2023-27
POWERLINK QUEENSLAND REVENUE PROPOSAL

Project Pack – PUBLIC

CP.02796
Goodna Secondary Systems Replacement

CP.02796 – Goodna Secondary Systems Replacement

Project Status: Not Approved

1. Network Requirement

The 275/110kV Goodna Substation, approx. 22km south-west of Brisbane CBD, was established in 2006 and is a bulk supply point for Brisbane's south-west / Ipswich area. It is also supports switching in the greater Brisbane meshed network. An outage of this asset would put up to 200MW of power and up to 3,200MWh of energy per day at risk[2].

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

Energy Queensland forecasts confirm there is an enduring need to maintain electricity supply to the Brisbane Southwest / Ipswich area. The removal or reconfiguration of the Goodna Substation due to secondary system failure or obsolescence would violate Powerlink's Transmission Authority reliability obligations (N-1-50MW / maximum 600MWh unserved energy). Failure to address the obsolescence of this asset is likely to result in non-compliance with Powerlink's reliability and system security obligations[6].

2. Recommended Option

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

The current recommended option is to replace all 275kV and 110kV secondary systems at Goodna Substation by 2026[2].

The following options were considered but not proposed:

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

Figure 2-1 shows the current recommended option reduces the forecast risk monetisation profile of the Goodna Substation secondary systems to approximately $5k per annum. The recommended option will extend the asset life by 20 years.

Where a 'Do Nothing' scenario is adopted, the forecast level of risk associated with the asset rapidly escalates from approximately $10k per annum in 2026 to an estimated $350k per annum in 2027 and continues to rise each year thereafter. The significant increase in risk cost in 2027 coincides with the depletion of available spares, which result in financial risks to replace the failed secondary systems in an unplanned (emergency) manner and network risks (unserved energy) from concurrent network outages due to equipment failures[3].

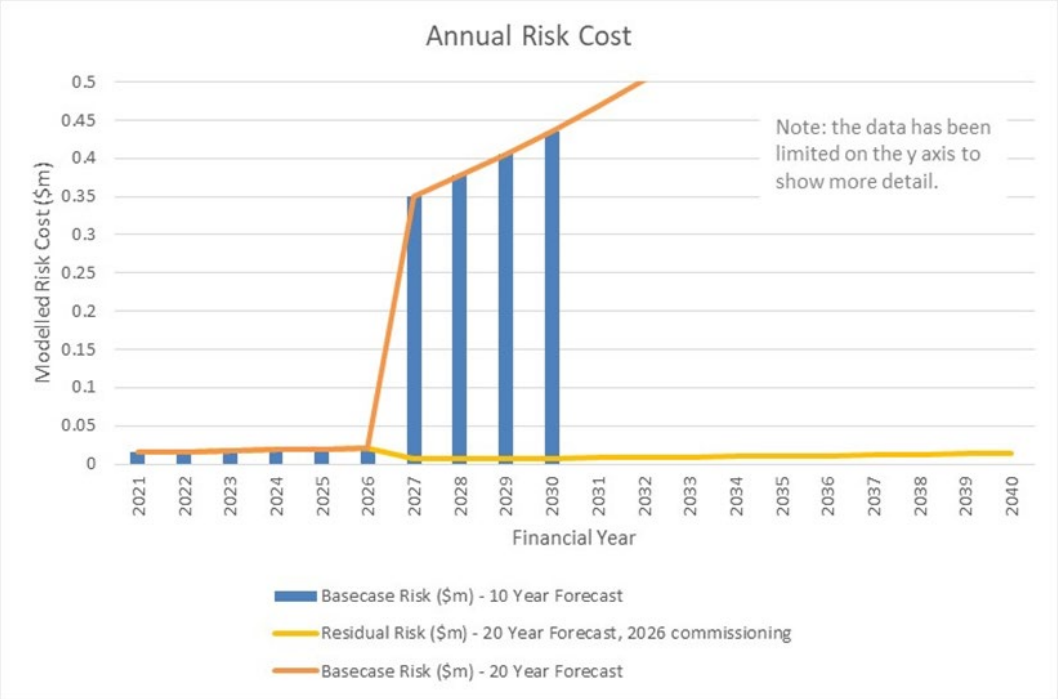

Figure 2-1 Annual Risk Monetisation Profile (Nominal)

3. Cost and Timing

The estimated cost to replace the 275/110kV secondary systems at Goodna Substation is $19.7m ($2019/20)[5].

Target Commissioning Date: August 2027

Note: The proposed need date of June 2026 has been extended due to the number of stages and outages required to construct and commission the 100kV and 275kV bays.

4. Documents in CP.02796 Project Pack

Public Documents

1. Secondary Systems Condition Assessment Report – H038 Goodna 275/110kV
2. CP.02796 Goodna Secondary Systems Replacement – Planning Statement
3. Base Case Risk Summary Report - CP.02796 Goodna Secondary Systems Replacement
4. Project Scope Report CP.02796 Goodna Secondary Systems Replacement
5. Concept Estimate for CP.02796 - Goodna Secondary Systems Replacement

Supporting Documents

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

H038 Goodna 275/110kV

Secondary Systems Condition Assessment Report

Document Details			
Version Number	1.0	**Principal Author**	[redacted]
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Date	Version	Nature of Change	Author	Authorisation
18/12/2019	1.0	New document	[redacted]	[redacted]

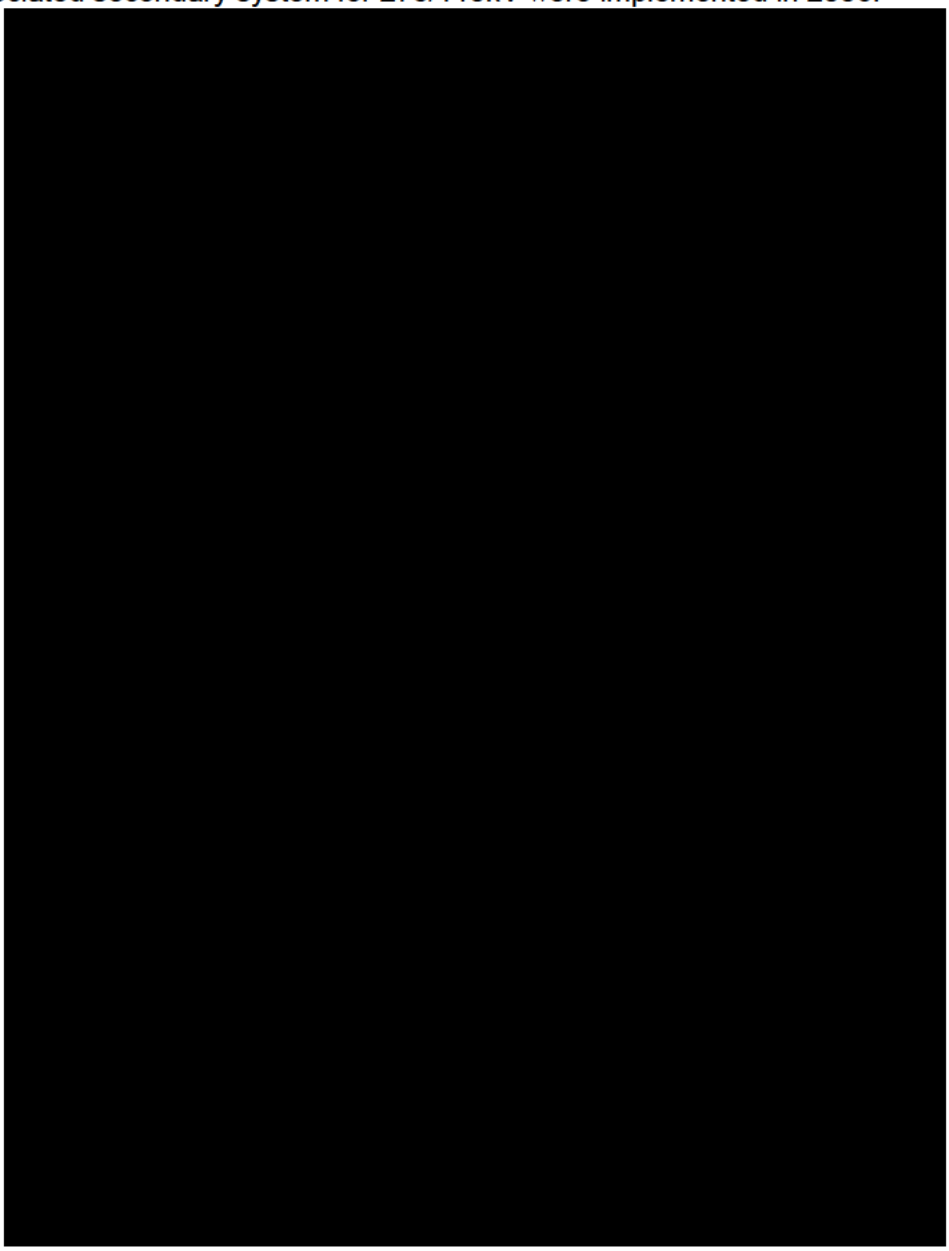
Table of Contents

1. Introduction

This report is pertinent to H038 Goodna substation 275/110kV secondary systems and associated site infrastructure. The report is provided to assist with determining the future asset strategies and scopes for refurbishment and replacement works of Goodna 275kV and 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.

H038 Goodna was built to meet the increased demand in the South West Brisbane / Ipswich area in 2006. Associated secondary system for 275/110kV were implemented in 2006.



H038 Goodna operating diagram

2. Inclusions and Exclusions

2.1 Inclusions

Secondary system assets and equipment provide monitoring, supervision, control and protection functions. The condition assessment of the following systems and equipment will be covered in this report.

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

2.2 Exclusions

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

- Condition of control buildings and associated light and power circuits,
  - Civil structures, cable trenches and foundations,
- AC auxiliary supply systems (> 230VAC), including transformers, diesel generators and building power and light circuits,
- Substation flood lights,

- Primary equipment and associated components e.g. transformer and circuit breaker control cubicles,
- Primary equipment kiosks and associated components, e.g. Power transformer, circuit breaker control kiosks. PLCs and Intelligent Electronic Devices (IED), regardless of their installed location (could be in transformer and circuit breaker control kiosks) are considered as secondary systems equipment.
- Cables from secondary systems outdoor kiosks (e.g. bay marshalling kiosks) to primary plant control kiosks,
- Cables from primary plant control kiosks to primary plant equipment

3. Secondary System Assessment Methodology

Principles of secondary systems condition assessment were based on Powerlink' s Secondary Systems Asset Risk Model developed in [2], and "Powerlink – Asset Risk Management – Framework" in [3]. The methodology consists of two main parts – Desktop assessment and site visual inspection. The latter is considered more subjective than the former.

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

The desktop assessment models equipment health indices based on the optimisation of risk, cost and performance of Powerlink' s secondary assets since 1999 [2]. Equipment health index is the key condition measurement for each equipment in service. The model takes into account equipment failure rates calculated based on operational data, environmental conditions where the equipment is installed and the mean physical ages of a group of equipment at bay and system (fleet) levels.

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

The key outcome of this report is the recommended replacement timing for secondary systems assets and equipment detailed in the Appendix section based on their health indices and condition assessment data.

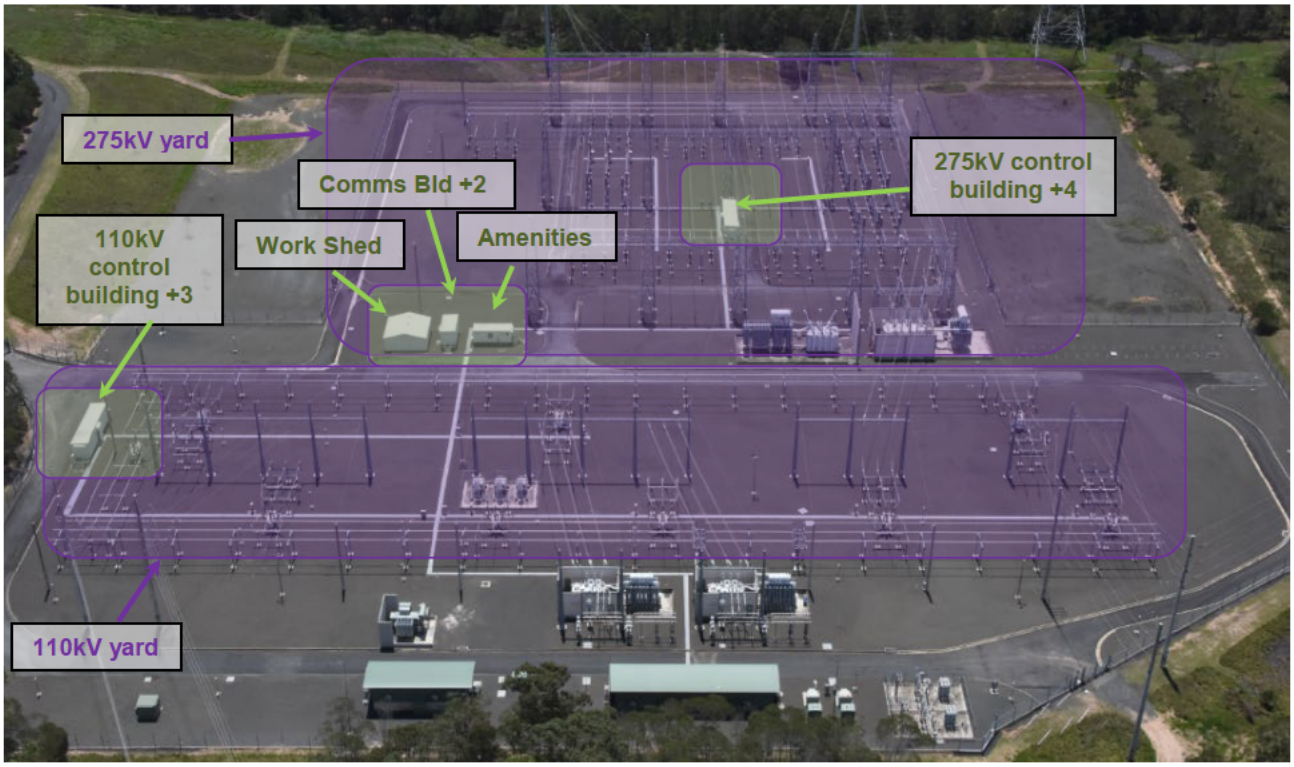
4. Site infrastructure

Goodna substation consists of one yard of 275kV and 110kV operating voltage enclosed by the one perimeter fence. The substation was built in 2006. Associated secondary systems were installed in 2006.

H038 Goodna Substation is a yard, with:-

- 2 x 275kV bus bays, =KC1 and =KC2;
- 2 x 275kV bus coupler bays, =C04-504 and =C07-507;
- 1 x 275/110kV transformer bays, =C07-541 and =D28-441 ;
- 2 x 275kV feeder bays, =C04-8819 and =C07-8842
- 3 x 110kV bus bays, =KD1, =KD2 and =KD3;
- 1 x 110kV bus coupler bay, =D01-411;
- 2 x 110/33kV transformer bays, =D17 and =D20;
- 4 x 110kV feeder bays, =D03.1, =D06.2, =D35.1 and =D36.3;
- 1 x 110kV Capacitor bank bay, =D14.2
- Energex 33kV assets owned by Energex

2 x 275kV feeder bays are energised through Blackwall and Belmont substation. 4 x 110kV feeder bays are connected to West Darra, Blackstone and Redbank Plains.



Goodna substation yard bird view

The existing Goodna substation site is located [redacted]. Emergency and routine maintenance of the secondary systems is done by Powerlink field staff.

4.1 Buildings

The condition assessment of buildings at H038 Goodna is included in a separate document and carried out by Substation Strategies. The following details are listed for information only.

There are 5 x buildings at H038 Goodna Substation, including:-

- Communication building +2
  The communication building +2 houses communication equipment and battery banks.
- 110kV control building +3
  The control building +3 houses all 110kV protection and control panels and battery banks
- 275kV control building +4
  The control building +4 houses all 275kV protection and control panels and battery banks
- Amenities building
- Work shed

Building +3 was established in 2006. It house all 132kV secondary systems such as protection and control panels. It is air-conditioned.

Control building +3

There are 10 x spare panel spaces available for future secondary system secondary system replacement or substation augmentation in the existing building +3.

Control building +3 inside

Building +4 was established in 2006. It house all 275kV secondary systems such as protection and control panels. It is air-conditioned.

Control building +4

There are 15 x spare panel spaces available for future secondary system secondary system replacement or substation augmentation in the existing building +4.

Control building +4 inside

The amenities building houses lunch room, office desk and washroom facilities. Also the AC change over panel is located within the amenities building.

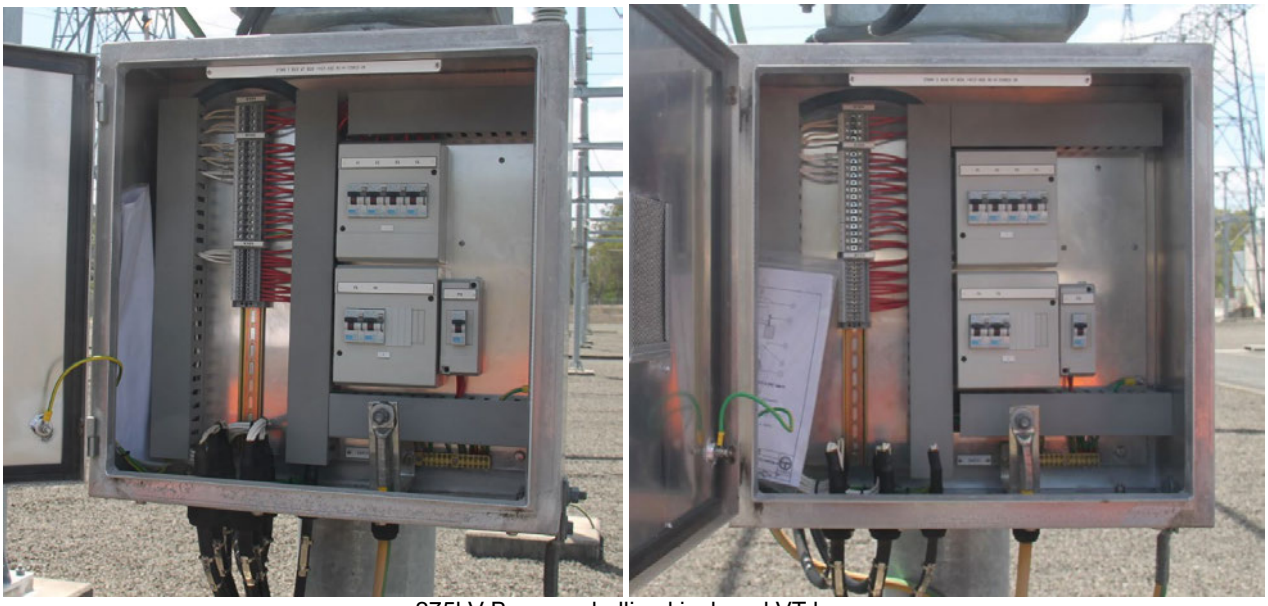
Amenities building

4.2 Trench, marshalling cubicles and control cables

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

4.2.1 275kV yard

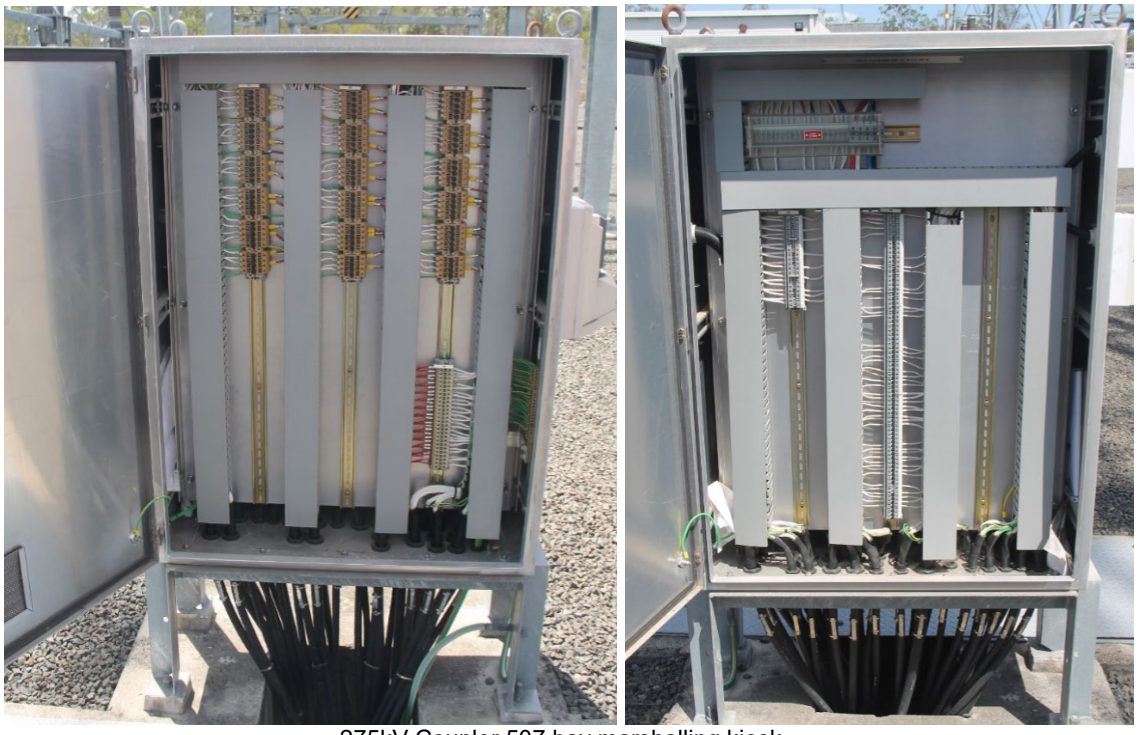
275kV bus marshalling kiosks and VT boxes were installed in 2005. Marshalling kiosks and associated control cables are in fair condition. There are no condition driven replacements required until 2045.



275kV Bus marshalling kiosk and VT box

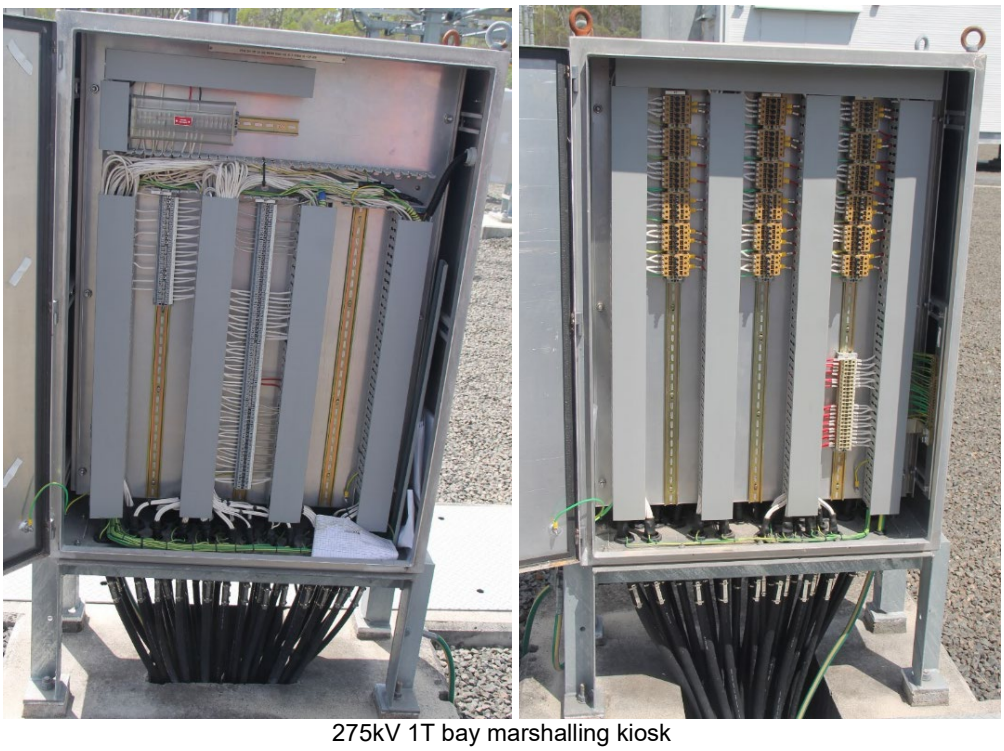
Marshalling kiosks for 275kV bus coupler 504 and 507 were installed in 2005. Marshalling kiosks and associated control cables are in fair condition. There are no condition driven replacements required until 2045.

275kV Coupler 504 bay marshalling kiosk



275kV Coupler 507 bay marshalling kiosk

Marshalling kiosks and VT boxes for 275kV 1 Transformer were installed in 2005. Marshalling kiosks and associated control cables are in fair condition. There are no condition driven replacements required until 2045.

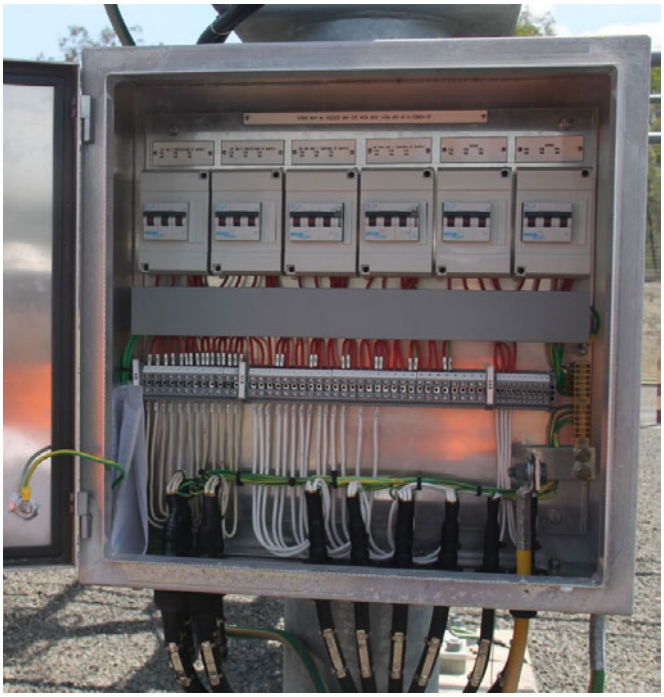


275kV 1T bay marshalling kiosk

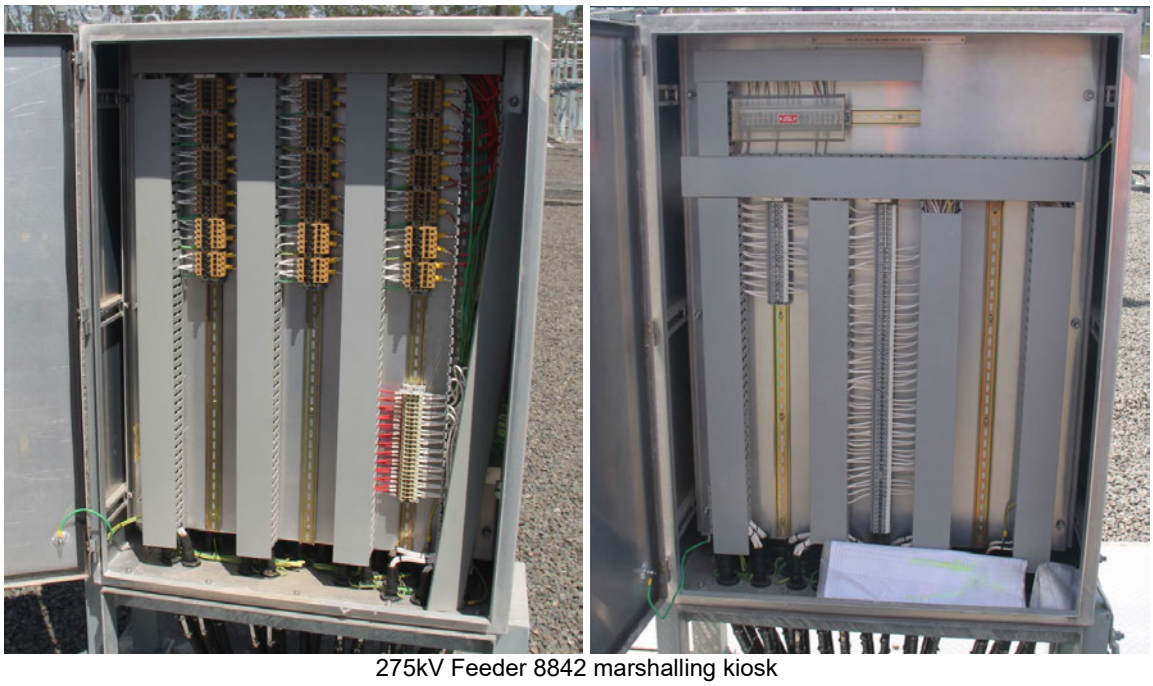
275kV 1T VT box

Marshalling kiosks and VT boxes for 275kV feeder 8819 and 8842 were installed 2005. They are in fair condition and there is no condition driven replacements required until 2045.

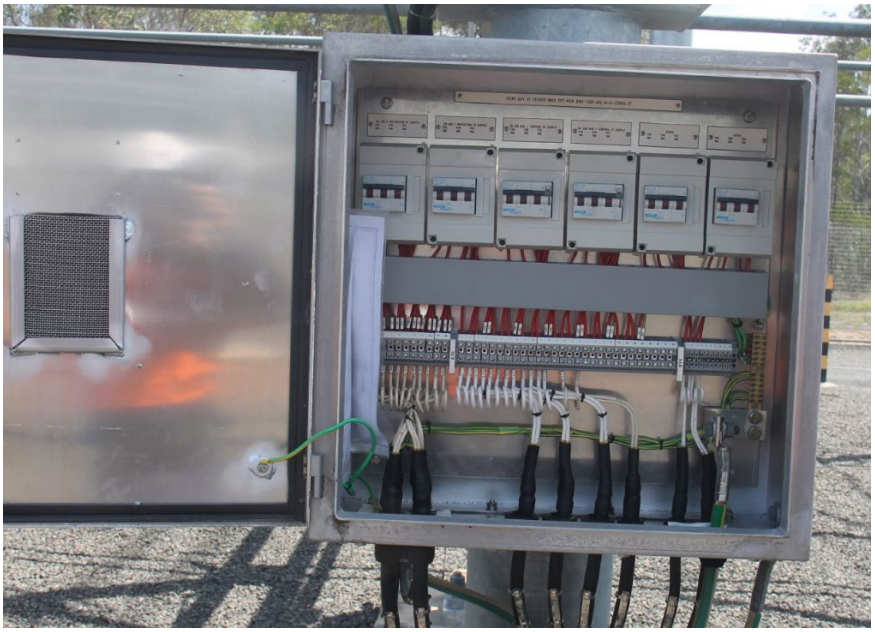
275kV Feeder 8819 bay marshalling kiosk



275kV Feeder 8819 VT box

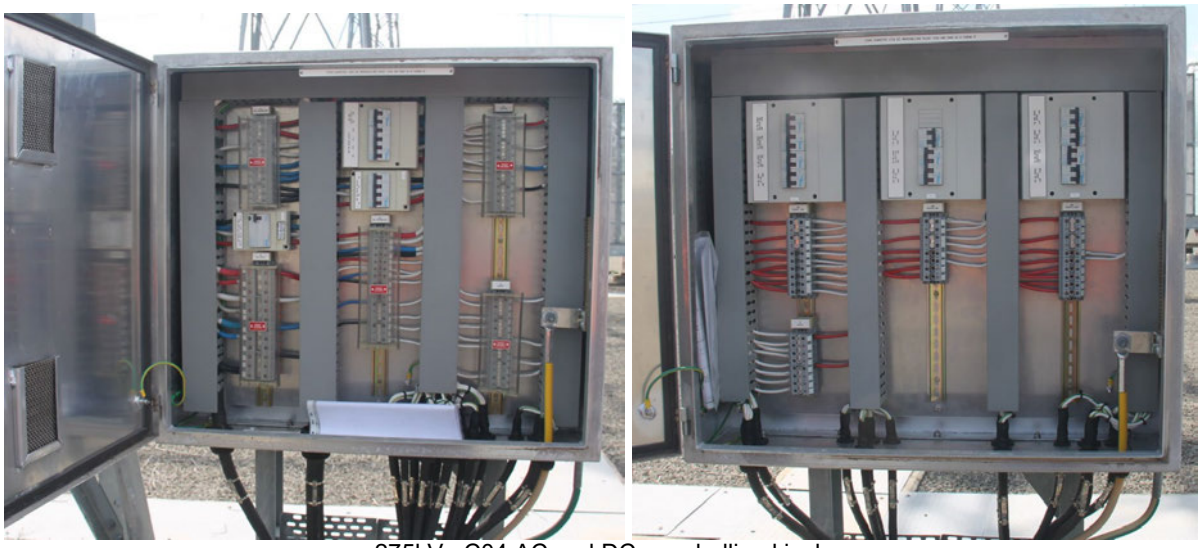


275kV Feeder 8842 marshalling kiosk



275kV Feeder 8842 VT box

Auxiliary kiosks for 275kV diameter =C04 and =C07 were commissioned/replaced in 2005. Marshalling kiosks and associated cables are in fair condition. There are no condition driven replacements required until 2045.



275kV =C04 AC and DC marshalling kiosk

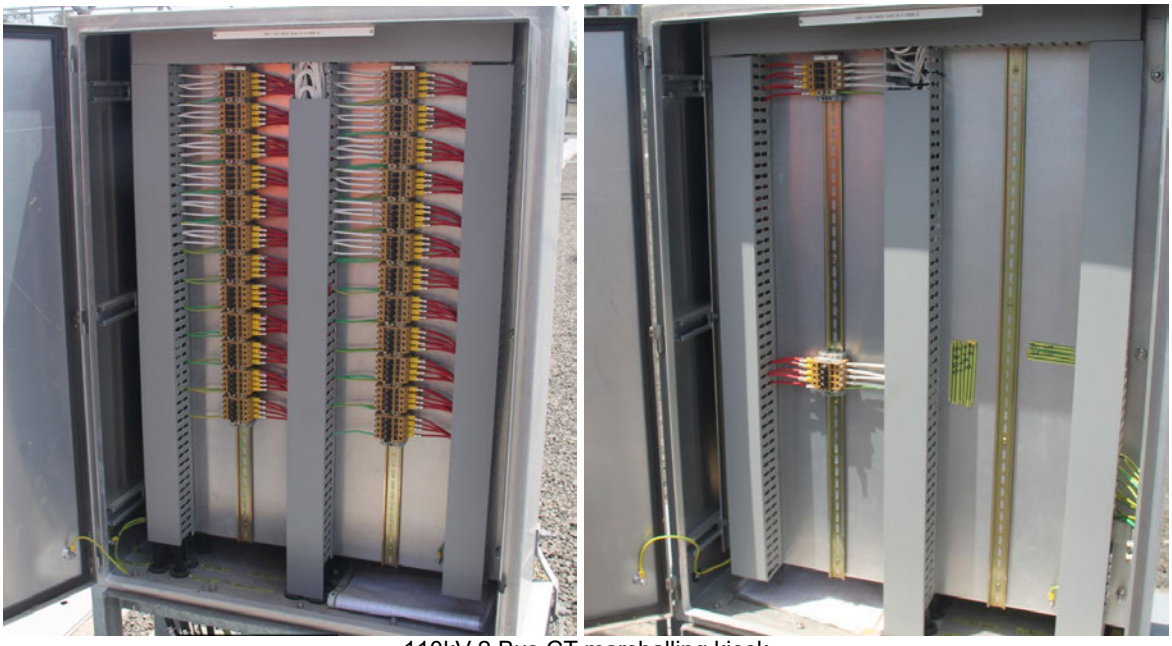
275kV =C07 AC and DC marshalling kiosk

4.2.2 110kV yard

110kV bus and bus coupler marshalling kiosks (including VT boxes) were installed in 2005. These kiosks and associated control cables are in fair condition and there are no condition-driven replacements required until 2045.

110kV 1 Bus CT marshalling kiosk

110kV 1 bus VT box

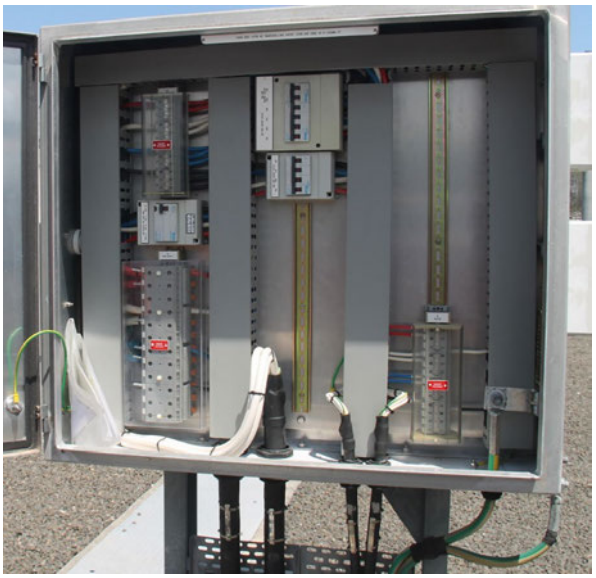
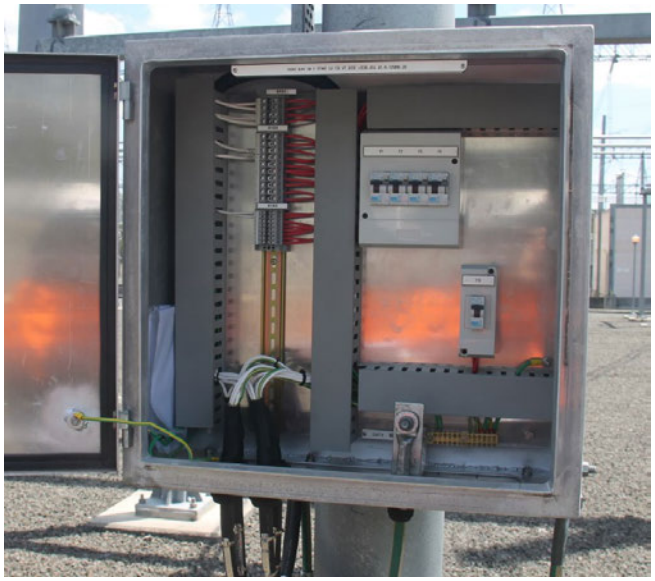


110kV 2 Bus CT marshalling kiosk

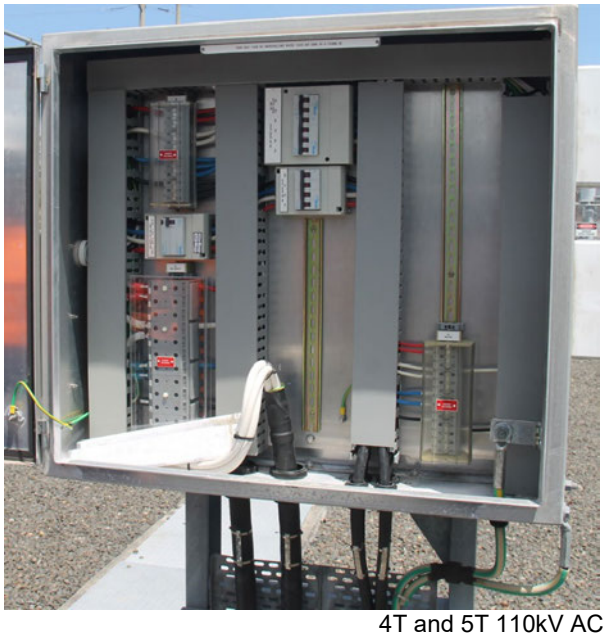
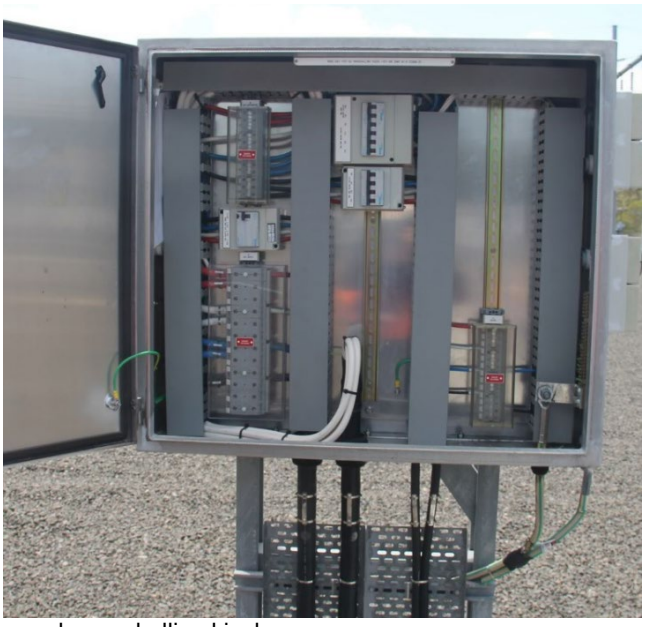
110kV 2 Bus VT box

110kV Coupler 411 AC supply marshalling kiosk

Marshalling kiosks and VT boxes for 1 Transformer LV, 4 transformer and 5 Transformer were built in 2005. These kiosks and associated control cables are in fair condition and there are no condition-driven replacements required until 2045.

1 Transformer LV bay AC supply and VT box

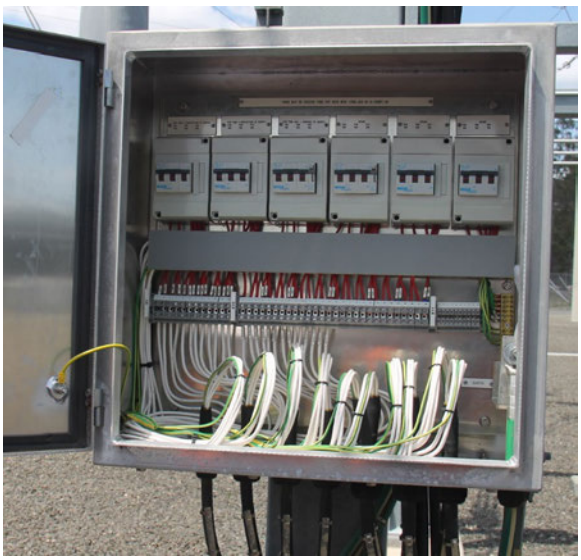



4T and 5T 110kV AC supply marshalling kiosk

T4 oil filter/maintenance outlet kiosk

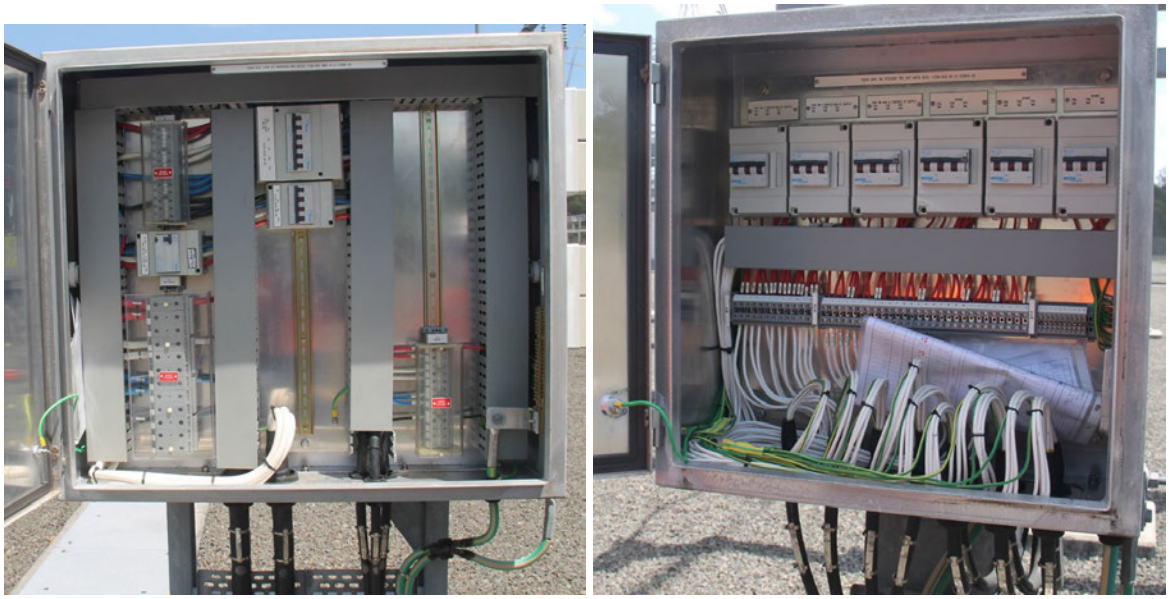
Marshalling kiosks and VT boxes for Feeder 718, 7295, 7296 and 791 were built in 2005. These kiosks and associated control cables are in fair condition and there are no condition-driven replacements required until 2045.

110kV Bay =D06 Feeder 718 bay AC supply and VT box

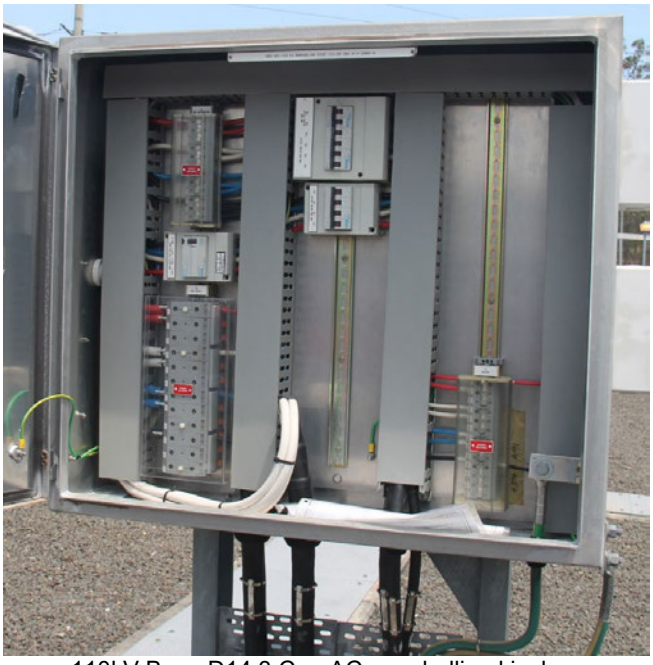
110kV Bay =D35 Feeder 7295 bay AC supply and VT box

110kV Bay =D03 Feeder 7296 bay VT box



110kV Bay =D36 Feeder 791 AC supply and VT box

AC marshalling kiosk for 1 CAP was built in 2005. The kiosks and associated control cables are in fair condition and there are no condition-driven replacements required until 2045.



110kV Bay =D14 3 Cap AC marshalling kiosks

Powerlink-Energex interface cubicle was built in 2005. The kiosks and associated control cables are in fair condition and there are no condition-driven replacements required until 2045.

Powerlink-Energex interface cubicle

Electrical fence was installed at H038 Goodna in 2018.

Electric fence and associated control cubicle

4.2.3 Summary of marshalling kiosks

Marshalling kiosks in H038 Substation were installed in 2005 and are in fair condition. Although there is no major condition-based replacements required until 2045, the ventilation film has fallen in apart and needs to be retrofitted with major secondary system replacement.

Marshalling cubicle ventilation film

4.3 Control and protection bays

4.3.1 Protection and control panels

Secondary systems at Goodna are housed in a type of swing frame panel. These panels and associated panel wiring are in fair condition.

4.3.2 275kV Bus zones and couplers

Equipment details of 275kV bus zones and couplers are given below:

275kV Bus and coupler	Relay & control	Model	Startup Date	Still Manufactured?	Manufacture Support?	PLQ Spares	Health Index
1 Bus	X	MFAC34	2006	Yes	Yes	Yes	6.48
		CB fail trip rack	2006	Yes	Yes	Yes	6.53
		MVAJ13	2006	Yes	Yes	Yes	6.53
		MVAJ12	2006	Yes	Yes	Yes	6.53
	Y	MFAC34	2006	Yes	Yes	Yes	6.48
		CB fail trip rack	2006	Yes	Yes	Yes	6.53
		MVAJ13	2006	Yes	Yes	Yes	6.53
		MVAJ12	2006	Yes	Yes	Yes	6.53
	Bay control	C50	2006	No	Yes	Yes	6.48
2 Bus	X	MFAC34	2006	Yes	Yes	Yes	6.53
		CB fail trip rack	2006	Yes	Yes	Yes	6.53
		MVAJ13	2006	Yes	Yes	Yes	6.45
		MVAJ12	2006	Yes	Yes	Yes	6.53
	Y	MFAC34	2006	Yes	Yes	Yes	6.53

275kV Bus and coupler	Relay & control	Model	Startup Date	Still Manufactured?	Manufacture Support?	PLQ Spares	Health Index
		CB fail trip rack	2006	Yes	Yes	Yes	6.53
		MVAJ13	2006	Yes	Yes	Yes	6.53
		MVAJ12	2006	Yes	Yes	Yes	6.53
	Bay control	C50	2006	No	Yes	Yes	6.53
Coupler 504	X	C60	2006	No	No	Yes	6.53
	Y	SEL-352	2006	No	Yes	Yes	6.53
	RTU	C50	2006	No	Yes	Yes	6.53
Coupler 507	X	C60	2006	No	No	Yes	6.53
	Y	SEL-352	2006	No	Yes	Yes	6.53
	RTU	C50	2006	No	Yes	Yes	6.53

High impedance differential relays ALSTOM MFAC34 relays are used to protect 275kV 1 and 2 bus. Powerlink has recovered modules of C50 RTU such as the CPU, ACT and ADI card. But these cards have been in service for more than 20 years and the capacitor electrolyte might have dried out. These recovered parts would be utilised only for emergency replacement. Powerlink has conducted a last buy in 2014 and are relying on these RTUs for maintenance spares. Health Index indicates that all protection and control systems for 275kV 1 and 2 Bus will reach the end of technical asset life and need to be replaced by 2026.

275kV 1 & 2 Bus protection and CB fail bus trip panel

Secondary systems for 275kV coupler 504 and 507 were installed in 2006. These secondary systems are in fair condition and there are no condition driven replacements required until 2026.

Coupler 504 protection and control panel

Coupler 507 protection and control panel

4.3.3 275/110kV transformer bays

Equipment for 275/110kV transformer bays is detailed below.

Transformer	Relay & control		Model	Startup Date	Still Manufactured?	Manufacture Support?	PLQ Spares	Health Index
1T	275kV	X	T60	2006	No	No	Yes	6.53
			MFAC14	2006	Yes	Yes	Yes	6.53
			F35	2006	No	No	Yes	6.53
		Y	SE-387-5	2006	No	Yes	Yes	6.53
		Bay control	C50	2006	No	Yes	Yes	6.53
	110kV	X CB MGMT	C60	2006	No	No	Yes	6.48
		Y CB MGMT	SEL-351-1	2006	No	Yes	Yes	6.48
		Bay control	C50	2006	No	Yes	Yes	6.48

Protection and control equipment including the panel for 275/110kV 1 Transformer were commissioned in 2006. Health index indicate that these secondary systems will reach the end of technical asset life and need to be replace by 2026.

1 Transformer 275/110kV protection and control panel

4.3.4 275kV feeder bays

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

Feeder	Relay & control	Model	Startup Date	Still Manufactured?	Manufacture Support?	PLQ Spares	Health Index
8819	X	C60	2006	No	No	Yes	6.53
		RED670	2016	Yes	Yes	Yes	4.50
	Y	SEL-421-5	2014	Yes	Yes	Yes	4.45
	Bay control	C50	2006	No	Yes	Yes	6.53
8842	X	C60	2006	No	No	Yes	6.53
		P442	2009	No	No	Yes	5.72
	Y	SEL-421	2006	Yes	Yes	Yes	6.53
	Protection Signalling	DM1200 Digital	2006	Yes	Yes	Yes	6.53
		9745 digital	2006	Yes	Yes	Yes	6.66
	Bay control	C50	2006	No	Yes	Yes	6.53

Majority of protection and control equipment (except RED670 and SEL-421 relay for Feeder 8819) for feeders 8819 and 8842 were commissioned in 2006. Health index shows that they will reach the end of technical asset life and need to be replaced in 2026.

Feeder 8819 protection and control panel

Feeder 8842 protection and control panel

4.3.5 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	MVAX12	2006	Yes	Yes	Yes	6.48
		MVAJ13	2006	Yes	Yes	Yes	6.48
		MFAC34	2006	Yes	Yes	Yes	6.48
		CB fail trip rack	2006	Yes	Yes	Yes	6.48
	Y	MVAX12	2006	Yes	Yes	Yes	6.48
		MVAJ13	2006	Yes	Yes	Yes	6.48
		MFAC34	2006	Yes	Yes	Yes	6.48
		CB fail trip rack	2006	Yes	Yes	Yes	6.48
	Bay control	C50	2006	No	Yes	Yes	6.48
2 Bus	X	MVAX12	2006	Yes	Yes	Yes	6.48
		MVAJ13	2006	Yes	Yes	Yes	6.48
		MFAC34	2006	Yes	Yes	Yes	6.48
		CB fail trip rack	2006	Yes	Yes	Yes	6.48
	Y	MVAX12	2006	Yes	Yes	Yes	6.48
		MVAJ13	2006	Yes	Yes	Yes	6.48
		MFAC34	2006	Yes	Yes	Yes	6.48
		CB fail trip rack	2006	Yes	Yes	Yes	6.48
	Bay control	C50	2006	No	Yes	Yes	6.48
Coupler 411	X	C60	2006	No	No	Yes	6.48
	Y	SEL-351-1	2006	No	Yes	Yes	6.48
	Bay control	C50	2006	No	Yes	Yes	6.48

Secondary systems for 110kV bus zones and the bus coupler were installed in 2005. Health index indicate that these protection and control equipment will reach the end of technical asset life and need to be replaced by 2026.

110kV 1 Bus zone protection and control panel

110kV 2 Bus zone protection and control panel

110kV Bus coupler protection and control panel

4.3.6 110/33kV transformer bays

Secondary systems for 110/33kV transformer bays is detailed below.

Transformer	Relay & control		Model	Startup Date	Still Manufactured?	Manufacture Support?	PLQ Spares	Health Index
4T	110kV	X	T60	2006	No	No	Yes	6.48
		Y	SE-387-5	2006	No	Yes	Yes	6.48
		Bay control	C50	2006	No	Yes	Yes	6.48
5T	110kV	X	T60	2006	No	No	Yes	6.48
		Y	SE-387-5	2006	No	Yes	Yes	6.48
		Bay control	C50	2006	No	Yes	Yes	6.48

Secondary systems for 110/33kV 4 and 5 Transformer were installed under CP.01121 Goodna 110kV substation establishment in 2006. Associated health index indicate that these protection and control equipment will reach the end of technical asset life and need to be replaced by 2026.

110kV 4T protection and control panel

110kV 5T protection and control panel

4.3.7 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
718	X	P543	2006	No	No	Yes	6.48
		P591	2007	No	Yes	Yes	6.27
	Y	SEL-311C	2006	Yes	Yes	Yes	6.48
	Bay control	C50	2006	No	Yes	Yes	6.48
7295	X	P543	2015	No	No	Yes	6.25
		P591	2006	No	Yes	Yes	6.48
	Y	SEL-311C	2006	Yes	Yes	Yes	5.13
	Protection Sig.	DM1200 Digital	2006	No	Yes	Yes	6.48
	Bay control	C50	2006	No	Yes	Yes	6.48
7296	X	P543	2006	No	No	Yes	6.48
		P591	2006	No	Yes	Yes	6.48
	Y	SEL-311C	2006	Yes	Yes	Yes	6.48
	Bay control	C50	2006	No	Yes	Yes	6.48
791	X	P543	2006	No	No	Yes	6.45
		P591	2007	No	Yes	Yes	6.26
	Y	SEL-311C	2006	Yes	Yes	Yes	6.49
	Protection Sig.	DM1200 Digital	2006	No	Yes	Yes	6.48
	Bay control	C50	2006	No	Yes	Yes	6.48

Majority of secondary systems for 110kV Feeder 718, 7295, 7296 and 791 were installed under CP.01121 Goodna 110kV substation establishment in 2006 (except for Feeder 7295 protection relay P543 which was faulty and replaced in 2015). Associated health index indicate that these protection and control equipment will reach the end of technical asset life and need to be replaced by 2026.

Feeder 718 protection and control panel

Feeder 7295 protection and control panel

Feeder 7296 protection and control panel

Feeder 791 protection and control panel

4.3.8 110kV 3 Capacitor bank

Secondary systems for 110kV 3 capacitor bank are detailed in the table below:

Capacitor	Relay & control	Model	Startup Date	Still Manufactured?	Manufacture Support?	PLQ Spares	Health Index
3 CAP	X	SPAJ140C	2006	No	Yes	Yes	6.48
		SPAJ160C	2006	No	Yes	Yes	6.48
		C60	2006	No	No	Yes	6.48
	Y	SEL-351	2006	No	Yes	Yes	6.48
	POW	E213	2007	No	No	No	6.32
	Bay control	C50	2006	No	Yes	Yes	6.48

Secondary systems on 110kV 3 Capacitor bank were installed in 2006. Associated health index indicate that these protection and control equipment will reached the end of technical asset life and need to be replaced by 2026.

3 CAP protection and control panel

4.3.9 Power System Control and Monitoring

Currently there are no power system monitoring such as High Speeding Monitoring, Power Quality Monitoring and Phasor Measurement Unit installed at Goodna. Installation of power system monitoring needs to be reviewed under major secondary system replacement.

4.3.10 Metering

Energy meter has been installed to record customer electricity consumption at H038 Goodna Substation according National Electricity Rules. Associated metering equipment is detailed in the table below:-

Item	Model	Start-up Date	Still Manufactured ?	Manufacturer Support?	PLQ Spares	Health Index
REVMET1 Transformer 4	EDMI 2000-0400 (Check)	2015	No	Yes	Yes	4.72
	EDMI 2000-0400 (Revenue)	2006	No	Yes	Yes	6.48
REVMET2 Transformer 5	EDMI 2000-0400 (Check)	2006	No	Yes	Yes	6.48
	EDMI 2000-0400 (Revenue)	2006	No	Yes	Yes	6.48

Revenue and check meters have been installed for the customer connection points 4 and 5 Transformer. Health index shows that those meters will reach the end of technical asset life (except the check meter for 4T) and need to be replaced to maintain their reliable performance by 2026. Panel wirings are in fair condition.

As PSTN is being phased out and public network providers are moving to packed switched technologies with TCP/IP protocol, Powerlink is to roll out the metering based on IP based technology. As such, these meters need to be implemented based on IP metering technology under associated secondary system replacement.

Metering panel

4.4 Non-bays

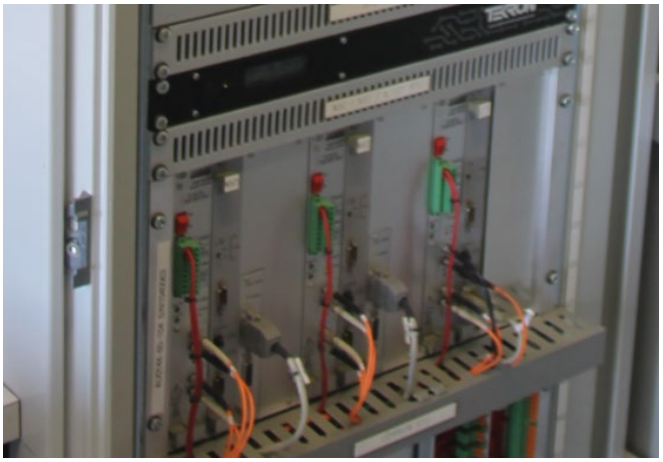
Secondary systems for Non-bays at H038 Goodna are detailed in the following table:

NBay	Relay & control	Model	Startup Date	Still Manufactured?	Manufacture Support?	PLQ Spares	Health Index
Local control (+3)	HMI	Blade 150	2009	No	No	Limited	9.58
	LCF RTU	C50	2006	No	Yes	Yes	6.53
	Common RTU	C50	2006	No	Yes	Yes	6.53
Local control (+4)	HMI Terminal	V90L	2009	No	No	Yes	8.77
	Common RTU	C50	2006	No	Yes	Yes	6.53
Master OpsWAN (+2)	Router	Cisco 2600	2006	Yes	Yes	Yes	10.00
	OpsWAN Switch	[redacted]	2017	Yes	Yes	Yes	2.50
	Switch Ethernet	[redacted]	2006	Yes	Yes	Yes	10.00
	OpsWAN Server	EB12002	2019	Yes	Yes	Yes	0.35
Station OpsWAN (+3)	Switch Ethernet	[redacted]	2006	No	No	No	10.00
	Switch 8 port	[redacted]	2006	Yes	Yes	Yes	10.00
	Serial Port Server	IOLAN STS16DC	2017	Yes	Yes	Yes	2.50
	OpsWAN Switch	[redacted]	2017	Yes	Yes	Yes	2.50
Station OpsWAN (+4)	Switch Ethernet	[redacted]	2006	No	No	No	10.00
	Switch 8 port	[redacted]	2006	Yes	Yes	Yes	10.00
	Serial Port Server	IOLAN STS16DC	2017	Yes	Yes	Yes	2.50
	OpsWAN Switch	[redacted]	2017	Yes	Yes	Yes	2.50
SCADA (+3)	NSC1	C50	2006	No	Yes	Yes	6.53
	NSC2	C50	2006	No	Yes	Yes	6.53
Timing Clock	GPS Clock (+3)	TCG01-D	2011	No	Yes	Yes	5.47
	GPA Clock (+4)	GCG01-C	2006	Yes	Yes	Yes	6.53

4.4.1 SCADA, Control and OpsWAN

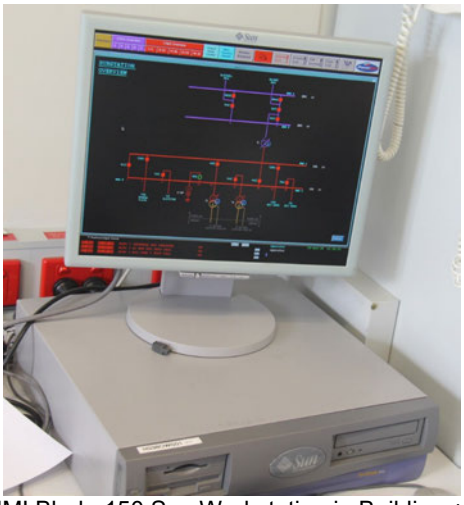
There is one 275/110kV OptoNet ring at H038 Goodna Substation.

Dedicated SCADA paths have been implemented for 275/110kV secondary systems at H038 Goodna. The SCADA system has independent NSC1 and NSC2 RTU to implement 2 x dual SCADA paths based on DNP serial protocol. The serial SCADA is being phased out and will need to be migrated to DNP over IP under major secondary system replacement.



SCADA NSC1/NSC2 RTU and LCF RTU

Blade 150 Sun Workstation is used for the local control. There are only limited spares available. This equipment needs to be replaced with major secondary system replacement.



HMI Blade 150 Sun Workstation in Building +3

HMI Wyse Terminal in Building +4

The router and Ethernet switch for Master OpsWAN in +2 were installed in 2006. Health index indicates that these equipment have reached the end of technical asset life. Powerlink's strategy is to carry out associate replacement with major secondary system replacement projects.

Master OpsWAN panel in Building +2

Ethernet switches for OpsWAN equipment in Building +3 and +4 were installed in 2006. Health index indicates that these equipment have reached the end of technical asset life and need to be replaced with major secondary system replacement.

Station OpsWAN panel in Building +3 and +4

4.4.2 Auxiliary supply

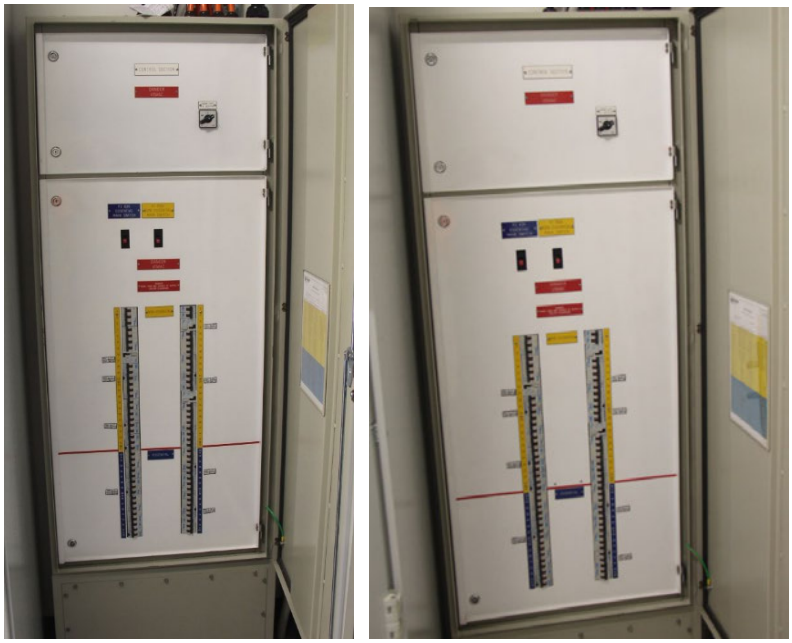
The 415VAC auxiliary supplies are derived from Energex 1 x 11kV/415V 300kVA and 1 x 33kV/415V 300kVA station transformers. Suitable monitoring and changeover arrangement are available for the site. The arrangement is considered acceptable for the situation.

Energex Station transformer TR8 and TR9

AC change over board was installed within the amenities building in 2005 and is in fair condition.

AC changeover board in Amenities building

The AC distribution boards in building +3 and +4 were installed in 2005 and are in fair condition.



AC distribution board in Building +3 and +4

The dual 125VDC and associated distribution boards in +3 and +4 were installed in 2006. DC batteries have reached the end of asset life and have been planned to be replaced under OR.02316 by 2020. Chargers need to be replaced with major secondary system replacement by 2026.

125VDC Batteries and charger in Building +3 and +4

Dual 48VDC batteries in Building +2 were replaced in 2015 and are in good condition. Associated chargers were installed in 2006. They will reach the end of technical asset life and need to be replaced by 2026.

48VDC Batteries and charger in telecommunication building +2

5. Telecommunication

Communication systems at H038 Goodna consist of fibre optic technology with Nokia PDH and Huawei SDH MUX devices. They have been providing reliable services for protection and control systems. Nokia no longer manufacturers the PDH equipment, and the support for hardware replacement is provided by AVARA.

SDH and PDH at Building +2

PDH at Building +3 and +4

No MPLS network has been installed at H038 Goodna substation.

6. Summary of Asset Health

The asset health of H038 Goodna 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 equipment obsolescence. Asset health index of equipment at H038 Goodna are summarised in the table below:-

Bay	Functional Loc.	Description	Secondary System Equipment					Protection/Control Panel		Marshalling kiosk and control cables			
			Model number	In Service Date	Health Index	Obsolete?	To be replaced by	HI	To be replaced	Item	In service date	HI	To be replaced by
=KD1 110kV 1 BUS	H038-SSS-1BU4-BAYCONT	REMOTE TERMINAL UNIT FOXBORO C50	C50	18/10/2006	6.48	Yes	2026	3.50	2046				
	H038-SSS-1BU4-XPROT	RELAY DIFF AREVA MFAC34 RANGE: 25-325VAC	MFAC34	18/10/2006	6.48	No							
	H038-SSS-1BU4-XPROT	RELAY TRIPPING LOW BURDEN ALSTOM MVAJ13	MVAJ13	18/10/2006	6.48	No							
	H038-SSS-1BU4-XPROT	RELAY TRIPPING SUPPLY FAIL ALSTOM MVAX12	MVAX12	18/10/2006	6.48	No				110kV 1 Bus VT box	25/11/2005	3.53	2045
	H038-SSS-1BU4-XPROT	RELAY CB FAIL BUS TRIP RACK	3A111K3	18/10/2006	6.48	No				110kV 1 Bus CT marshalling kiosk	25/11/2005	3.53	2045
	H038-SSS-1BU4-YPROT	RELAY DIFF AREVA MFAC34 RANGE: 25-325VAC	MFAC34	18/10/2006	6.48	No							
	H038-SSS-1BU4-YPROT	RELAY TRIPPING LOW BURDEN ALSTOM MVAJ13	MVAJ13	18/10/2006	6.48	No							
	H038-SSS-1BU4-YPROT	RELAY TRIPPING SUPPLY FAIL ALSTOM MVAX12	MVAX12	18/10/2006	6.48	No							
	H038-SSS-1BU4-YPROT	RELAY CB FAIL BUS TRIP RACK	3A111K3	18/10/2006	6.48	No							
=KC1 275kV 1 BUS	H038-SSS-1BU5-BAYCONT	REMOTE TERMINAL UNIT FOXBORO C50	C50	10/11/2006	6.48	Yes	2026	3.50	2046				
	H038-SSS-1BU5-XPROT	RELAY DIFF AREVA MFAC34 RANGE: 25-325VAC	MFAC34	18/10/2006	6.48	No							
	H038-SSS-1BU5-XPROT	RELAY TRIPPING LOW BURDEN ALSTOM MVAJ13	MVAJ13	18/09/2006	6.53	No							
	H038-SSS-1BU5-XPROT	RELAY TRIPPING SUPPLY FAIL ALSTOM MVAX12	MVAX12	18/09/2006	6.53	No							
	H038-SSS-1BU5-XPROT	RELAY CB FAIL BUS TRIP RACK	CB FAIL TRIP RACK	18/09/2006	6.53	No							
	H038-SSS-1BU5-YPROT	RELAY DIFF AREVA MFAC34 RANGE: 25-325VAC	MFAC34	18/09/2006	6.53	No							
	H038-SSS-1BU5-YPROT	RELAY TRIPPING LOW BURDEN ALSTOM MVAJ13	MVAJ13	18/09/2006	6.53	No							
	H038-SSS-1BU5-YPROT	RELAY TRIPPING SUPPLY FAIL ALSTOM MVAX12	MVAX12	18/09/2006	6.53	No				1 Bus VT Box	24/11/2005	3.53	2045
	H038-SSS-1BU5-YPROT	RELAY CB FAIL BUS TRIP RACK	CB FAIL TRIP RACK	18/09/2006	6.53	No							
=KD2 110kV 2 BUS	H038-SSS-2BU4-BAYCONT	REMOTE TERMINAL UNIT FOXBORO C50	C50	18/10/2006	6.48	Yes	2026	3.50	2046				
	H038-SSS-2BU4-XPROT	RELAY DIFF AREVA MFAC34 RANGE: 25-325VAC	MFAC34	18/10/2006	6.48	No				110kV 2 Bus marshalling kiosk	25/11/2005	3.53	2045
	H038-SSS-2BU4-XPROT	RELAY TRIPPING LOW BURDEN ALSTOM MVAJ13	MVAJ13	18/10/2006	6.48	No							
	H038-SSS-2BU4-XPROT	RELAY TRIPPING SUPPLY FAIL ALSTOM MVAX12	MVAX12	18/10/2006	6.48	No							
	H038-SSS-2BU4-XPROT	RELAY CB FAIL BUS TRIP RACK	3A111K3	18/10/2006	6.48	No				110kV 2 Bus VT box	25/11/2005	3.53	2045
	H038-SSS-2BU4-YPROT	RELAY DIFF AREVA MFAC34 RANGE: 25-325VAC	MFAC34	18/10/2006	6.48	No							
	H038-SSS-2BU4-YPROT	RELAY TRIPPING LOW BURDEN ALSTOM MVAJ13	MVAJ13	18/10/2006	6.48	No							
	H038-SSS-2BU4-YPROT	RELAY TRIPPING SUPPLY FAIL ALSTOM MVAX12	MVAX12	18/10/2006	6.48	No							
	H038-SSS-2BU4-YPROT	RELAY CB FAIL BUS TRIP RACK	3A111K3	18/10/2006	6.48	No							
=KC2 275kV 2 BUS	H038-SSS-2BU5-BAYCONT	REMOTE TERMINAL UNIT FOXBORO C50	C50	18/09/2006	6.53	Yes	2026	3.50	2046				
	H038-SSS-2BU5-XPROT	RELAY DIFF AREVA MFAC34 RANGE: 25-325VAC	MFAC34	18/09/2006	6.53	No							
	H038-SSS-2BU5-XPROT	RELAY TRIPPING LOW BURDEN ALSTOM MVAJ13	MVAJ13	18/09/2006	6.53	No				2Bus VT box	24/11/2005	3.53	2045
	H038-SSS-2BU5-XPROT	RELAY TRIPPING SUPPLY FAIL ALSTOM MVAX12	MVAX12	10/11/2006	6.45	No							
	H038-SSS-2BU5-XPROT	RELAY CB FAIL BUS TRIP RACK	CB FAIL TRIP RACK	18/09/2006	6.53	No							
	H038-SSS-2BU5-YPROT	RELAY DIFF AREVA MFAC34 RANGE: 25-325VAC	MFAC34	18/09/2006	6.53	No							
	H038-SSS-2BU5-YPROT	RELAY TRIPPING LOW BURDEN ALSTOM MVAJ13	MVAJ13	18/09/2006	6.53	No							
	H038-SSS-2BU5-YPROT	RELAY TRIPPING SUPPLY FAIL ALSTOM MVAX12	MVAX12	18/09/2006	6.53	No							
	H038-SSS-2BU5-YPROT	RELAY CB FAIL BUS TRIP RACK	CB FAIL TRIP RACK	18/09/2006	6.53	No							
=D01 110kV Coupler 411	H038-SSS-411--BAYCONT	REMOTE TERMINAL UNIT FOXBORO C50	C50	18/10/2006	6.48	Yes	2026	3.50	2046				
	H038-SSS-411--XPROT	RELAY CB MGMT GE C60 (VER 2.93 FIRMWARE)	C60 (VER 2.93)	18/10/2006	6.48	Yes				110kV coupler AC supply marshalling	22/11/2005	3.53	2045
	H038-SSS-411--YPROT	RELAY CBMAN SEL-351-1 (1A)	SEL-351-1 (1A)	18/10/2006	6.48	Yes							
=D28-441 1T 110kV	H038-SSS-441--BAYCONT	REMOTE TERMINAL UNIT FOXBORO C50	C50	18/10/2006	6.48	Yes	2026	3.50	2046				
	H038-SSS-441--XPROT	RELAY CB MGMT GE C60 (VER 2.93 FIRMWARE)	C60 (VER 2.93)	18/10/2006	6.48	Yes				1 Transformer 110kV VT box	25/11/2005	3.53	2045
	H038-SSS-441--YPROT	RELAY CBMAN SEL-351-1 (1A)	SEL-351-1 (1A)	18/10/2006	6.48	Yes				1 Transformer 110kV AC supply marshalling	22/11/2005	3.53	2045
=D20 4T 110kV	H038-SSS-444--BAYCONT	REMOTE TERMINAL UNIT FOXBORO C50	C50	18/10/2006	6.48	Yes	2026	3.50	2046				
	H038-SSS-444--XPROT	RELAY TRANSF DIFF GE T60 (3.48)	T60 (3.48)	18/10/2006	6.48	Yes				4 Transformer 110kV AC supply marshalling	22/11/2005	3.53	2045

	H038-SSS-444--YPROT	RELAY BIASED DIFF SEL-387-5 (1A) (3U)	SEL-387-5 (1A) (3U)	18/10/2006	6.48	Yes				4 Transformer maintenance outlet	20/10/2005	3.55	2045
=D17 5T 110kV	H038-SSS-445--BAYCONT	REMOTE TERMINAL UNIT FOXBORO C50	C50	18/10/2006	6.48	Yes	2026	3.50	2046				
	H038-SSS-445--XPROT	RELAY TRANSF DIFF GE T60 (3.48)	T60 (3.48)	18/10/2006	6.48	Yes				5 Transformer 110kV AC supply marshalling	22/11/2005	3.53	2045
	H038-SSS-445--YPROT	RELAY BIASED DIFF SEL-387-5 (1A) (3U)	SEL-387-5 (1A) (3U)	18/10/2006	6.48	Yes							
=D14.2 110kV 3 Cap	H038-SSS-483--BAYCONT	REMOTE TERMINAL UNIT FOXBORO C50	C50	18/10/2006	6.48	Yes	2026	3.50	2046				
	H038-SSS-483--POWAVE	RELAY POINT ON WAVE ABB E213	SWITCHSYNC E213	16/02/2007	6.32	Yes							
	H038-SSS-483--XPROT	RELAY CB MGMT GE C60 (VER 2.93 FIRMWARE)	C60 (VER 2.93)	18/10/2006	6.48	Yes				3 CAP AC supply marshalling kiosk	22/11/2005	3.53	2045
	H038-SSS-483--XPROT	RELAY OC & EF ABB SPAJ140C	SPAJ140C	18/10/2006	6.48	Yes							
	H038-SSS-483--XPROT	RELAY CAP PROTN ABB SPAJ160C	SPAJ160C	18/10/2006	6.48	Yes							
	H038-SSS-483--YPROT	RELAY CBMAN SEL-351-1 (1A)	SEL-351-1 (1A)	18/10/2006	6.48	Yes							
=C04 275kV Coupler 504	H038-SSS-504--BAYCONT	REMOTE TERMINAL UNIT FOXBORO C50	C50	18/09/2006	6.53	Yes	2026	3.50	2046				
	H038-SSS-504--XPROT	RELAY CB MGMT GE C60 (VER 2.93 FIRMWARE)	C60 (VER 2.93)	18/09/2006	6.53	Yes				Coupler 504	2/12/2005	3.52	2045
	H038-SSS-504--YPROT	RELAY CB MGMT SEL 352 1A, 125Vdc, 4U	SEL-352 (1A) (4U)	18/09/2006	6.53	Yes							
=C07 275kV Coupler 507	H038-SSS-507--BAYCONT	REMOTE TERMINAL UNIT FOXBORO C50	C50	18/09/2006	6.53	Yes	2026	3.50	2046				
	H038-SSS-507--XPROT	RELAY CB MGMT GE C60 (VER 2.93 FIRMWARE)	C60 (VER 2.93)	18/09/2006	6.53	Yes				Coupler 507	2/12/2005	3.52	2045
	H038-SSS-507--YPROT	RELAY CB MGMT SEL 352 1A, 125Vdc, 4U	SEL-352 (1A) (4U)	18/09/2006	6.53	Yes							
=C07-541 1T 275kV	H038-SSS-541--BAYCONT	REMOTE TERMINAL UNIT FOXBORO C50	C50	18/09/2006	6.53	Yes	2026	3.50	2046				
	H038-SSS-541--XPROT	RELAY TRANSF DIFF GE T60 (3.48)	T60 (3.48)	18/09/2006	6.53	Yes				1 Transformer marshalling cubicle	6/12/2005	3.52	2045
	H038-SSS-541--XPROT	RELAY TRANSF O/LOAD GE F35 (2.93)	F35 (2.93)	18/09/2006	6.53	Yes				1 Transformer 275kV 13 VT box	6/12/2005	3.52	2045
	H038-SSS-541--XPROT	RELAY DIFF 25-325V 1POLE GEC MFAC14	MFAC14	18/09/2006	6.53	No							
	H038-SSS-541--YPROT	RELAY BIASED DIFF SEL-387-5 (1A) (3U)	SEL-387-5 (1A) (3U)	18/09/2006	6.53	Yes							
=D06.2 Feeder 718	H038-SSS-718--BAYCONT	REMOTE TERMINAL UNIT FOXBORO C50	C50	18/10/2006	6.48	Yes	2026	3.50	2046				
	H038-SSS-718--XPROT	CURR DIFF RELAY MICOM P543 + 2ND PORT	P543 (+ 2nd Port)	18/10/2006	6.48	Yes				Feeder 718 AC supply marshalling cubicle	22/11/2005	3.53	2045
	H038-SSS-718--XPROT	COMMS INTERFACE UNIT ALSTOM P591	P591 (50VDC)	26/03/2007	6.27	Yes				Feeder 718 VT box	25/11/2005	3.53	2045
	H038-SSS-718--YPROT	RELAY DISTANCE SEL 311C 1A	SEL-311C (1A)	18/10/2006	6.48	No							
==D35.1 Feeder 7295	H038-SSS-7295-BAYCONT	REMOTE TERMINAL UNIT FOXBORO C50	C50	18/10/2006	6.48	Yes	2026	3.50	2046				
	H038-SSS-7295-PSDIT	DEWAR DM1200 PROT SIG DIG 90-320V SUPPLY	DM1200 DIGITAL	18/10/2006	6.48	No				AC Marshalling kiosk	22/11/2005	3.53	2045
	H038-SSS-7295-PSPIT	DEWAR DM1200 PROT SIG DIG 90-320V SUPPLY	DM1200 DIGITAL	18/10/2006	6.48	No				Feeder 7295 VT box	25/11/2005	3.53	2045
	H038-SSS-7295-XPROT	COMMS INTERFACE UNIT ALSTOM P591	P591 (50VDC)	18/10/2006	6.48	Yes							
	H038-SSS-7295-XPROT	CURR DIFF RELAY MICOM P543 + 2ND PORT	P543 (+ 2nd Port)	9/01/2015	5.13	Yes							
	H038-SSS-7295-YPROT	RELAY DISTANCE SEL 311C 1A	SEL-311C (1A)	14/11/2006	6.45	No							
=D03.1 Feeder 7296	H038-SSS-7296-BAYCONT	REMOTE TERMINAL UNIT FOXBORO C50	C50	18/10/2006	6.48	Yes	2026	3.50	2046				
	H038-SSS-7296-XPROT	CURR DIFF RELAY MICOM P543 + 2ND PORT	P543 (+ 2nd Port)	18/10/2006	6.48	Yes				Feeder 7296 VT box	25/11/2005	3.53	2045
	H038-SSS-7296-XPROT	COMMS INTERFACE UNIT ALSTOM P591	P591 (50VDC)	18/10/2006	6.48	Yes							
	H038-SSS-7296-YPROT	RELAY DISTANCE SEL 311C 1A	SEL-311C (1A)	18/10/2006	6.48	No							
=D36.3 Feeder 791	H038-SSS-791--BAYCONT	REMOTE TERMINAL UNIT FOXBORO C50	C50	18/10/2006	6.48	Yes	2026	3.50	2046	Feeder 791 AC supply	22/11/2005	3.53	2045
	H038-SSS-791--PSDIT	DEWAR DM1200 PROT SIG DIG 90-320V SUPPLY	DM1200 DIGITAL	18/10/2006	6.48	No				Feeder 791 VT box	25/11/2005	3.53	2045
	H038-SSS-791--PSPIT	DEWAR DM1200 PROT SIG DIG 90-320V SUPPLY	DM1200 DIGITAL	18/10/2006	6.48	No							
	H038-SSS-791--XPROT	COMMS INTERFACE UNIT ALSTOM P591	P591 (50VDC)	30/03/2007	6.26	Yes							
	H038-SSS-791--XPROT	CURR DIFF RELAY MICOM P543 + 2ND PORT	P543 (+ 2nd Port)	14/11/2006	6.45	Yes							
	H038-SSS-791--YPROT	RELAY DISTANCE SEL 311C 1A	SEL-311C (1A)	18/10/2006	6.48	No							
=C04 Feeder 8819	H038-SSS-8819-BAYCONT	REMOTE TERMINAL UNIT FOXBORO C50	C50	18/09/2006	6.53	Yes	2026	3.50	2046				
	H038-SSS-8819-XPROT	RELAY CB MGMT GE C60 (VER 2.93 FIRMWARE)	C60 (VER 2.93)	18/09/2006	6.53	Yes				Feeder 8819 marshalling cubicle	29/11/2005	3.52	2045
	H038-SSS-8819-XPROT	RELAY ABB RED670 REM END CCIS IPASS 6I6U	RED670 REM END CCIS	27/05/2016	4.50	No				Feeder 8819 VT Box	29/11/2005	3.52	2045
	H038-SSS-8819-YPROT	RELAY DISTANCE SCHW'ZER 421-5 1A 24 LED	SEL-421-5 (1A) (5U)	6/11/2014	4.45	No				Diameter C04 AC and DC marshalling cubicle	19/10/2005	3.55	2045
=C07 Feeder 8842	H038-SSS-8842-BAYCONT	REMOTE TERMINAL UNIT FOXBORO C50	C50	18/09/2006	6.53	Yes	2026	3.50	2046				
	H038-SSS-8842-PSPIT	DEWAR DM1200 PROT SIG DIG 90-320V SUPPLY	DM1200 DIGITAL	18/09/2006	6.53	No							
	H038-SSS-8842-PSPITY	DEWAR DM1200 PROT SIG DIG 90-320V SUPPLY	DM1200 DIGITAL	18/09/2006	6.53	No				Feeder 8842 Marshalling cubicle	23/11/2005	3.53	2045
	H038-SSS-8842-PSSITA	DEWAR DM1200 PROT SIG DIG 90-320V SUPPLY	DM1200 DIGITAL	18/09/2006	6.53	No				Feeder 8842 VT box	2/12/2005	3.52	2045
	H038-SSS-8842-PSSITB	RFL 9745 PROT SIG DIG I/O 48-125V	9745 DIGITAL	18/09/2006	6.66	No				Diameter =C07 AC and DC marshalling cubicle	19/10/2005	3.55	2045
	H038-SSS-8842-XPROT	RELAY CB MGMT GE C60 (VER 2.93 FIRMWARE)	C60 (VER 2.93)	18/09/2006	6.53	Yes							
	H038-SSS-8842-XPROT	RELAY DISTANCE MICOM P442 (WITH R/PORT	P442 (WITH R/PORT)	16/04/2009	5.72	Yes							
	H038-SSS-8842-YPROT	RELAY DISTANCE SEL-421 (1A) (5U)	SEL-421 (1A) (5U)	18/09/2006	6.53	No							
Metering	H038-SSS-METR-	TRANSF 2 WH/VARH METER (CHECK)	2000-0400 5A Cl 0.5	11/12/2015	4.72	Yes	2026	3.50	2046				

	REVMET1												
	H038-SSS-METR-REVMET1	METER KWH/KVARH EDMI (REVENUE)	2000-0400 5A Cl 0.5	18/10/2006	6.48	Yes							
	H038-SSS-METR-REVMET2	METER KWH/KVARH EDMI (CHECK)	2000-0400 5A Cl 0.5	18/10/2006	6.48	Yes							
	H038-SSS-METR-REVMET2	METER KWH/KVARH EDMI (REVENUE)	2000-0400 5A Cl 0.5	18/10/2006	6.48	Yes							
Non-bay	H038-SSS-NBAY-LCF3	LOCAL CONTROL FACILITY SUN BLADE	BLADE 150	9/03/2009	9.58	Yes	To be replaced with major secondary system replacement	3.50	2046				
	H038-SSS-NBAY-LCF4	LOCAL CONTROL FACILITY PC X TERMINAL	V90L XPe 1GB/512MB	29/12/2009	8.77	Yes							
	H038-SSS-NBAY-LCF4	LOCAL CONTROL FACILITY PC X TERMINAL	Z90D7	1/01/2017	2.50	Yes							
	H038-SSS-NBAY-LCFINT3	REMOTE TERMINAL UNIT FOXBORO C50	C50	18/09/2006	6.53	Yes							
	H038-SSS-NBAY-NSCLNK13	REMOTE TERMINAL UNIT FOXBORO C50	C50	18/09/2006	6.53	Yes							
	H038-SSS-NBAY-NSCLNK23	REMOTE TERMINAL UNIT FOXBORO C50	C50	18/09/2006	6.53	Yes							
	H038-SSS-NBAY-OWNTWK2	SWITCH ETHERNET	[redacted]	18/09/2006	10.00	No							
	H038-SSS-NBAY-OWNTWK2	ROUTER	[redacted]	18/09/2006	10.00	No							
	H038-SSS-NBAY-OWNTWK2	SWITCH E/NET 32PRT RUGGED RSG2300 OPSWAN	[redacted]	1/01/2017	2.50	No							
	H038-SSS-NBAY-OWNTWK3	SWITCH ETHERNET	[redacted]	18/09/2006	10.00	No							
	H038-SSS-NBAY-OWNTWK3	SWITCH 8PORT	[redacted]	18/09/2006	10.00	No							
	H038-SSS-NBAY-OWNTWK3	SERIAL PORT SERVER 48VDC PERLE OPSWAN	IOLAN STS16DC	1/01/2017	2.50	No							
	H038-SSS-NBAY-OWNTWK3	SWITCH E/NET 32PRT RUGGED RSG2300 OPSWAN	[redacted]	1/01/2017	2.50	No							
	H038-SSS-NBAY-OWNTWK4	SWITCH ETHERNET	[redacted]	18/09/2006	10.00	No							
	H038-SSS-NBAY-OWNTWK4	SWITCH 8PORT	[redacted]	18/09/2006	10.00	No							
	H038-SSS-NBAY-OWNTWK4	SERVER PORT 48VDC PERLE 04030450 -OPSWAN	IOLAN STS16DC	1/01/2017	2.50	No							
	H038-SSS-NBAY-OWNTWK4	SWITCH E/NET 32PRT RUGGED RSG2300 OPSWAN	[redacted]	1/01/2017	2.50	No							
	H038-SSS-NBAY-OWSERV2	GEN 4 SERVER OPSWAN	EB15002	31/07/2019	0.35	No							
	H038-SSS-NBAY-RTUCOM3	REMOTE TERMINAL UNIT FOXBORO C50	C50	18/09/2006	6.53	Yes							
	H038-SSS-NBAY-RTUCOM4	REMOTE TERMINAL UNIT FOXBORO C50	C50	18/09/2006	6.53	Yes							
	H038-SSS-NBAY-TIMING3	GPS CLOCK TEKRON TCG01-D:1	TCG01-D09.009	29/06/2011	5.47	No							
	H038-SSS-NBAY-TIMING4	GPS CLOCK - TEKRON TCG01	TCG01-C:4	18/09/2006	6.53	No							
Powerlink Energex Interface										Powerlink-Energex Interface Cubicle	4/11/2005	3.54	2045

7. Conclusions

Based on the condition assessment, the main recommendations for the replacement of secondary systems equipment at H038 Goodna are:-

1. **Conduct following secondary system replacements by 2026:-**
   - Replace the ventilation film of all marshalling kiosks
   - Replace all 275kV 1 and 2 Bus protection and control equipment
   - Replace all 275kV coupler 504 and 507 protection and control equipment
   - Replace all 1 Transformer protection and control equipment (both 275kV and 110kV side)
   - Replace C60 relay and C50 RTU for feeder 8819
   - Replace all protection and control equipment for feeder 8842
   - Replace all protection and control equipment for feeder 110kV 1 & 2 Bus and bus coupler 411
   - Replace all protection and control equipment for 4 and 5 Transformer
   - Replace all protection and control equipment for 110kV feeder 718, 7295, 7296 and 791
   - Replace all protection and control equipment for 110kV 3 Cap
   - Install Power Quality Monitoring device
   - Replace all metering equipment based on current design standard
   - Replace NSC1, NSC2 and LCF RTU and upgrade the SDACA DNP serial to NP/IP
   - Replace common RTU in building +3 and +4
   - Replace Comms RTU in building +2
   - Replace HMI Blade 150 Sun workstation
   - Replace OpsWAN in Building +2 , +3 and Building +4
   - Replace Arbiter GPS clock in building +4
   - Replace 125VDC battery charger in Building +3
   - Replace 125VDC battery charger in Building +4
   - Replace 48VDC charger in Building +2

2. **Carry out following replacement by 2035**
   - Replace Feeder 8819 RED670 and SEL-421-5 relay
   - Replace the check meter for 4T
   - Replace GPS clock in Building +3

8. References

(1) National Electricity Rules (NER) Version 106, AEMC, 27/02/2018
(2) “Modelling Substation control and Protection Asset Condition for Optimal reinvestment Decision Based on Risk, Cost and Performance”, CIGRE PARIS 26-31 August 2018, T Vu, M. Pelevin, D. Gibbs, J.Horan, C. Zhang.
(3) “Powerlink – Asset Risk Management – Framework”, ASM-I&P-FRA-A2417558, Powerlink Queensland, 2019.

Planning Statement	September 2020
Title	**CP.02796 Goodna Secondary Systems Replacement – Planning Statement**[1]
Zone	Moreton
Need Driver	Emerging risks arising from the condition of the secondary systems requiring replacement of the secondary systems by July 2026.
Network Limitations and statutory requirements	Secondary systems at Goodna Substation are not compliant with Schedule 5.1.9(c) of the National Electricity Rules (NER). Goodna Substation is required to meet Powerlink Queensland's N-1-50MW/600MWh reliability obligations.
Pre-requisites	None

Executive Summary

Ageing and obsolete secondary systems at Goodna Substation are increasingly at risk of failing to comply with Schedule 5.1.9(c) of the National Electricity Rules and AEMO's Power System Security Guidelines[2].

Energy Queensland's forecasts confirm there is an enduring need to maintain electricity supply into the Brisbane Southwest/Ipswich area. The removal or reconfiguration of the Goodna 275/110kV Substation due to secondary system failure/obsolesce would violate Powerlink's N-1-50MW/600MWh Transmission Authority reliability standard.

Therefore, there is an enduring need to maintain the current function and capacity of the Goodna Substation by replacing the at-risk secondary systems by July 2026.

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

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

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

Table of Contents

1. Introduction

Goodna Substation (H038) is located approximately 22km south-west of the Brisbane CBD. The substation was established in 2006 to meet growing demand in the Brisbane Southwest/Ipswich area and forms part of the greater Brisbane meshed network.

Goodna Substation contains two 275kV feeder bays energised from Blackwall and Belmont substations, a 275/110kV transformer and four 110kV feeder bays connected to West Darra, Blackstone and Redbank Plains Substations. Further, it contains two 110/33kV transformers to supply the bulk load in the local area.

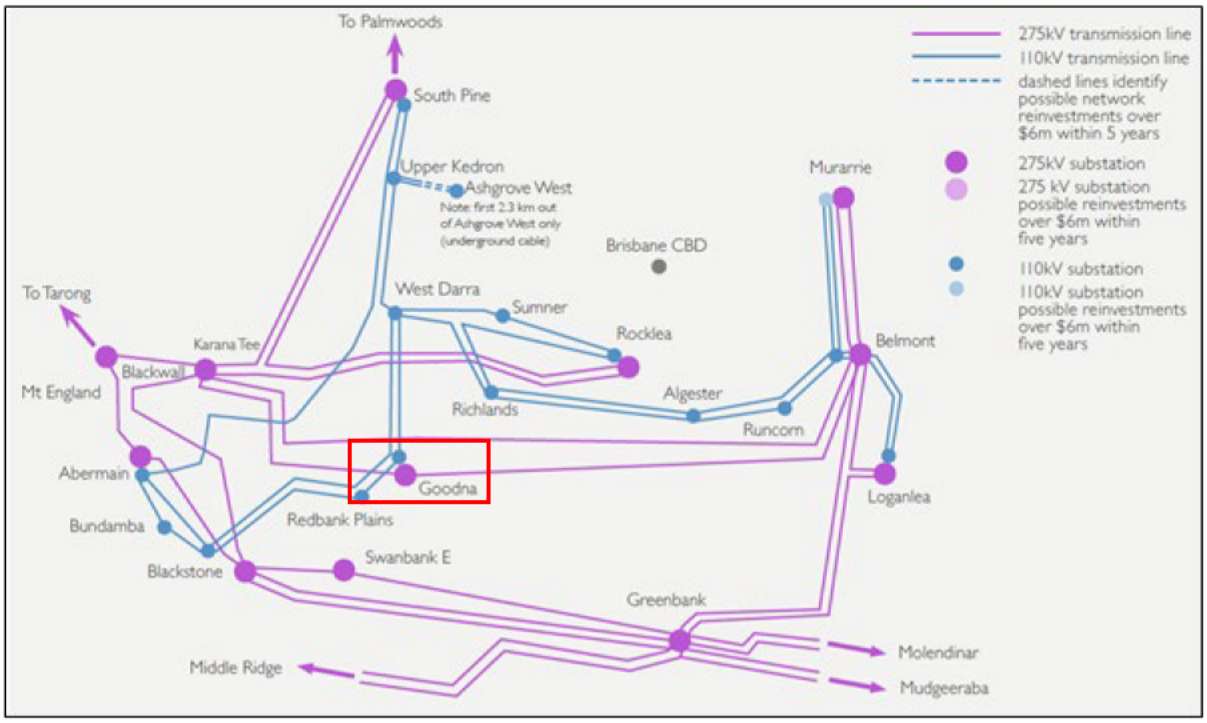


Figure 1 – Goodna Substation – Greater Brisbane Transmission Zone

A November 2019 condition assessment of the secondary systems at Goodna Substation has confirmed that they are reaching the end of their technical service lives, with many components no longer supported by the manufacturer and limited spares available. The condition assessment report recommends that the secondary systems be replaced by July 2026.

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

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

2. Goodna Demand and Constraints Forecast

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

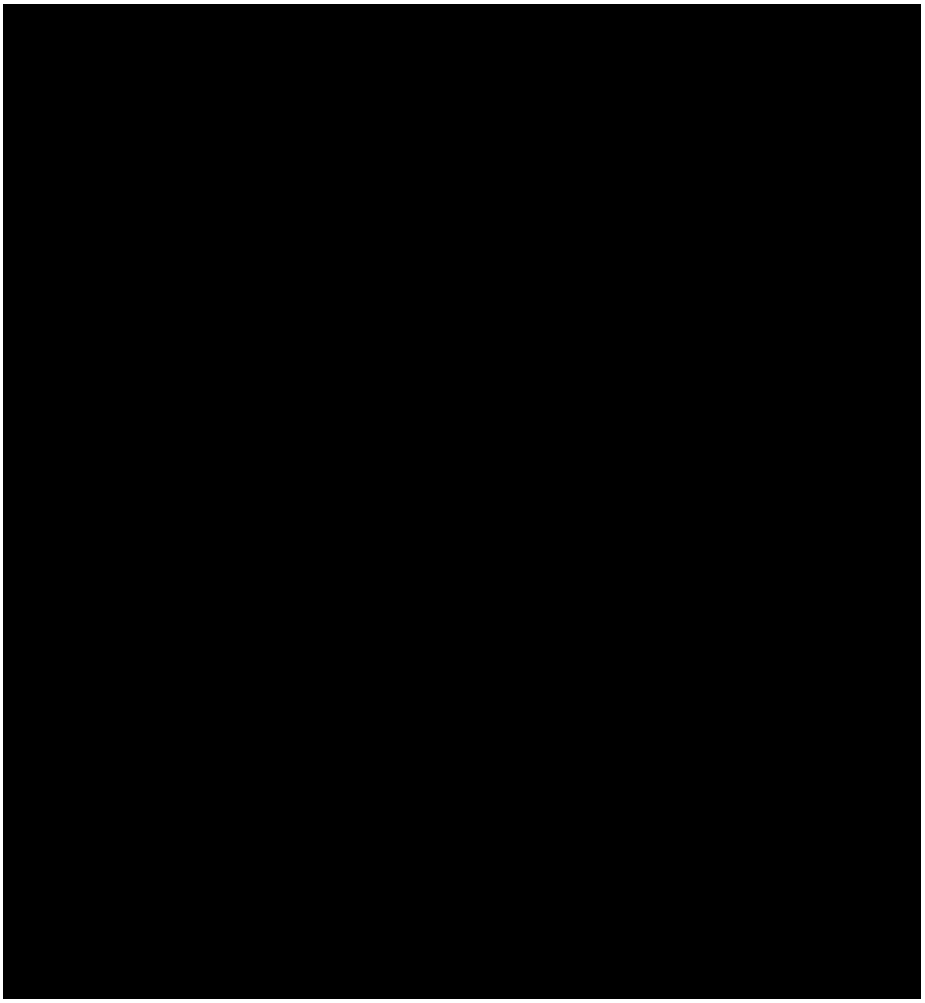


Figure 2 Goodna 275/110kV Operating Dagram

Figure 3 is the duration curve for the loads connected to Goodna's 110kV network.

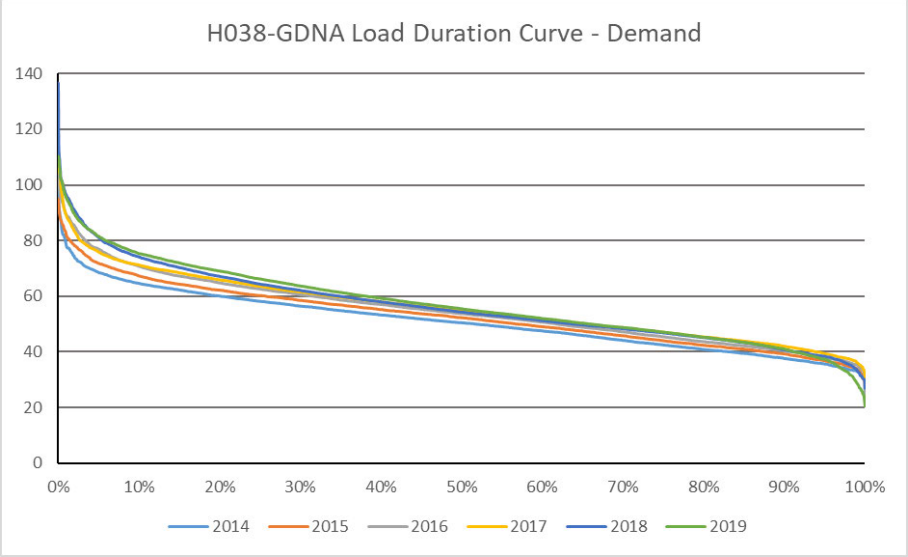


Figure 3 – Goodna 110kV Load Duration Curve

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

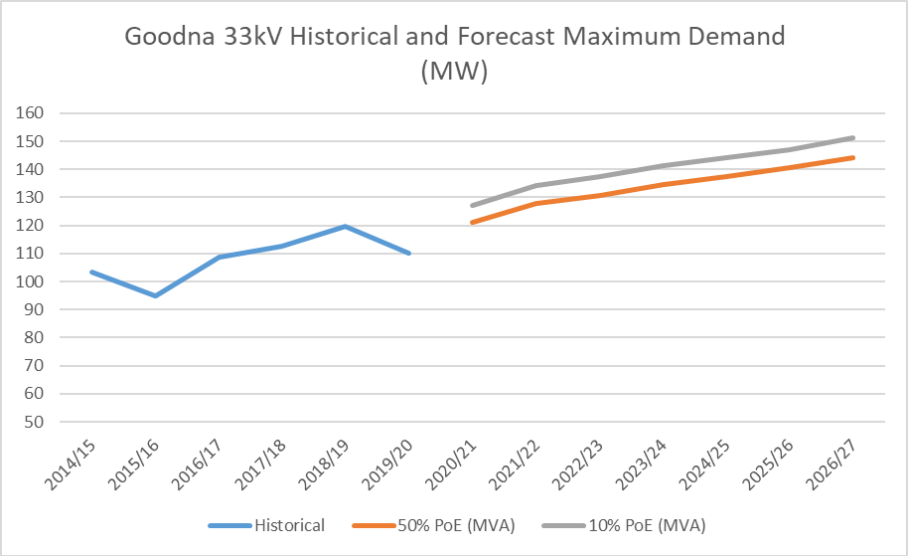


Figure 4 – Goodna 33kV Maximum Demand

3. Statement of Investment Need

As outlined in Section 1 the Goodna Substation is a major bulk supply point for Energex loads in the Brisbane Southwest/Ipswich area. The local load supplied from 110/33kV transformers at Goodna Substation is forecast to exceed 140MW from the mid-2020s (refer to Figure 4). The substation also switches 275kV and 110kV feeders to help maintain the reliable power supply to Powerlink substations in the Brisbane South region.

Therefore, addressing the risks arising from the condition of the secondary systems by removing the functionality of the Goodna Substation would have a major impact on the performance of the south Brisbane network as well reliability of supply to the local Goodna load. Even if the 110kV bus is retained with the 110/33kV transformers and associated replaced secondary systems, load in excess of Powerlink's required reliability obligations would be exceeded for credible contingencies on the 110kV network (refer to Table 1 – Goodna 275/110kV transformer out-of-service with loss of Richlands 707 feeder).

Therefore, the secondary systems are required to operate the Goodna Substation. The removal of Goodna Substation due to secondary system failure would violate the N-1-50MW/600MWh standard.

4. Network Risk

The table below presents the load (MW) and energy (MWh) at risk for credible contingencies assuming that a network element is removed from service due to a failure of a Goodna Substation secondary system element. This table is used to inform the Risk Cost assessment.

Table 1 – Load at Risk

At Risk	Contingency	Metric	2025
Goodna Loads	Both Goodna 110/33kV transformers	Max (MW)	148
		Average (MW)	65
		24h Energy Unserved Max (MWh)	2309
		24h Energy Unserved Average (MWh)	1551
Redbank Plains Loads	Goodna – 7296 Redbank Plains – 717	Max (MW)	30
		Average (MW)	10
		24h Energy Unserved Max (MWh)	456
		24h Energy Unserved Average (MWh)	241
Richlands Loads	With Goodna 275/110kV transformer OOS (Loss of Richlands fdr 707 overloads fdr 710)	Max (MW)	55
		Average (MW)	1.4
		24h Energy Unserved Max (MWh)	638
		24h Energy Unserved Average (MWh)	32
Belmont Loads (Wecker Road & Cleveland)	With Goodna 275kV feeder 8819 OOS (Loss of Belmont fdr 8822 overloads fdr 817)	Max (MW)	197
		Average (MW)	0.69
		24h Energy Unserved Max (MWh)	1419
		24h Energy Unserved Average (MWh)	16
Richland Loads (with Algester & Runcorn)	With Goodna 275kV feeder 8842 OOS (Loss of Richlands fdr 710 overloads fdr 707)	Max (MW)	199
		Average (MW)	30
		24h Energy Unserved Max (MWh)	3181
		24h Energy Unserved Average (MWh)	725
Richlands Loads	With Goodna 110kV feeder 7295 OOS (Loss of Richlands fdr 710 overloads fdr 707)	Max (MW)	117
		Average (MW)	8
		24h Energy Unserved Max (MWh)	1495
		24h Energy Unserved Average (MWh)	181
Richlands Loads	With Goodna 110kV feeder 791 OOS (Loss of Richlands fdr 710 overloads fdr 707)	Max (MW)	117
		Average (MW)	8
		24h Energy Unserved Max (MWh)	1495
		24h Energy Unserved Average (MWh)	181

5. Non Network Options

The Goodna 275/110kV Substation hosts one 275/110kV and two 110/33kV transformers to facilitate supply to Brisbane Southwest/Ipswich and Goodna areas respectively.

To meet the Goodna demand, the non-network solution must be capable to delivering up to 200MW and 3200MWh of energy each day (Refer Table 1). The non-network solution would be required to be capable of operating during a contingency or outage on a continuous basis until normal supply can be restored.

Potential non-network solutions would need to provide supply to individual loads as per the load at risk table to reduce the scope of this project.

Powerlink is not aware of any Demand Side Solutions (DSM) in the area supplied by Goodna 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.

6. Network Options

6.1 Proposed Option to address the identified need

Planning recommends the replacement of all secondary systems reaching end of life at the Goodna Substation by the July 2026. This option ensures that all reliability of supply and asset condition criteria is met.

6.2 Option Considered but Not Proposed

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

6.2.1 Do Nothing

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

7. Recommendations

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

Retaining Goodna Substation will allow Powerlink to continue to meet its required reliability obligations (N-1-50MW/600MWh).

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

8. References

1. H038 Goodna 275/110kV Substation – Secondary Systems Condition Assessment Report
2. Transmission Annual Planning Report 20120
3. Asset Planning Criteria Framework

9. Appendix A – Network Risk methodology

Goodna 110/33kV transformers

Goodna substation consists of two parallel 110/33kV transformers to provide the bulk supply to the Energy Queensland's local network. The loss of these transformers will results in the loss of supply to Goodna and the local area.

Goodna 275/110kV transformer

This transformer is a key 275kV injection point for the power supply to Southwest/Ipswich area. Without this transformer, a contingent outage of a local 110kV feeder may overload the parallel feeder, requiring load curtailment. Assessment is based on Goodna 275/110kV transformer OOS, then curtailing targeted load such that loss of feeder 707 does not overload 710.

275kV Feeder 8819

Feeder 8819 normally supplies power from Blackwall to Goodna Substation. If this feeder is out of service (OOS) then contingency outages, especially in 275kV network, could overload some feeders e.g. loss of 8822 overloads 817. Assessment is based on Goodna feeder 8819 OOS, then curtailing targeted load such that loss of feeder 8822 does not overload 817.

275kV Feeder 8842

This feeder normally supplies power from Goodna to Belmont substation. If this feeder is out of service (OOS) then it will lead to a higher flow via 110kV network from Goodna to Belmont direction and some of these lines may get overloaded post-contingency. Assessment is based on Goodna feeder 8842 OOS, then curtailing targeted load such that loss of feeder 710 does not overload 707.

110kV Feeder 7296

Redbank Plains substation is fed from Blackstone substation via feeder 717, and from Goodna substation via feeder 7296. Losing both of these feeders will cut-off the supply to Redbank Plains Substation.

110kV Feeder 7295 & 791

Both of these feeders mainly supply power from Goodna to Sumner, Richlands and Algester substations. If one of these lines is out of service then a contingency outage will overload the local 110kV network. Assessment is based on Goodna feeder 7295 or 791 OOS, then curtailing targeted load such that loss of feeder 710 does not overload 707.

Assumptions

In practice, pre-contingent operational switching may mitigate the impact of possible outages with the above. A detail switching strategy would be formulated closer to the implementation period.

Base Case Risk Summary Report

CP.02796 Goodna Secondary Systems Replacement

Version Number	Objective ID	Date	Description
1.0	A4367200	29/10/2020	Original document.

1 Purpose

The purpose of this model is to quantify the base case risk cost profiles for the secondary systems at Goodna substation which is proposed for reinvestment under CP.02796.

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

2 Key Assumptions

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

- Spares for secondary system equipment items have been assumed to be available prior to the point of expected spares depletion, which coincides with the expected technical asset life. After this point the cost and time to return the secondary system back to service increases significantly;
- Historical load profiles have been used when assessing the likelihood of unserved energy under failure events;
- Due to the network and substation configuration, unserved energy generally accrues under concurrent failure events and consideration has been given to potential feeder trip events within the wider south west Queensland area;
- Goodna substation supplies a mixture of residential, commercial and light industrial loads. Historical load data and estimates have been used to analyse the proportion of these load types;
- VCRs within the relevant climate zone published within the AER's 2019 Value of Customer Reliability Review Final Report have been used within this risk cost assessment. A weighted average VCR of $35,342/MWh has been used when evaluating network risk cost derived from the proportions identified from historical data.

3 Base Case Risk Analysis

3.1 Risk Categories

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

3.2 Secondary Systems Analysis

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

Table 1: Risks associated with at risk secondary systems

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

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

3.3 Base Case Risk Cost

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

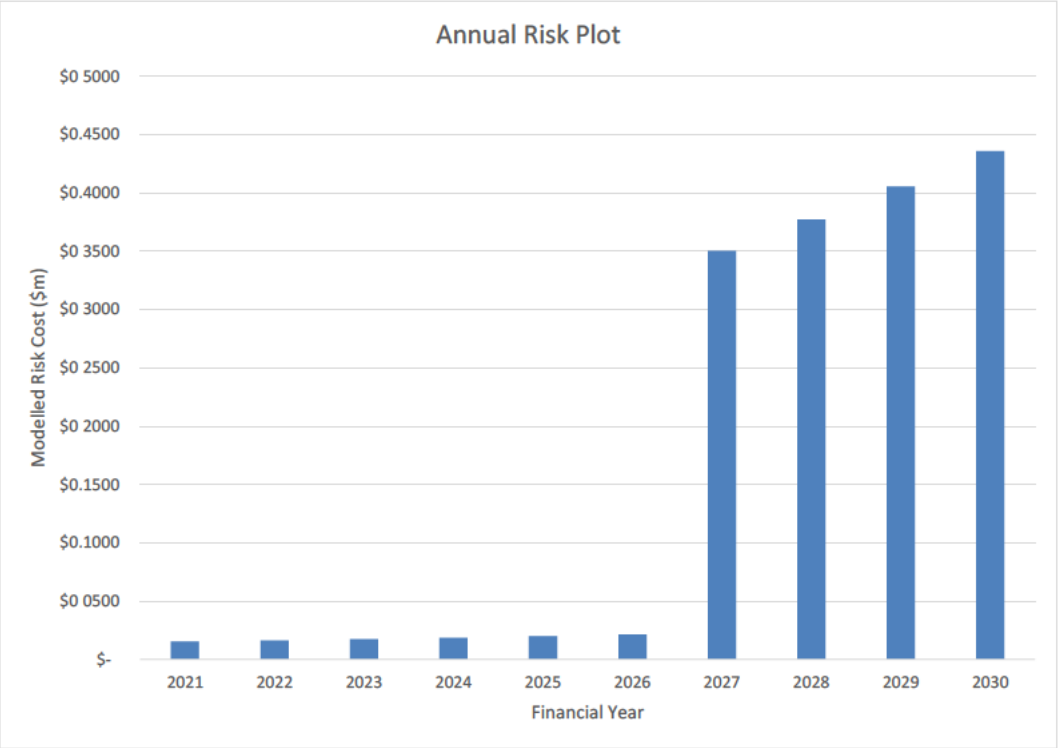


Figure 1 – Goodna secondary systems total risk cost

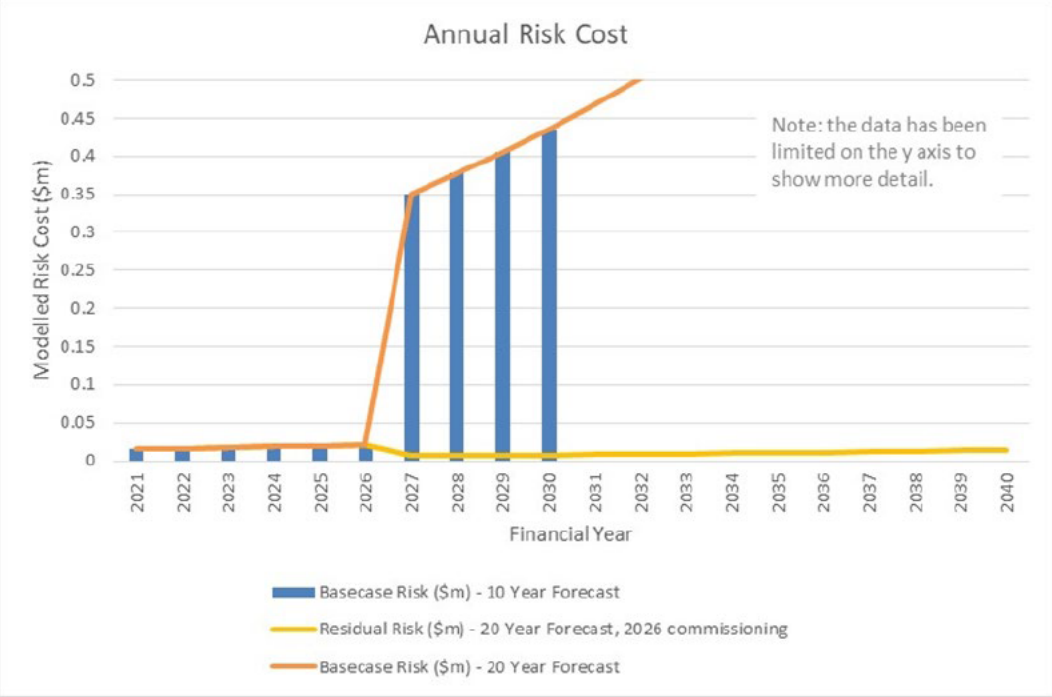


Figure 2 – Goodna secondary systems risk cost (10 and 15 years)[2]

[2] The significant increase in modified risk cost in 2027 coincides with the depletion of available spares (refer Section 4).

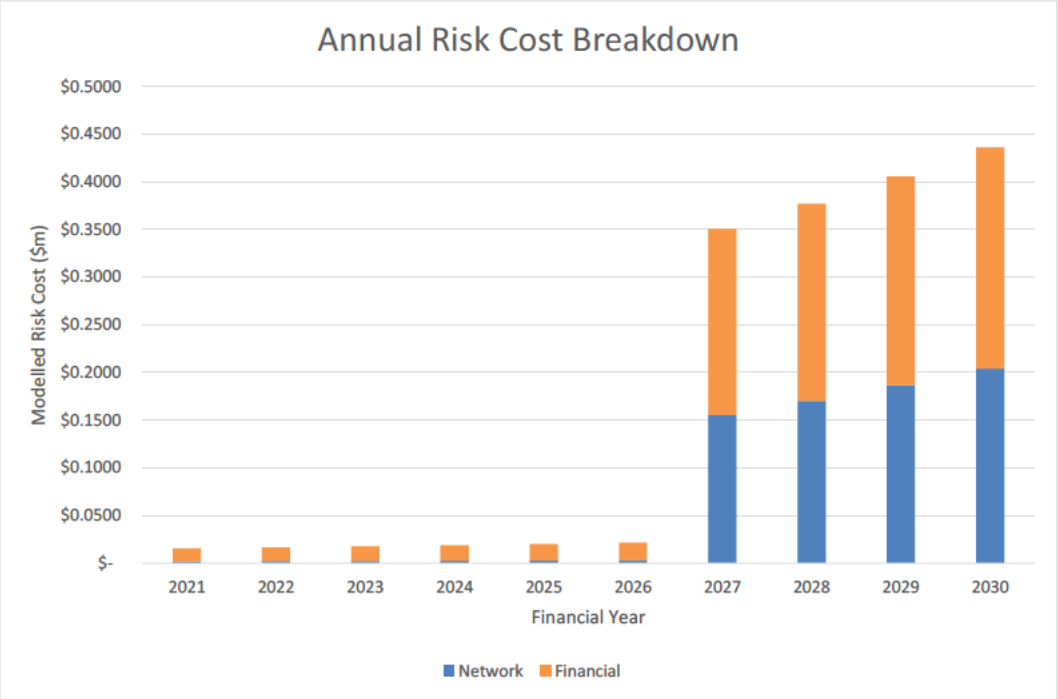


Figure 3 – Goodna secondary systems risk cost by category

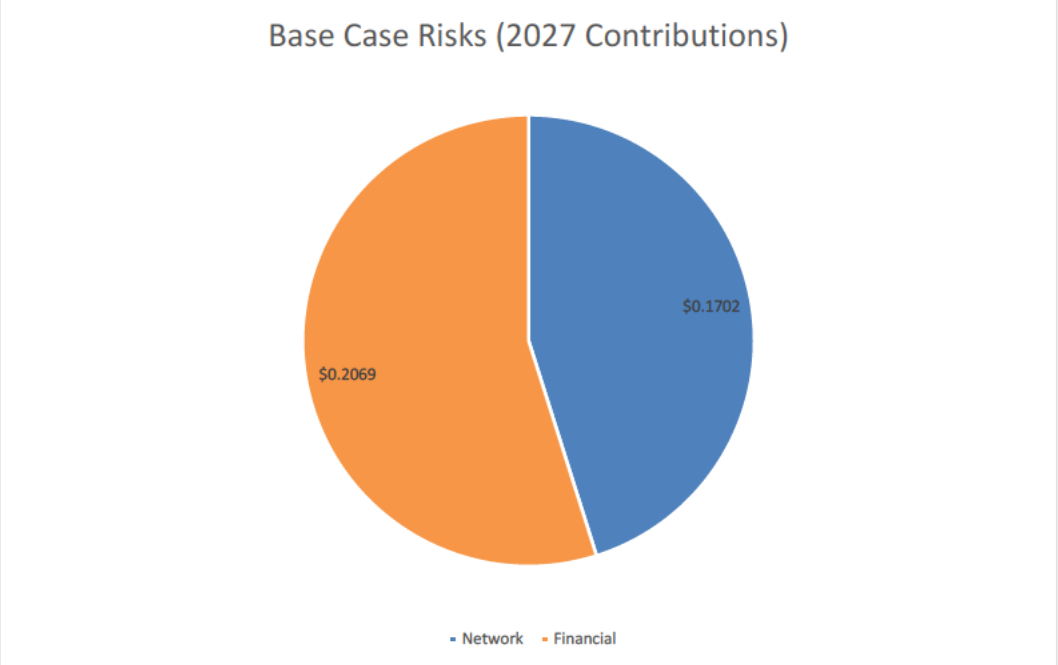


Figure 4 – Goodna 2027 risk cost by category

3.4 Base case risk statement

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

4 Participation factors

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

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

As an example, the participation of VCR to risk cost post obsolescence is approximately 45%. Hence, an increase in VCR of 100% would increase the overall risk cost by around 45%.

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

The following observations can be made:

- Pre-secondary systems obsolescence: the model is most sensitive to emergency replacement cost followed by plant restoration time.
- Post-secondary systems obsolescence: the model is most sensitive to plant restoration time followed by emergency replacement cost.

Table 2: Input values, secondary systems model

	Item	Value	Unit
Network	VCR	35,432	$/MWh
	Plant restoration time with spares	1	Day
	Plant restoration time with no spares	7	Days
Financial	Emergency replacement cost with spares	0.01	$million
	Emergency replacement cost with no spares	0.1	$million

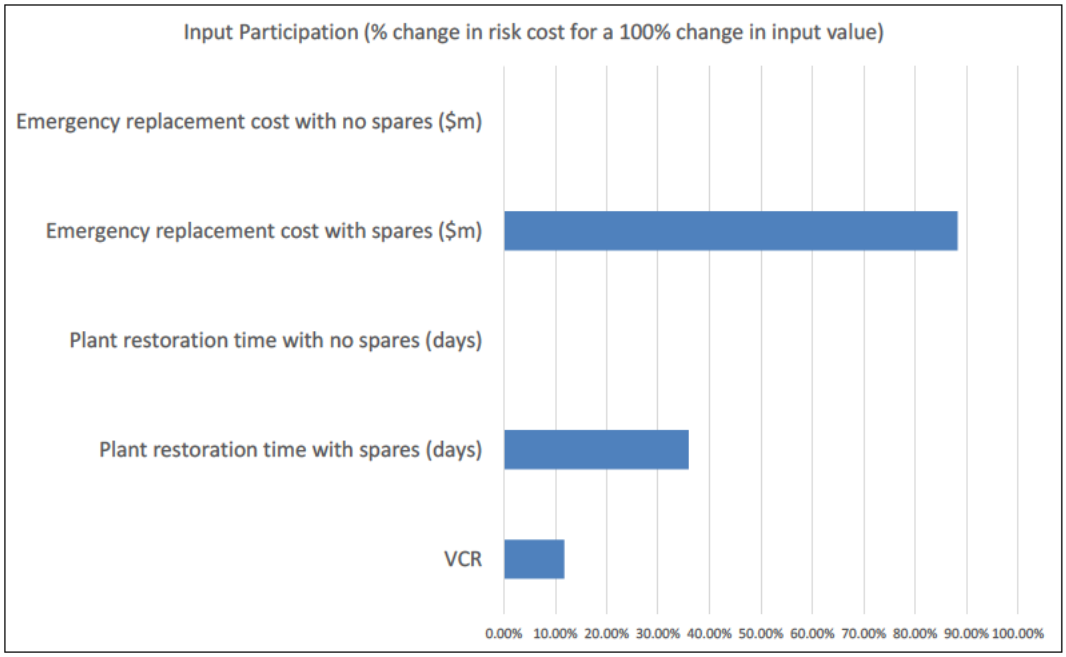


Figure 5 - Participation factors, secondary systems model – pre secondary systems obsolescence

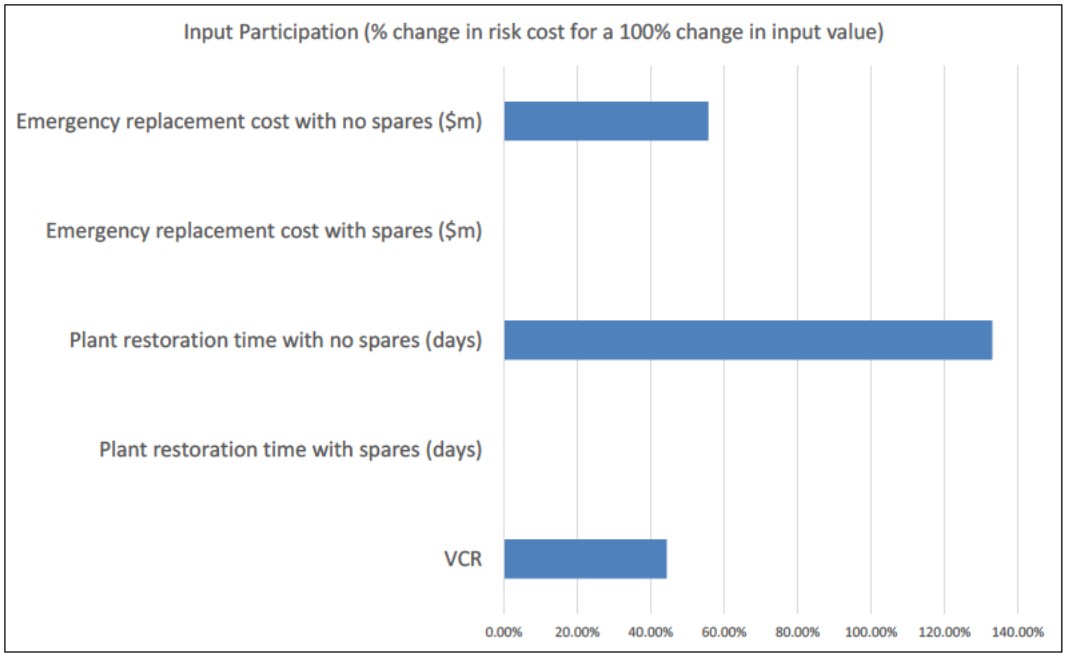


Figure 6 - Participation factors, secondary systems model – post secondary systems obsolescence

Project Scope Report

CP.02796

Goodna Secondary Systems Replacement

Concept – Version 3

Document Control

Change Record

Issue Date	Responsible Person	Objective Document Name	Background
06/03/20	[redacted]	Project Scope Report CP.0xxxx Goodna Secondary Systems Replacement Concept	Preliminary scope
08/04/2020	[redacted]	Project Scope Report CP.02796 Goodna Secondary Systems Replacement Concept	In-Situ option removed
01/05/2020	[redacted]	Project Scope Report CP.02796 Goodna Secondary Systems Replacement Concept	Clarification of scope inclusions

Related Documents

Issue Date	Responsible Person	Objective Document Name
18/12/2019	[redacted]	H038 Goodna Secondary Systems Condition Assessment Report – November 2019 (A3276786)

Project Contacts

Project Sponsor	[redacted]	[redacted]
Strategist – HV/Digital Asset Strategies	[redacted]	[redacted]
Team Leader Grid Planning	[redacted]	[redacted]
Planner – Main/Regional Grid	TDB	Ext.
Manager Projects	TDB	Ext.
Project Manager	TDB	Ext.
Design Coordinator	TDB	Ext.

Project Details

1. Project Need & Objective

H038 Goodna Substation was built to meet the increased demand in the South West Brisbane / Ipswich area in 2006, including the original secondary systems for both 275 and 110kV primary plant. Goodna Substation consists of one yard of 275kV and 110kV operating voltage enclosed by the one perimeter fence.

A condition assessment of H038 Goodna secondary systems was carried out in December 2019. The assessment concluded that secondary systems for 275kV and 110kV network will reach the end of technical asset life in 2026. As a result, it is recommended that these systems need to be replaced to mitigate associated risks, including: -

- Maintainability issues, including unavailability of spare parts and lack of technical support; and
- Declining condition of equipment causing decreased reliability.

The objective of this project is to replace secondary systems 275kV and 110kV system bays by 2026.

2. Project Drawing

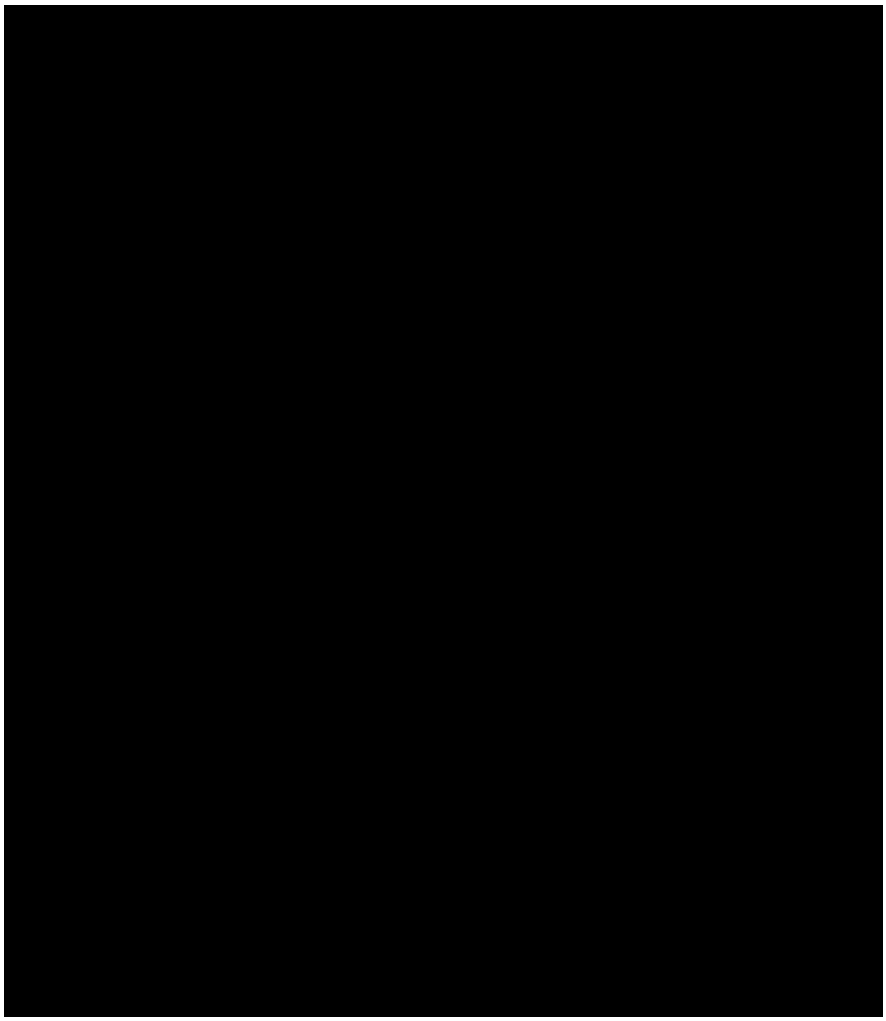


Figure 1 – Operational Diagram for H038 Goonda

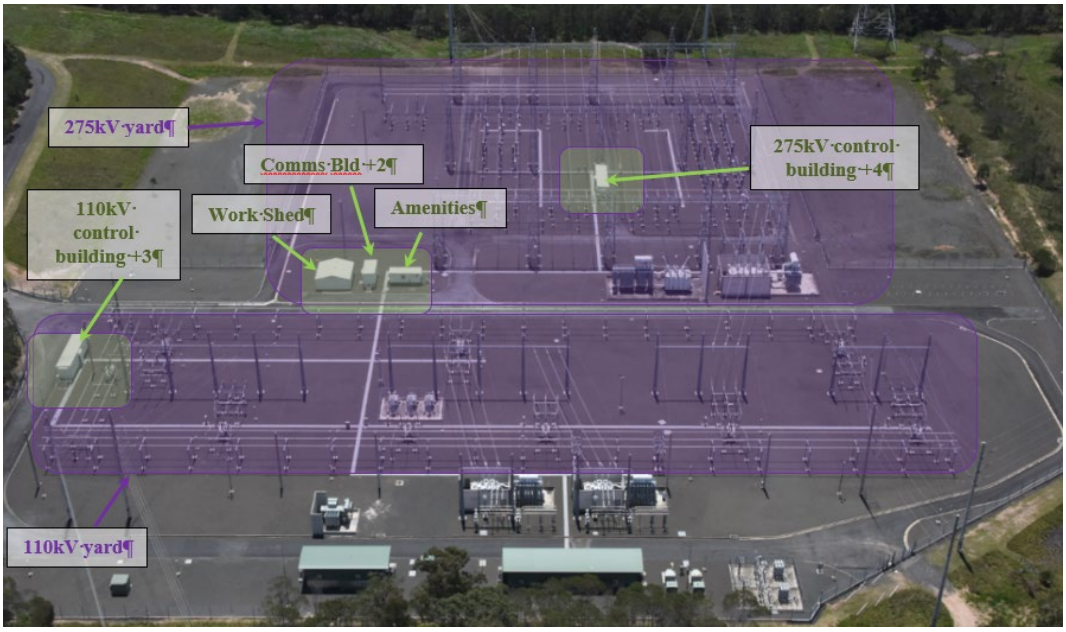


Figure 2 - Goodna Substation Aerial View – Looking North

3. Project Scope

3.1. Option 1 – Replacement of panels into new control Buildings

The following scope presents a functional overview of the desired outcomes of the project. The proposed solution presented in the estimate must be developed with reference to the remaining sections of this Project Scope Report, in particular *Section 6 Special Considerations*.

Briefly, this project option consists of a single stage replacement of the 275kV and 110kV Secondary System panels in buildings +3 & +4 into two new control buildings at H038 Goodna. Also, some selected replacement of equipment in building +2.

3.1.1. Transmission Line Works

Not Applicable

3.1.2. H038 Substation Works

The following items are to be done in a single stage and completed by 2026:

- Design, procure, construct and commission new 275kV and 110kV control buildings for a staged cutover of secondary systems panels from the existing +3 & +4 buildings to the new buildings.
- Design, procure, construct and commission a new cable termination racks.
- Design, procure, construct and commission cable trenches to the new cable termination racks and run cables from the new cable termination rack to the new control buildings as appropriate.
- Replacement of the following secondary systems panels to the current standard into the new control build:

  In Building +4
  - Replacement of the following secondary systems panels to the current standard into a new control building: -
    - 275kV BUS ZONE 1;
    - 275kV BUS ZONE 2;
    - C04- 275kV BUS COUPLER;
    - C04 - 275kV FEEDER 8819;
    - C07 - TRANSFORMER 1 275kV;
    - C07 - 275kV BUS COUPLER; and
    - C07 - 275k V FEEDER BELMONT 8842.
  - Replacement of 125V DC X & Y DB & Battery Charger and Cubicle;
  - Replacement of Common RTU, OPSWAN and associated panel; and
  - Replacement of Arbiter GPS clock

  In Building +3
  - Replacement of the following secondary systems panels to the current standard into a new control building: -
    - 110kV BUS ZONE 1;
    - 110kV BUS ZONE 2;

    - D01 - 110kV BUS COUPLER;
    - D03 - 110kV FEEDER 7296;
    - D06 - 110kV FEEDER 718;
    - D14 - 62.5MVar CAPACITOR BANK = M01-C1;
    - D17 - TRANSFORMER 5 ;
    - D36 - 110kV FEEDER 791;
    - D35 - 110kV FEEDER 7295 ;
    - D28 - 110kV INCOMER FROM 275/110kV TX; and
    - D20 - TRANSFORMER 4
  - Replacement of 125V DC X & Y DB & Battery Charger & Cubicle;
  - Replace all metering equipment and panel based on current standard;
  - Replacement of NSC1, NSC2 and LCF RTU and associated panel. Upgrade SCADA to DNP/IP;
  - Replacement of NSC/LCF, Common RTU, OPSWAN and associated panel;
  - Replacement of HMI Blade 150 Suns Workstation; and
  - Install new Power Quality Monitoring panel.
  - Replacement of GPS clock

  In Building +2 replacement of the following equipment: -
  - Replace Comms RTU
  - Replace OpsWAN
  - Replace dual 48VDC charger and batteries

- Move all fibre termination panels to one of the new buildings as appropriate

- Move fire panels, fire protection equipment as well as substation security related equipment to one of the new buildings or amenities building as appropriate.

- Decommissioning and removal of the old control buildings +3 & +4.

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

3.1.3. Remote End Substation Works

Modify remote end protection, control, automation and communications systems as required at H036 Blackwall, H003 Belmont, H072 Blackstone, T155 West Darra and T080 Redbank Plains.

3.1.4. Telecoms Works

Adjust telecoms for new protection/control equipment as required.

3.1.5. Easement/Land Acquisition & Permits Works

Not applicable

3.2. Key Scope Assumptions

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

- The replacement of any new control building should be done in a manner that minimizes the required cable runs; and
- The location of the new cable termination rack should be such that cables terminated directly between secondary systems panels and the marshalling kiosks can be relocated from the existing control building to the new cable termination rack without need to re-run cables to the yard marshalling kiosks.
- Existing control cables are assumed to have sufficient remaining life so as not to require replacement.

4. Project Timing

4.1. Project Approval Date

The anticipated date by which the project will be approved is June 2024

4.2. Site Access Date

Site access is immediately available as H038 Goodna is a Powerlink site.

4.3. Commissioning Date

The latest date for the commissioning of the new assets included in this scope the decommissioning and removal of redundant assets, where applicable, is 31 December 2026.

5. Special Considerations

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

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

6. Asset Management Requirements

Equipment shall be in accordance with Powerlink equipment strategies.

Unless otherwise advised [redacted] will be the Project Sponsor for this project. The Project Sponsor must be included in any discussions with any other areas of Investment & Planning.

[redacted] will provide the primary customer interface with Energex. The Project Sponsor should be kept informed of any discussions with the customer.

7. Asset Ownership

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

The asset boundary with Energex will be the LV terminals of the 110/33kV transformers.

8. System Operation Issues

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

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

9. Options

Not applicable.

10. Division of Responsibilities

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

11. Related Projects

None

Concept Estimate for CP.02796 - Goodna Secondary Systems Replacement

Record ID	A3345462	
Policy stream	Asset Management	
Authored by	Project Manager	[redacted]
Reviewed by	Team Leader	[redacted]
Approved by	Manager Projects	[redacted]

Table of Contents

1. Executive Summary

This proposal is based on the Project Scope Report (PSR) CP.0XXXX Goodna Secondary Systems Replacement Concept - Version 3 dated 1 May 2020.

H038 Goodna was built to meet the increased demand in the South West Brisbane / Ipswich area in 2006.

A condition assessment of H038 Goodna secondary systems was carried out in December 2019. The assessment concluded that secondary systems for 275kV and 110kV network will reach the end of technical asset life in 2026. As a result, it is recommended that these systems need to be replaced to mitigate associated risks with aged equipment.

The scope includes a single stage replacement of the 275kV and 110kV Secondary System panels in buildings +3 & +4 into two new control buildings at H038 Goodna. Also, some selected replacement of equipment in building +2.

The project will upgrade 275kV & 110kV secondary systems at H038 Goodna and remote end substation at H036 Blackwall, H003 Belmont, H072 Blackstone, T155 West Darra and T080 Redbank Plains.

This Concept Estimate proposal offers a 40month delivery schedule from the project approval date. The PSR requested a 30month schedule however this was not achievable to deliver the scope of works identified with the multiple staging required.

The objective of this project is to replace secondary systems 275kV and 110kV system bays by 2027.

The project delivery is predicated on the following terms:

- Project Approval is received on or before June 2024;
- Contractor Design and Construction resources are available as scheduled;
- MSP resources will be available as scheduled; and
- Planned Outage dates will be available during the stages when required.

1.1 Project Estimate

Estimate Components		Base $	Escalated $
Estimate Class	5		
Estimate Accuracy	+100% / -50%		
Base Estimate		**19,727,370**	**25,171,346**
Mitigated Risk	[redacted]	[redacted]	[redacted]
Contingency Allowance	[redacted]	[redacted]	[redacted]
TOTAL		[redacted]	[redacted]

1.2 Project Financial Year Cash Flows

	June 2020 Base $	Escalated $
To June 2024	382,348	439,756
To June 2025	6,901,896	8,437,661
To June 2026	5,448,863	6,934,422
To June 2027	5,274,598	6,987,864
To June 2028	1,719,663	2,371,643
TOTAL	**19,727,370**	**25,171,346**

2. Project and Site Specific Information

2.1 Project Dependencies & Interactions

This project has not identified any dependencies, interactions or related projects that may impact the delivery of this project.

Only the remote end feeders have been considered in the project delivery staging. Should there be other project works at the remote ends this will need further investigation if the staging at H038 Goodna will be impacted.

2.2 Site Specific Issues

The substation H038 Goodna is situated near residential areas therefore construction noise must be kept at a minimum and early morning and late afternoon traffic should be limited since a primary school is located on the same street less than 1km away.

3. Replacement of panels into new control Buildings

3.1 Replacement of panels into new control buildings

3.1.1 Scope

The scope includes a single stage replacement of the 275kV and 110kV Secondary System panels in buildings +3 & +4 into two new control buildings at H038 Goodna. Also, some selected replacement of equipment in building +2.

The project will upgrade 275kV & 110kV secondary systems at H038 Goodna and remote end substation at H036 Blackwall, H003 Belmont, H072 Blackstone, T155 West Darra and T080 Redbank Plains.

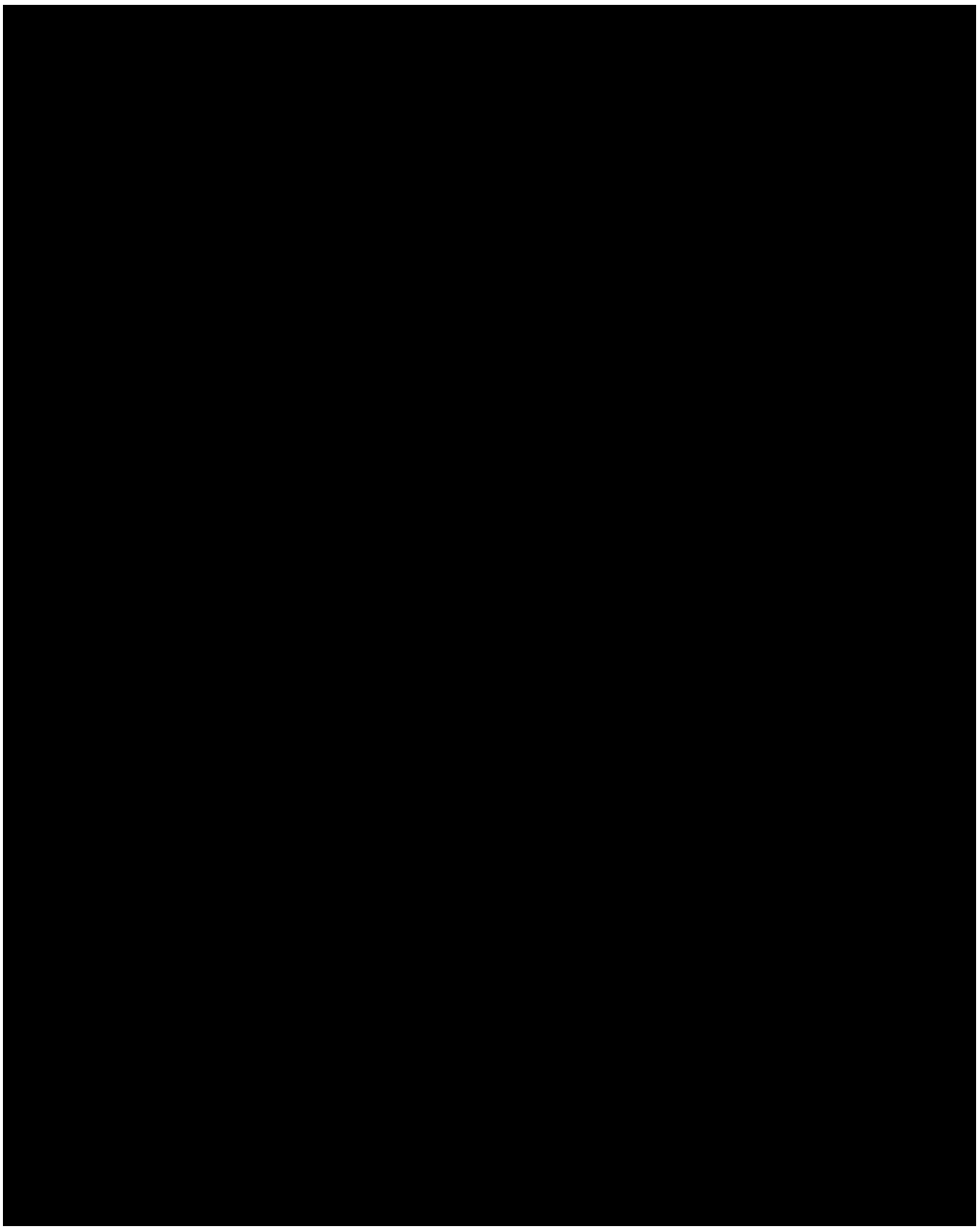


Figure 1 – Operational Diagram for H038 Goonda

3.1.1.1 Substations Works

Design, procure, construct and commission the following works.

- Design, procure, construct and commission new 275kV and 110kV control buildings for a staged cutover of secondary systems panels from the existing +3 & +4 buildings to the new buildings.
- Design, procure, construct and commission a new cable termination rack.
- Design, procure, construct and commission cable trenches to the new cable termination racks and run cables from the new cable termination rack to the new control buildings as appropriate;
- Replacement of the following secondary systems panels to the current standard into the new control build:

In Building +4: -

- Replacement of the following secondary systems panels to the current standard into a new control building: -
    - 275kV Bus Zone 1;
    - 275kV Bus Zone 2;
    - C04- 275kV Bus Coupler;
    - C04 - 275kV Feeder 8819;
    - C07 - Transformer 1 275kV;
    - C07 - 275kV Bus Coupler; and
    - C07 - 275kV Feeder Belmont 8842.
- Replacement of 125V DC X & Y DB & Battery Charger and Cubicle;
- Replacement of Common RTU, OPSWAN and associated panel; and
- Replacement of Arbiter GPS clock

In Building +3: -

- Replacement of the following secondary systems panels to the current standard into a new control building: -
    - 110kV Bus Zone 1;
    - 110kV Bus Zone 2;
    - D01 - 110kV Bus Coupler;
    - D03 - 110kV Feeder 7296;
    - D06 - 110kV Feeder 718;
    - D14 - 62.5MVar Capacitor Bank = M01-C1;
    - D17 - Transformer 5 ;
    - D36 - 110kV Feeder 791;
    - D35 - 110kV Feeder 7295 ;
    - D28 - 110kV Incomer From 275/110kV TX; and
    - D20 - Transformer 4
- Replacement of 125V DC X & Y DB & Battery Charger & Cubicle;
- Replace all metering equipment and panel based on current standard;
- Replacement of NSC1, NSC2 and LCF RTU and associated panel. Upgrade SCADA to DNP/IP;
- Replacement of NSC/LCF, Common RTU, OPSWAN and associated panel;
- Replacement of HMI Blade 150 Suns Workstation; and
- Install new Power Quality Monitoring panel.
- Replacement of GPS clock

In Building +2 replacement of the following equipment: -

- Replace Comms RTU
- Replace OpsWAN
- Replace dual 48VDC charger and batteries

- Move all fibre termination panels to one of the new buildings as appropriate
- Move fire panels, fire protection equipment as well as substation security related equipment to one of the new buildings or Amenities building as appropriate.
- Decommissioning and removal of the old control buildings +3 & +4 at H038 Goodna.

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

Modify remote end protection, control, automation and communications systems as required at H036 Blackwall, H003 Belmont, H072 Blackstone, T155 West Darra and T080 Redbank Plains.

3.1.1.2 Transmission Line Works

Not Applicable

3.1.1.3 Telecommunication Works

Adjust telecoms for new protection/control equipment as required.

3.1.1.4 Easement/Land Acquisition & Permit Works

Not Applicable

3.1.2 Major Scope Assumptions

This Concept Estimate is based on the following assumptions:

- Resources will be available as planned in the Project Schedule;
- It is assumed that the new buildings will be located within the vicinity of the existing buildings. The new foundations will use bored piers;
- Cables terminated directly between the existing secondary systems panels and marshalling kiosks can be relocated from the existing control buildings to new cable termination racks without needing to re-run cables to the yard marshalling kiosks;
- Existing cable trenches can accommodate rerouting to the new cable termination racks in new control buildings;
- The 110Kv and 275kV Secondary system will be replaced with 26 commissioning stages. The final two stages are demolition of the redundant buildings and making good.
- Initial conversations with the Network Outage Coordinators have occurred and it is assumed that the outages as discussed and proposed will be available as required and no Live Sub/Live lines are required.
- A two hours Return to service time has been assumed for 110kV Bays.
- It is assumed that 275kV bays can remain out of service for the short durations (as staged), e.g. the 275/110kV transformer is out of service during the refurbishment.
- The Spare 275kV bays are excluded from the scope as there are no associated Secondary Systems.

3.1.3 Scope Exclusions

This Concept Estimate is based on the follow exclusions:

- Any extension of the existing platform, fence earth grid and roads is excluded;
- Rock is excluded from the base estimate;
- This estimate does not include any costs for repairing or modification to the primary plants;
- The estimate excludes upgrades for the following: earth grid, internal roads, lights, fences and gates;
- No asbestos removal is included in the scope of this project.

3.2 Project Execution

3.2.1 Project Schedule

The duration of the project is 40 months or 3.3 years. It is based on a start date of July 2024 and final project commissioning date October 2027. The PSR project completion date of December 2026 is not achievable with the current identified scope of works.

Task	Target Completion
Project Approval	Jun 2024
Design	Jul 2024 – Dec 2024
Contract Award	Mar 2025
Procurement	Aug 2024 – Apr 2025
FAT Control Buildings	Mar 2025 – Jul 2025
Construction	May 2025 – Sep 2025
MSP Construction	Oct 2025 – Nov 2025
Staged Commissioning to new Control Buildings	Apr 2026 – Aug 2027
MSP Decommissioning	Aug 2027 – Sep 2027
Decommissioning	Sep 2027 – Oct 2027
Project Completion	27 Oct 2027

3.2.2 Network Impacts

The delivery of this project will require multiple outages to cutover each of the 110kV and 275kV bays. The network will not only impact the main site H038 Goodna but also the remote ends at H036 Blackwall, H003 Belmont, H072 Blackstone, T155 West Darra and T080 Redbank Plains with the respective connected feeders.

Further to this the following Network Impacts have also been identified:

- The 275kV bays can remain out of service for the short durations (as staged), e.g. the 275/110kV transformer is out of service during the refurb; and
- Outages with a two hour return to service is expected to be available for the 110kV bays.

3.2.3 Project Staging

The project staging plan below details a sequential list of tasks with minor paralleled activities. The commissioning cutover stages could be optimised further to combine multiple stages in parallel or packaged together. The number and duration of outages could also be reduced. This should be considered when a class 3 proposal is developed.

Stage	Description/Tasks	Comments	Outages
	Internal Design		No
	Procurement		No
1	FAT		No
2	Construction		No
3	MSP Construction		Yes
4	MSP Telecoms & Data Networks		TBA
5	SAT		Yes
6	MSP staged commissioning cutover	Building +3 and +4	Yes
7	MSP Construction Decommissioning		Yes
8	Construction		Yes

3.2.4 Resourcing

The delivery of this project is based on utilising a combination of the following resources Powerlink Design, MSP and Contractor.

Design

All detailed design will be completed internally for Primary, Civil/Structural, Telecommunications, Automation and Protection.

Substation Construction

Construction work will be mostly conducted by the Contractor for all Civil works and Electrical Cable installations. All work that integrates with operational equipment will be performed by the MSP.

Test and Commissioning

All testing and commissioning for the cut over of secondary systems will be performed by MSP.

3.3 Project Estimate

Estimate Components		Base $	Escalated $
Estimate Class	5		
Estimate Accuracy	+100% / -50%		
Base Estimate		**19,727,370**	**25,171,346**
Mitigated Risk	[redacted]	[redacted]	[redacted]
Contingency Allowance	[redacted]	[redacted]	[redacted]
TOTAL		[redacted]	[redacted]

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To June 2027	5,274,598	6,987,864
To June 2028	1,719,663	2,371,643
TOTAL	**19,727,370**	**25,171,346**

3.5 Project Asset Classification

Asset Class	Asset Life	Base $	Percentage
Secondary systems	15 years	14,961,342	76%
Communications	15 years	893,957	5%
Primary plant	40 years	3,872,070	20%
Transmission lines	50 years		
TOTAL		19,727,370	

4. References

Document name	Version	Date
Project Scope Report	3.0	01/05/2020