system
- Review suitability of 415VAC supplies and upgrade as required;
- Modify and upgrade telecommunications equipment as required to support the new secondary systems;
- Upgrade fire and security systems as required to incorporate the new control buildings
- Decommission and recover all redundant equipment, and update drawing records, SAP records, config files, etc. accordingly

4.1.3. Substation Works – Remote Ends

Modification of protection, control and communications systems at the remote ends as required to accommodate the new secondary systems at H014 Middle Ridge.

4.1.4. Telecoms Works

As per Section 4.1.2. Telecommunications works to be coordinated with CP.02813 Telecommunication Network Consolidation RAN 4 and CP.02822 OpsWAN and MPLS Replacement RAN 4.

4.1.5. Easement/Land Acquisition & Permits Works

Not applicable

4.2. Key Scope Assumptions

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

- The in-panel replacement methodology currently being utilised under CP.02929 T160 Sumner Secondary Systems Replacement is to be assumed for estimation purposes. This approach will need to be confirmed by the design team prior to project execution.
- Control cables do not require replacement except as outlined in section 4.1.2.
- Access to perform works will be unimpeded and coordinated around the ABB IMB300 CT replacement works
- Telecommunications works under CP.02813 Telecommunication Network Consolidation RAN 4 and CP.02822 OpsWAN and MPLS Replacement RAN 4 will need to be coordinated with this project.

4.3. Variations to Scope (post project approval)

Not applicable

5. Key Asset Risks

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

6. Project Timing

6.1. Project Approval Date

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

6.2. Site Access Date

H014 Middle Ridge Substation is an existing Powerlink site and access is available immediately.

6.3. Commissioning Date

The latest date for the commissioning of the new assets included in this scope is 30 June 2032.

7. Special Considerations

H014 Middle Ridge Substation is one of the sites under CP.03107 Replace 275kV ABB IMB CTs – Metro. Overlapping impacts to access and delivery should be considered in the planning phases of this project.

In-panel replacement has been identified as a possible option for H014 Middle Ridge Substation (refer ETR10528572). This option should be further explored and compared against a full replacement as part of the project development phase.

Marshalling kiosks and associated control cables were installed in the mid 2000s and are in fair condition. No condition driven replacements are required until 2040.

8. Asset Management Requirements

Equipment shall be in accordance with Powerlink equipment strategies.

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

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

9. Asset Ownership

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

10. System Operation Issues

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

- interaction of project outage plan with other outage requirements;
- likely impact of project outages upon grid support arrangements; and
- likely impact of project outages upon the optical fibre network.
- There may be Restricted Access Zones in place for any [redacted] at H014 Middle Ridge Substation yet to be replaced under [redacted]

11. Options

Not applicable

12. Division of Responsibilities

Not applicable.

13. Related Projects

Project No.	Project Description	Planned Comm Date	Comment
Pre-requisite Projects			
CP.02929	Sumner Secondary Systems Replacement	Nov 25	In panel replacement methodology to be proven under this project
Co-requisite Projects			
Other Related Projects			
CP.03107	Replace 275kV ABB IMB300 CTs - Metro	June 2033	Works to be coordinated
CP.02813	Telecommunication Network Consolidation RAN4	June 2032	Works to be coordinated
CP.02822	OpsWAN and MPLS Replacement RAN3	June 2032	Works to be coordinated

CP.02760 Middle Ridge Secondary Systems Replacement

Concept Estimate

Table of Contents

1. Executive Summary

This concept estimate has been developed based on the CP.02760 H014 Middle Ridge Secondary Systems Replacement PSR.

H014 Middle Ridge substation is a 330/275/110kV transmission substation located at the Southern Queensland transmission network and is a major node in the wider interconnected network supplying power to Southern Queensland. The substation consists of a 330kV, 275kV and 110kV yard, with two 330/275kV transformers, three 275/110kV transformers, 330kV capacitor banks and 110kV capacitor banks.

A secondary systems condition assessment concluded that secondary systems for 330kV, 275kV and 110kV network will reach the end of its technical asset life by 2032. As a result, it recommends replacing these systems to mitigate risks, including unavailability of spare parts, lack of technical support and declining condition of equipment causing decreased reliability.

The secondary systems at Middle Ridge are housed in SDM7/8 type swing frame panels. There are safety concerns with these types of panels, such as isolation issues and risks of terminations falling loose. Updates on the panels are required as part of a major secondary system replacement in accordance with SU0020 Updates to SDM8 Panels to Mitigate Safety in Design Concerns.

The secondary systems for 110kV 1 and 2 Capacitor bank were installed in 2002. They are located within air-conditioned control cubicles in the switching yard. Due to the harsh working environment, the cubicles have high rates of failures. These will be replaced into the control building as part of the secondary systems replacement.

The marshalling kiosks and associated control cables for 2 and 3 Transformer 110kV side were installed in 1987. The Utilux terminals in the marshalling kiosks are showing signs of embrittlement. The fuses utilised within these marshalling kiosks do not provide safety and monitoring features and make event investigations difficult. These bay marshalling kiosks and associated cables will be replaced.

The assessment in this proposal has established that the project can be delivered by July 2032.

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

1.1 Project Estimate

No escalation costs have been considered in this estimate.

		Total ($)
Estimate Class	5	
Base Estimate – Un-Escalated (2025/2026)		62,447,923
TOTAL		**62,447,923**

1.2 Project Financial Year Cash Flows

No escalation costs have been considered in this estimate.

DTS Cash Flow Table	Un-Escalated Cost ($)
To June 2027	314,268
To June 2028	8,465,811
To June 2029	3,661,390
To June 2030	7,533,682
To June 2031	20,161,509
To June 2032	20,161,509
To June 2033	2,149,753
TOTAL	**62,447,923**

2. Project and Site-Specific Information

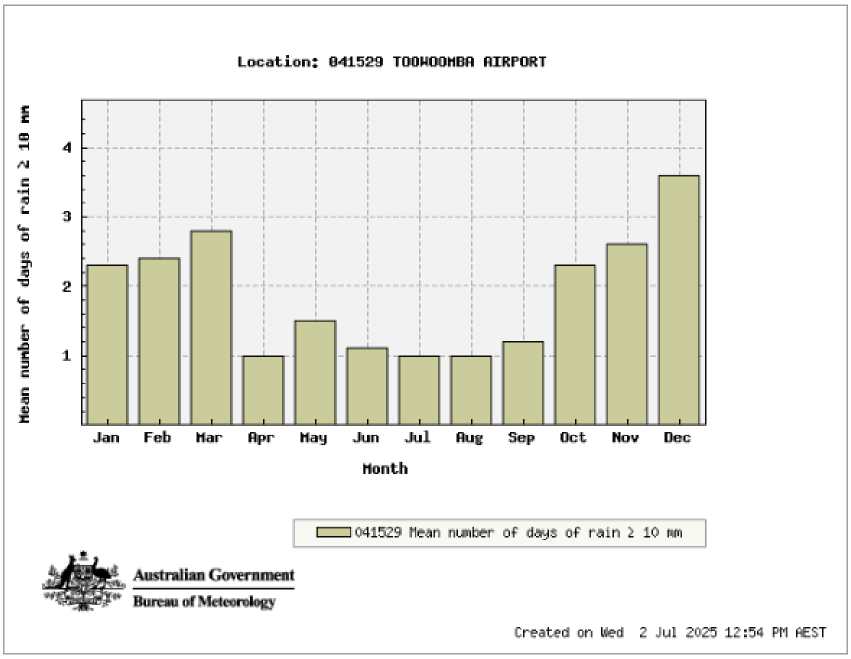
2.1 Project Dependencies & Interactions

This project is related to the following projects:

Project No.	Project Description	Planned Commissioning Date	Comment
Dependencies			
CP.02929	Sumner Secondary Systems Replacement	September 2026	First project to utilise the in-panel replacement methodology.
Interactions			
CP.02798	Middle Ridge Transformer 2 and 3 Replacement	June 2028	Middle Ridge Transformer Replacement
CP.02813	Telecommunications Network Consolidation RAN4	June 2032	SDH and PDH Multiplexer replacement program.
CP.02822	OpsWAN and MPLS Replacement RAN4	June 2032	OpsWAN and MPLS Router replacement program.
CP.02986	Trench CVT Replacement – South Phase 3	December 2027	Statewide CVT Replacement program.
CP.03107	Replace 275kV ABB IMB CTs – Metro	April 2029	Statewide CT Replacement program.
Other Related Projects			

2.2 Site Specific Issues

- H014 Middle Ridge substation is located on Ruthven Street, Kearneys Spring, south of Toowoomba. It is surrounded by residential areas and a Bushland Reserve.
- The substation consists of one yard of 330kV, 275kV and 110kV operating voltage enclosed by the one perimeter fence.
- Asbestos containing material (ACM) has been identified at H014 Middle Ridge substation throughout the existing brick building. Ensuring the ACM is maintained in a condition that prevents exposure may be compromised if major refurbishment works are undertaken within the building.
- There are [redacted] at H014 Middle Ridge which have invoked Restricted Access Zone(s) (RAZ) in the substation. The RAZ does not impact access to the H014 Middle Ridge Control Buildings, however access to the 275kV substation yard is restricted. An appropriate RAZ Works Plan will be required if the RAZ is not revoked by the time of works where access required. The [redacted] are planned to be replaced by September 2028 under CP.03107.
- The Toowoomba area is subject to the following average number of days of rain. Consideration was given to this when developing the project schedule.



Statistics	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Annual	Years
Mean number of days of rain ≥ 10 mm for years 1996 to 2025	2.3	2.4	2.8	1.0	1.5	1.1	1.0	1.0	1.2	2.3	2.6	3.6	22.8	29

Figure 1 - Number of Days of Rain >10mm Toowoomba (Source: Bureau of Meteorology 2nd July 2025)

3. Project Scope

The following works have been costed for in the estimate.

3.1 Substation Works

H014 Middle Ridge

Design, procure, construct and commission selective replacement of the 330kV, 275kV, and 110kV secondary systems.

- Replacement of the following secondary systems and associated protection relays within the existing control buildings for the following bays:
  - 110kV 1, 2 and 3 Bus
  - 110kV Bus Coupler 401, 402 and 411
  - 110kV Feeders 7233, 7234, 727, 731, 732, 733, 735, 7348, 728, 730, 734, 736
  - 110kV Spare Bay 5
  - 110kV 1 and 2 Capacitor Bank
  - 275kV 1 and 2 Bus
  - 275kV Bus Coupler 501, 502, 503 and 504
  - 275/110 kV Transformers 1T, 2T and 3T
  - 275kV Feeder 831, 8848, 8849
  - 330kV Feeder 9907 and 9908

  - 330kV/275kV transformers 4T and 5T
  - 330kV 3 and 4 Capacitor Bank
- Establishment of WAMPAC schemes to trip Ergon radial loads as part of the CQSQ WAMPAC scheme.
- Replace 110kV marshalling cubicles and associated control cables for 275/110kV transformers 2T and 3T.
- Replacement of the 110kV 1 and 2 Capacitor Bank Secondary Systems, moving them from the air-conditioned control cubicles in the switching yard to the control building.
- All Current Transformer (CT) link terminals associated with CT circuits, are to be replaced with a new physical disconnect terminal, as per Standards Update, SU0049.
- Replace all SCADA RTU for 330kV, 275KV and 110kV and upgrade the DNP serial to DNP over IP.
- Replace all Comms and common RTU in buildings +5, +6, +7 and +8.
- Replace timing clocks for Buildings +6, +7 and +8.
- Replace all OpsWAN equipment (including all OpsWAN cameras) in the brick building, +5, +6, +7 and +8.
- Replace 125V DC battery banks and chargers.
- Replace 48V DC battery banks.
- Replace [redacted]
- Replace metering equipment for Feeder 727, 7234, 728, 733, 736, 7233, 730, 734, 735 and 7348 and migrate to IP based metering.
- Replace the existing travelling wave-based fault locator for feeder 9907 and 9908 with an approved new unit such as SEL-T400L.
- Replace power quality monitoring and high speed monitoring equipment.
- Replace GIC monitoring and integrate into new control system.
- Review GIC monitoring and integrate into new control system.
- Review suitability of 415V AC supplies.
- Upgrade fire and security systems.
- Decommission and recover all redundant equipment.
- Update drawing records, SAP records, config files, etc. accordingly.

Remote Ends

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

- Feeders 8848 & 8849 from S003 Greenbank substation.
- Feeder 831 from H018 Tarong substation.
- Feeder 9907 & 9908 from R014 Tummaville substation.
- Feeder 732 & 731 from T147 Tangkam substation.
- At the following Energy Queensland substations (free-issue of secondary systems relays).
  - SST29 Postmans Ridge
  - T010 Yarranlea
  - T043 South Toowoomba
  - T058 Warwick
  - T116 Torrington

- T167 Kearneys Spring
- T243 Yarranlea North

[redacted]

Figure 2 - Line Diagram of H014 Middle Ridge Substation

3.2 Telecommunication Works

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

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

3.3 Major Scope Assumptions

The following key assumptions were made for this Project Estimate.

- Minor Secondary Systems works only is expected to integrate the remote end substation with the new H014 Middle Ridge Secondary Systems. All works at the remote end substations will be completed by MSP.
- Powerlink Internal Design teams and Design Services Panel will be used to carry out the design work.
- Estimate is based on Powerlink architectures, standards and equipment in place and available at the time of development.
- H014 Middle Ridge [redacted] will be replaced, revoking the Restricted Access Zones, prior to work starting on the site.
- No further Restricted Access Zone will be deployed on this site during construction.
- Outages will be available as being request. Please refer to Section 4.2 Network Impacts for further details.
- MSP resources will be available to complete the works.
- Procurement of required equipment aligns with project delivery requirements.
- Energy Queensland Design and construction resources will be available when required for remote end works. Timely agreement of Division of Responsibility (DOR) between Energy Queensland and Powerlink for all the works involved.

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

- Design standard of the new secondary systems will be of SDM9.3.
- The In-panel Replacement Methodology will be accepted as the delivery method for this project, this will be further explored as part of the project development phase.
- There will be space within the existing control buildings to house panels as required for WAMPAC schemes and Power Monitoring.
- Sufficient space within the existing Control Buildings for In-Situ replacement of the substation secondary systems.
- Field cables do not require replacement except as outlined in Section 3.1 (Transformer cables).
- New termination racks will not be installed.
- Bay kiosks to be re-used except as outlined in Section 3.1 (Transformer marshalling cubicles).
- AC Changeover Board is fit for purpose and will be re-used.
- New relays considered for the upgrade of the remote sites will be suitable for the customer’s needs and requirements.

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

- A bench extension is not required.
- The existing substation platform and yard drainage system drains freely and is fit for purpose.
- The existing internal substation road is fit for purpose.
- Drainage for any new pits shall be provided into the existing drainage system or off the substation platform.
- Existing building structures are suitable for any new loads due to the secondary system replacement.

3.4 Scope Exclusions

- Easement acquisitions work, including permits, approvals, development applications or the like. All works are within Powerlink-owned land.
- No allowance is included for any Energy Queensland projects that may impact Powerlink works.
- Additional time and cost for Design, Planning and Implementation of any restoration plans required for outages is not included in this estimate.
- No major modification to the earth grid is included in this estimate.
- Remove rock or unsuitable material, including asbestos and other contaminants.
- This estimate does not include any costs for repairing or modification to the primary plants not listed to be replaced under the scope. That also includes the replacement of bushing CTs on [redacted] circuit breakers, breaker's control cubicles and associated CT links.
- No modification and upgrading the internal roads, lights, fences and gates.
- No modification on the existing transmission lines is considered in this estimate.
- No allowance has been made for Live Substation work.

4. Project Execution

4.1 Project Schedule

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

A high-level Project Schedule has been developed for the project stages:

Milestones	High-Level Timing
Request for Class 5 Estimate	November 2026
Class 5 Project Proposal Submission	January 2027
Request for Class 3 Estimate	March 2027
Class 3 Project Proposal Submission	September 2027
Stage 1 Approval (PAN1) includes funds for design & procurement	November 2027
RIT-T (assumed 26 weeks)	December 2027 – June 2028
Project Development Phase 1 & Phase 2	November 2027 – June 2028
Reconcile Estimate and Submit PMP for Stage 2 Approval	June 2028
Stage 2 Approval (PAN2)	August 2028
Execute Delivery – Design and FAT	September 2028 – March 2030
MSP Site Establishment	April 2030
Staged Bay Construction and Commissioning	April 2030 – May 2032
Project Commissioning	May 2032
Final Decommissioning & Removal of Redundant Assets	June 2032 – July 2032

4.2 Network Impacts

Powerlink Net Ops – Operating Manual 01 – SW QLD provides the following recommendations for outages of H014 Middle Ridge feeders and transformers.

330kV H014 Middle Ridge Feeders and Transformers

- For an outage on Feeder 9907/H014 5T or Feeder 9908/H014 4T the network requires the following elements in service.
  - Remaining Fdr 9907 or Fdr 9908.
  - Fdr 9901 & Fdr 9902 & Fdr 9903 & Fdr 9904 & Fdr 9915.
  - Fdr 831 & Fdr 837 & Fdr 8812.
  - Fdr 827 & Fdr 875.

275kV H014 Middle Ridge Feeders and Transformers

- For an outage on Feeder 831 the network requires the following elements in service.
  - Fdr 805 & Fdr 8819.
  - Fdr 9907/H014 5T & Fdr 9908/H014 4T & Fdr 9914 & Fdr 9915.
- For an outage on 1T, 2T or 3T transformers the network requires the following elements in service.
  - Remaining H014 Transformers (1T and/or 2T and/or 3T).
- Outages on 1T, 2T or 3T transformers are to avoid mid May to the end of August.
- For an outage on Feeders 8848 or 8849 the network requires the following elements in service.
  - Remaining Fdr 8848 or 8849.
  - Fdr 805 & Fdr 817 & Fdr 8821 & Fdr 8819 & Fdr 8842.

4.3 Resourcing

Design for the project will be completed by a combination of external design partners and internal design resources. The construction works will be completed by Maintenance Service Providers.

5. Project Asset Classification

Asset Class	Base ($)	Base (%)
Substation Primary Plant	2,767,455	4
Substation Secondary Systems	58,063,742	93
Telecommunications	1,616,725	3
Overhead Transmission Line		
TOTAL	**62,447,923**	**100**

6. References

Document Name	Version	Date
Project Scope Report	1.0	4/06/2025

Risk Cost Summary Report

CP. 02760

Middle Ridge Secondary Systems Replacement

Document Control

Change Record

Issue Date	Revision	Prepared by
07/01/2026	1.0	Asset Strategies

Related Documents

Issue Date	Responsible Person	Objective Document Name

Document Purpose

The purpose of this model is to quantify the base case risk cost profiles for the secondary systems at Middle Ridge substation which are proposed for reinvestment under CP.02760. These risk cost profiles are then included as part of the overall cost-benefit analysis (CBA) to understand the economic benefit of the proposed infrastructure upgrades. This process provides a benchmarking and internal gate process to support Powerlink in effectively identifying prioritised infrastructure upgrades.

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

Key Assumptions

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

- Whilst the re-investment scope of secondary system upgrade projects contains a range of supporting devices (i.e network switches, revenue metering, firewalls and human machine interfaces), for simplicity of risk cost modelling only main protection relays, bay controllers and RTUs were considered.

- Spares for secondary system equipment have been assumed to be available prior to the point of expected spares depletion, which coincides with the expected technical asset life (20 years). After this point the cost and time to return the secondary system back to service increases significantly.

- When calculating network risk cost, it has been assumed that after 24 hours of any network element being protected by a single protection system (due to failure of the alternate system) the Australian Energy Market Operator (AEMO) will direct Powerlink to de-energise the network element.

- A site-specific value of customer reliability (VCR) of $26,140 has been applied when calculating network risks.

Base Case Risk Analysis

Risk Categories

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

- Financial Risk

- Network Risk (including market impact if applicable)

Table 1: Risk categories

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

Base Case Risk Cost

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

Risk costs associated with the equipment in scope are expected to increase from $1.83 million in 2026 to $4.5 million in 2036 and $7.6 million by 2045. Key highlights of the analysis include:

- Financial risk accounts for approximately 65% of the overall risk cost in 2030 with network risk accounting for the remaining 35%.
- As the probability of failure (PoF) continues to grow over time, the network risk cost grows to become a greater proportion of the overall risk. In the year 2040, financial risk is 49% of the total risk cost (≈$5.8m) compared with network risk which contributes 51%.

Figure 1: Total risk cost

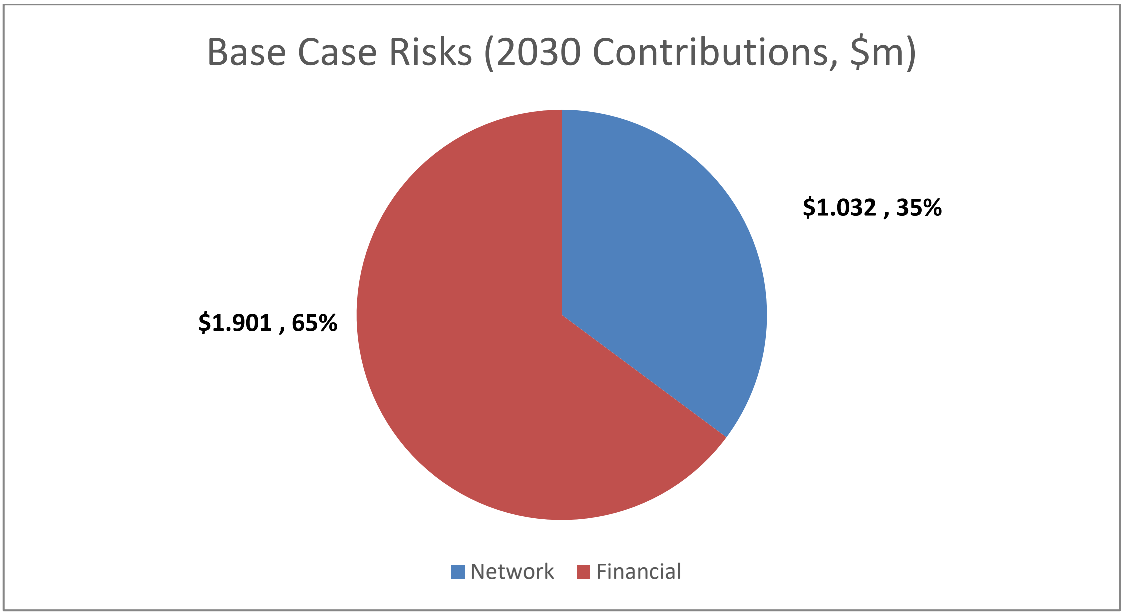


Figure 2: Base case risk cost by contributions (2030)

Option Risk Cost

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

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

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

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

Cost Benefit Analysis

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

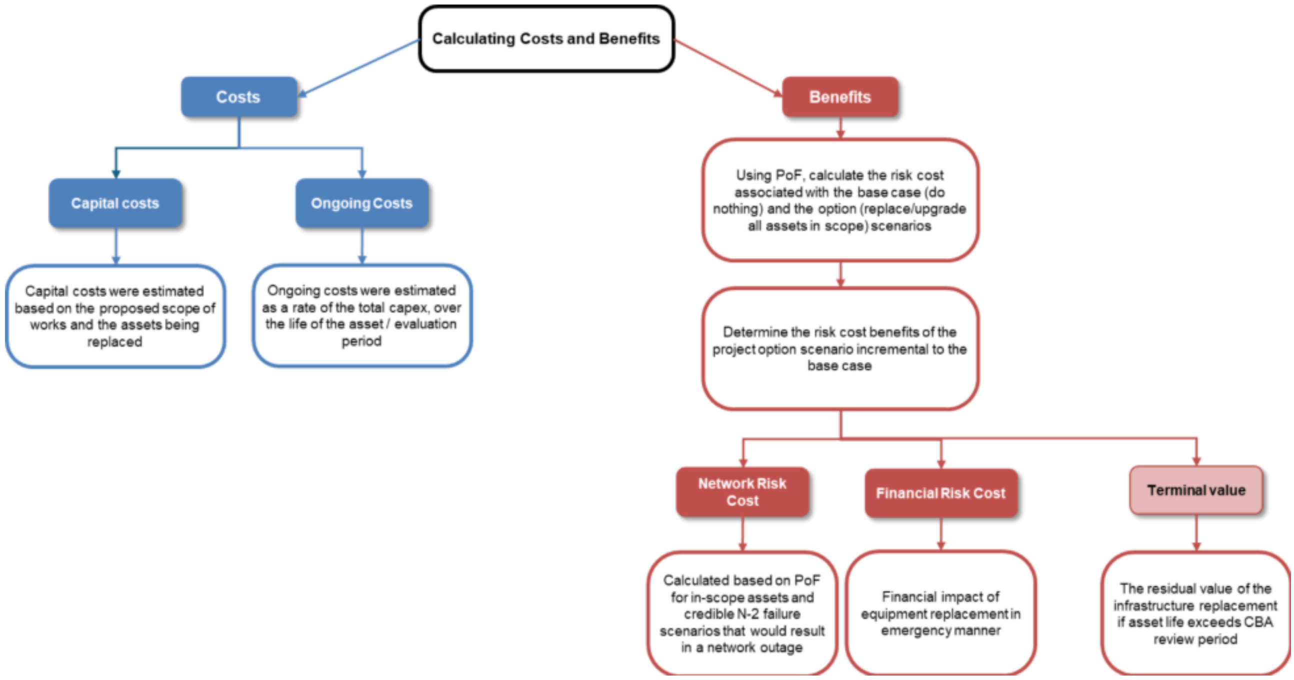


Figure 4: CBA methodology

The project is estimated to cost approximately $62.45 million resulting in a negative NPV and benefit-cost ratio (BCR) less than 1.

Table 2: Net Present Value and Benefit-Cost Ratio

		Present Value Table ($m)		
Discount rate	%	**3%**	**7%**	**10%**
NPV of Net Gain/Loss	$m	-$4.9	-$12.2	-$13.4
Benefit-Cost Ratio	ratio	0.91	0.68	0.56

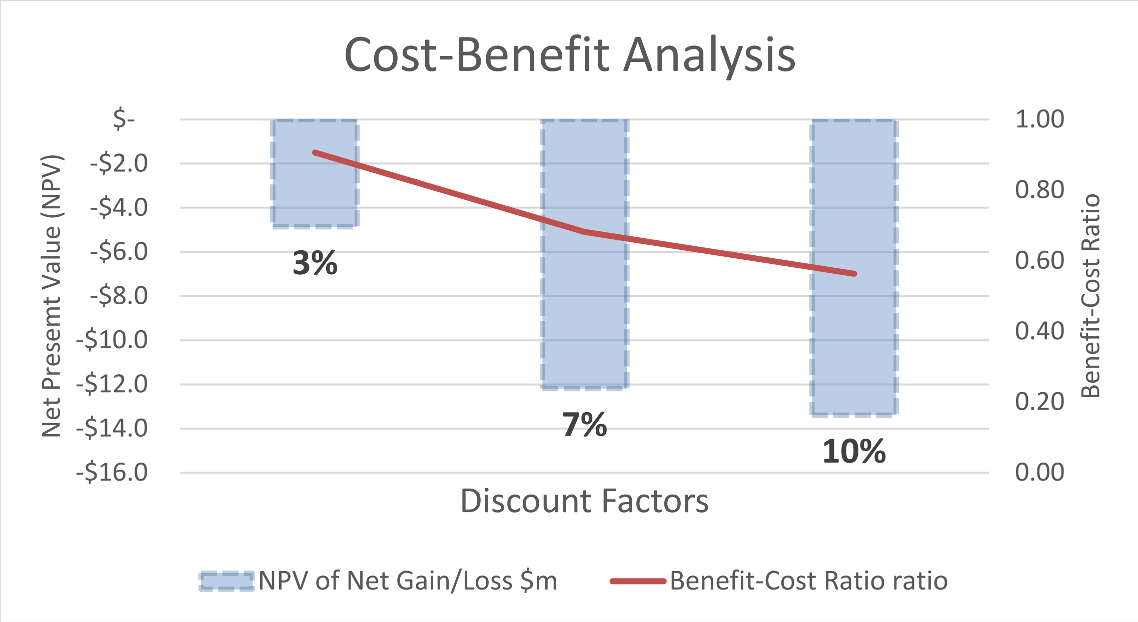


Figure 5: Cost benefit summary

Participation Factors

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

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

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

The model is most sensitive to:

- **changes in the restoration time of a relay with no spares** (halving the restoration time) results in a decrease in risk cost of $0.82 million, or approximately 28.1% of the original base case risk (at 2030).

- **changes in the value of customer reliability** (halving the value) results in a decrease in risk cost of $0.52 million, or approximately 17.6% of the original base case risk (at 2030).

- **changes in bay controller emergency replacement cost** (halving the cost) results in a decrease in risk cost of $0.48 million, or approximately 16.5% of the original base risk (at 2030).

Table 3: Participation Factors

Input	Baseline value	Sensitivity value (-50%)	Change in risk cost at 2030 ($m)	Participation (%)
Network				
VCR ($/MWh)	26140	13070	-0.52	-17.6%
Restoration Time with spares – Relay (days)	2	1	-0.01	-0.50%
Restoration Time with no spares – Relay (days)	10	5	-0.82	-28.1%
Financial				
Emergency replacement cost with spares - Relay ($m)	0.02	0.01	-0.01	-0.30%
Emergency replacement cost without spares – Relay ($m)	0.09	0.05	-0.46	-15.5%
Emergency replacement cost with spares – Bay Controller ($m)	0.02	0.01	0.00	-0.07%
Emergency replacement cost without spares – Bay Controller ($m)	0.20	0.10	-0.48	-16.5%